



Minto Mine

Water Licence QZ14-031

Quartz Mining Licence QML-0001

2017 Annual Report

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Minto Mine

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Appendix L – Minto Creek Fish Monitoring Program Review and Recommendations

Appendix M – Copper Toxicity in Turbid Flow Report (Minnow)

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Appendix R - 2017 Annual Socio-Economic Monitoring Report

List of Acronyms

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

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

List of Units

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

1 Introduction

This Annual Report has been prepared by Minto Explorations Ltd. (Minto) for the 2017 calendar year, as required by Type A Water Use Licence (WUL) QZ14-031-01 and Quartz Mining Licence (QML) QML-0001. Specific requirements for the Annual Report, as outlined in the respective licences, are summarized in Table 1-1.

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

An aerial photo taken in August 2017, with updated site infrastructure labeled, is presented in Figure 1-1. For comparison, the 2016 site layout is shown in Figure 1-2.

Table 1-1: Reporting Requirements as per WUL and QML (2017)

| Licence | Section | Clause | Requirement | Annual Report Section |
|-----------------|---------|--------|--|-----------------------|
| WUL QZ14-031 | | | | |
| WUL QZ14-031 | 16 | | Summary of the review of the <i>Spill Contingency Plan</i> including any changes needed. | 2.5.4 App. B |
| WUL QZ14-031 | 18 | | Summary list of all spills for 2016 7 . | 2.5.3 |
| WUL QZ14-031 | 25 | | The Licensee shall submit Annual Reports to the Board no later than March 31 of the year following the reporting period. The reporting period is January 1 to December 31 of each year. | All |
| WUL QZ14-031 | 26 | a | Summary of all data collected as per the EMSRP, including analysis and interpretation by a qualified party and a discussion of any variances from baseline conditions, from previous years' data, and from expected performance. | 5-8, 11-14 |
| | | b | Summary of actions as per the Operations Adaptive Management Plan, including analysis and interpretation by a qualified party and a discussion of any variances from baseline conditions, from previous years' data, and from expected performance. | 10 App H |
| | | c | A record of any major maintenance carried out on any physical works. | 2.2 |
| | | d | Detailed data on the volume of water used during the year including water withdrawal from each water source, water routed around and through the site as part of the water conveyance system, water diverted around the site, water routed for storage in the pits, water deposited with mine wastes in waste storage facilities, water routed to the Water Storage Pond, water routed to the treatment plant and water discharged to Minto Creek. | 8 |

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

| Licence | Section | Clause | Requirement | Annual Report Section |
|--|---------|--------|--|------------------------|
| WUL QZ14-031 | 100 | f | For each operating year, the following information shall be provided as part of the Annual Report for the Physical Monitoring Program: | 9.2 |
| | | | i. interpretation of physical monitoring data, and summary of the stability, integrity and status of all the inspected structures, works, and installations inspected by the Professional Engineer; | 9.2 |
| | | | ii. a list of each of the Professional Engineer's recommendations for remedial action; | Table 9-1 |
| | | | iii. an explanation of how and when each recommendation was addressed, including supporting documentation, and | Table 9-1 |
| iv. a list of outstanding recommendations (including previous inspection reports) and associated approach and timelines to address them. | | | | |
| WUL QZ14-031 | 102 | | The Licensee shall review and evaluate the Aquatic Environmental Monitoring Program design every three (3) years and submit the findings to the Board, along with any recommendations for further refinements, as part of the Annual Report, starting in 2016. | 11.4 |
| WUL QZ14-031 | 104 | | Results and interpretations of the QA/QC program shall be provided in the Annual Report. | 5.1.2 |
| WUL QZ14-031 | 108 | a | The Licensee shall submit an updated Water Balance and Water Quality Model as part of the Annual Report. The updated models shall include without limitation all model assumptions. | App. E |
| | | b | Updated site data collected as per the EMSRP including: | 6 |
| | | | i. water quality results and water levels from all groundwater monitoring wells; | 12 |
| | | | ii. the most current climatic, environmental and operational conditions and data; | 5.3 |
| | | | iii. surface water quality and quantity data; | 7 |
| | | | iv. seepage monitoring quality and quantity data, and | App. E |
| v. geochemical source terms from tailings and waste rock. | | | | |
| | | c | A comparison of the updated geochemistry for Phase V/VI tailings and waste rock with that of previously-produced tailings and waste rock, and a comparison of model source term chemistry with equivalent operation monitoring results. | 13 App. O App. E |
| | | | | |
| | | d | Updated predictions for operations and Permanent Closure water quality, including discussion of any variances identified and associated implications on site water management. | App. E |
| WUL QZ14-031 | 109 | | Specifications for the Annual Report to include but not be limited to: | 10 8.5 App. H |
| | | | i. activities undertaken in relation to the Adaptive Management Plan; | |
| | | | ii. trend analysis and water levels in Minto and McGinty creeks; | |
| | | | iii. proposed updates and revisions to the Adaptive Management Plan, and | |
| | | | iv. any other revisions necessary to comply with the conditions of this Licence. | Through out |
| WUL QZ14-031 | 114 | a | Annual reporting on reclamation research activities. | 16.3 |

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

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



MINTO MINE

Water License
 QZ14-031/QML-0001
 2017 Annual Report

FIGURE 1-1

**SITE CONFIGURATION AND
 EXISTING INFRASTRUCTURE**

DECEMBER 2017



1:18,000 when printed on 8x11 inch paper



National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced under license from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Datum: NAD 83 Projection: UTM Zone 8N

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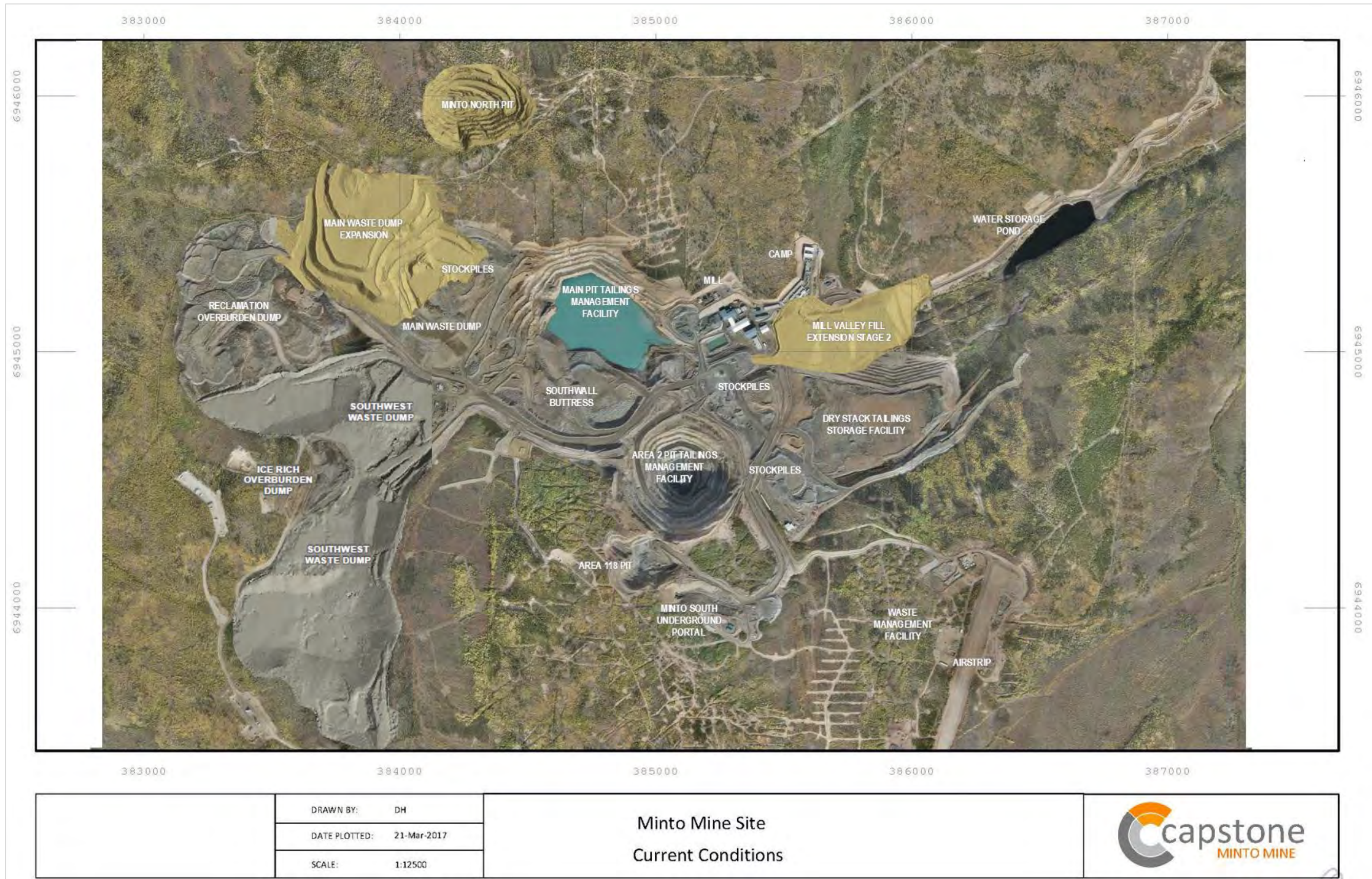


Figure 1-2: Site Layout (2016)

2 Site Activities

Operation of the Minto Mine continued in 2017, with the production of 36.0 million pounds (Mlb) of copper from the milling of 1.44 million tonnes (Mt) of ore.

Surface mining for the year totaled 3.80 million bank cubic meters (BCM). Surface mining took place in the Area 2 Stage 3 pit throughout the year.

Underground mining took place in the Area 2 and Minto East zones during 2017. Both zones are in the Minto South Underground.

Waste rock produced from mining activities was hauled to either the Main Pit Dump, Main Waste Dump Expansion, Main Pit Tailings Management Facility or Area 2 Tailings Management Facility as per the Waste Rock and Overburden Management Plan. Overburden produced from mining activities was hauled to the Area 118 Backfill Dump or closed facilities for progressive reclamation. Milling was a combination of run-of-mine ore from both surface and underground operations, as well as ore stockpiled from previous mining.

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

2.1 Exploration

Although no exploration drilling occurred at Minto in 2017, a total of 5,468 meters were drilled in 46 holes targeting various ore lenses with the intent of upgrading resources to probable reserves and to provide geological confidence for the optimization of the mine design.

These totals include 410 meters of drilling in 5 underground targeting gaps in coverage on the fringe of the Area 2 lower ore lens. In addition, two surface holes, totaling 171m, were drilled at the eastern edge of the Area 2 Stage 3 pit primarily to confirm the depth of overburden. Both programs were conducted in February 2017.

Four holes, totaling 1,526m, were drilled in September 2017 targeting the Minto East ore lens. One of the holes was drilled to test ground conditions in advance of the planned Minto East ventilation raise, and 3 holes were drilled to test the ground conditions around the Minto East fault.

The final program was conducted in October-November and consisted of 35 holes, totaling 3,361m. This program targeted the Ridgetop deposit with the goal of improving drill coverage where any significant gaps existed.

2.2 Maintenance, Infrastructure and Construction Projects

There were no major maintenance activities conducted in 2017 on the physical works. One construction project was started in 2017, the Tailings Diversion Ditch (TDD) portal road re-alignment. The following is a summary of the project.

2.2.1 Tailings Diversion Ditch Portal Road Re-Alignment

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

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

2.3 Mining Activities

Section 2.3 discusses the mining activities for 2017 including open pit and underground mining, waste rock and tailings management, ore stockpiles, operating results, and concentrate shipments.

2.3.1 Open Pit Mining

In January 2017, mining of the Area 2 Stage 3 pit began with the removal and stockpiling of organic rich soil from within the pit footprint, followed by stripping of overburden and waste rock. The first ore release from the pit occurred in February. In July, the Area 2 Stage 3 pit design was revised based on current economic conditions, increasing the size of the pit. Mining activities in the expansion of Area 2 Stage 3 commenced in August, and ramped up to full production after the original Area 2 Stage 3 pit design was completed on September 12th, 2017. The first ore release from Area 2 Stage 3 Expansion occurred in November.

2017 total mined waste and ore quantities are summarized in Table 2-1, below.

Table 2-1: Open Pit Mined Quantities: Mining Waste Volume and Ore Volume (2017)

| | Waste / Overburden (BCM) | Ore (BCM) | Ore (t) |
|--------------------------|--------------------------|----------------|----------------|
| Area 2 Stage 3 | 2,124,554 | 299,119 | 800,344 |
| Area 2 Stage 3 Expansion | 1,326,603 | 52,766 | 140,777 |
| Total | 3,451,157 | 351,885 | 941,121 |

2.3.2 Underground Mining

Mining activities in the Minto South Underground continued throughout 2017. Production continued from the Area 2 zone, with ore release totaling 328,000 tonnes.

A ramp was developed to the Minto East ore zone, from which three level accesses, accesses to ventilation and escapeway raises, and supporting infrastructure such as sumps and an electrical substation were completed. Development within the ore zone itself did not begin in 2017. 142,000 tonnes of waste rock were hauled to surface. See Appendix A for the underground development map.

2.3.3 Waste Rock Management

Waste rock dump development continued in 2017, as per the *Minto Mine Waste Rock and Overburden Management Plan*. Table 2-2 summarizes the waste materials and ultimate destinations, and the volumes deposited. Current waste rock inventory in the various waste rock and overburden dumps at the Minto Mine site are summarized in Table 2-3.

Table 2-2: Waste Rock Destination and Volumes – Unreconciled truck counts (2017)

| Material Type | Destination | Volume (BCM) |
|----------------------------|---|------------------|
| Waste - Construction Grade | Roads/Ramps | 106,000 |
| Waste - Construction Grade | Tailings Diversion Ditch – Portal Road Re-Alignment | 39,000 |
| Waste | Main Pit Dump | 950,000 |
| Waste | Main Waste Dump | 148,000 |
| Waste Rock - SAT | Main Pit Buttress | 26,000 |
| Waste Rock - SAT | A2S2 In-Pit | 56,000 |
| Total | | 1,325,000 |

Table 2-3: Waste Dump Location and Storage Volumes (2017)

| Dump Location | Quantity Stored as of December 31, 2017 (m ³) |
|------------------------------|---|
| Main Pit Buttress | 4,230,000 |
| Main Pit Dump | 1,230,000 |
| Southwest Dump | 12,120,000 |
| Mill Valley Fill Extension | 1,440,000 |
| Reclamation Overburden Dump | 4,300,000 |
| Main Waste Dump | 8,360,000 |
| Main Waste Dump Expansion | 3,600,000 |
| Mill Valley Fill Extension 2 | 1,360,000 |
| Total Waste Dumped | 36,640,000 |

2.3.4 Tailings Management

All tailings produced in 2017 were deposited in the Area 2 Pit Tailings Management Facility (A2PTMF). The following table lists the deposition schedule.

Table 2-4: Tailings Deposition Schedule in 2017

| Tailings Management Facility | Date Range | Quantity Deposited (dry metric tonnes) |
|------------------------------|-------------------------|--|
| A2PTMF | January 1 – December 31 | 1,402,004 |
| Total 2017 Tailings | | 1,402,004 |

A total of 1,402,004 dry metric tonnes (dmt) of tailings were discharged to the A2PTMF in 2017. Since November 2012, the Main Pit Tailings Management Facility (MPTMF) has received 3,347,000 tonnes of tailings. Since March 2015, the Area 2 Pit has received 3,756,000 tonnes of tailings.

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

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

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

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

Minto's filter press plant, previously used to prepare tailings for deposition to the Dry Stack Tailings Storage Facility (DSTS), has been deactivated and did not operate in 2017. While the filtration equipment is still in place, a substantial portion of the building's electrical supply has been re-routed to the Minto South Portal.

2.3.5 Ore Stockpiles

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

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

West of the Main Pit, adjacent to the Main Waste Dump, the Top of the World stockpile consisting of partially oxidized run-of-mine (ROM) ore is being actively depleted.

The stockpile areas are displayed in Figure 2-1.

Ore is segregated by copper grade and percentage of acid-soluble copper as shown in Table 2-5.

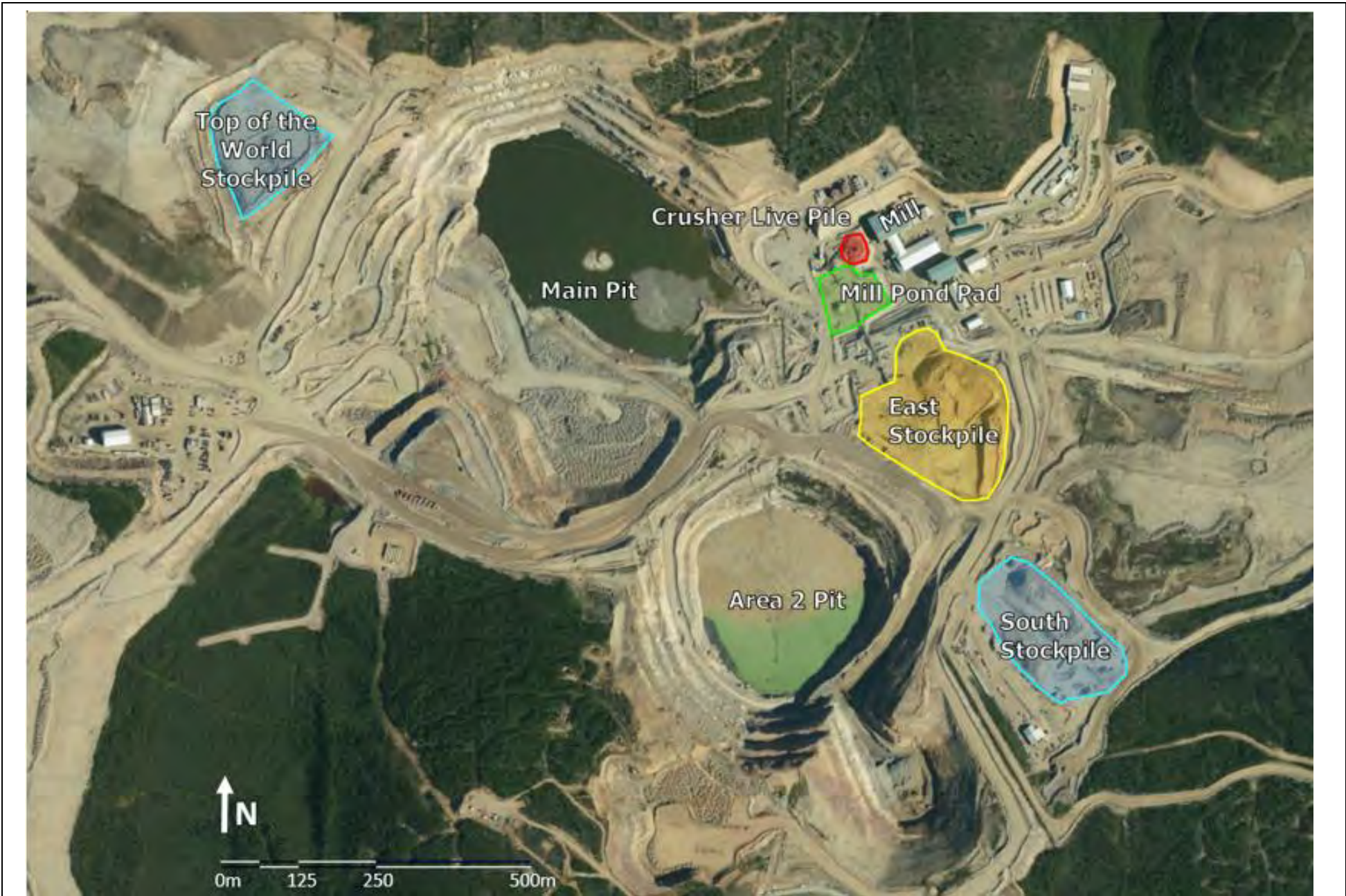
Table 2-5: Ore Stockpiles

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

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

Table 2-6: Stockpile Inventory

| | December 31, 2016 | | | December 31, 2017 | | |
|------------------|-------------------|-------------|-------------|-------------------|-------------|-------------|
| | Mass (tonnes) | Cu (%) | Ag (g/t) | Mass (tonnes) | Cu (%) | Ag (g/t) |
| Red | 33,235 | 5.54 | 24.27 | - | - | - |
| Yellow | 30,427 | 2.76 | 12.36 | - | - | - |
| Green | 71,477 | 1.44 | 6.28 | - | - | - |
| Blue | 245,851 | 0.73 | 2.76 | 1,707 | 0.78 | 3.93 |
| POX | 0 | - | - | 235,296 | 1.21 | 3.50 |
| LG POX | 56,809 | 0.91 | 2.24 | 199,582 | 0.66 | 1.74 |
| Portal Ore Pad | 29,259 | 1.58 | 7.81 | 9,434 | 2.36 | 12.78 |
| Live Pile | 22,230 | 2.07 | 8.63 | 21,583 | 1.71 | 6.09 |
| Total Ore | 489,287 | 1.42 | 5.84 | 467,601 | 1.02 | 3.06 |



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DATE PLOTTED: 03-AUG-17

Figure 2-1
Ore Stockpiles – 2017



2.3.6 Operating Results

Ore processing and metal production results for the 2017 calendar year are summarized in Table 2-7, below.

Table 2-7: Operating Results (2017)

| Metal Production | Quantity |
|------------------------------|-----------------|
| Copper (t) | 16,331.71 |
| Gold (kg) | 787.86 |
| Silver (kg) | 5,263.88 |
| Ore Milled | |
| Ore processed (t) | 1,439,374 |
| Copper grade (%) | 1.37 |
| Gold grade (g/t) | 0.79 |
| Silver grade (g/t) | 4.76 |
| Recoveries | |
| Copper (%) | 82.6 |
| Gold (%) | 59.3 |
| Silver (%) | 77.6 |
| Concentrates Produced | |
| Copper concentrate (dmt) | 37,372.0 |
| Copper (%) | 43.7 |
| Gold (g/t) | 18.01 |
| Silver (g/t) | 142.16 |

2.3.7 Concentrate Shipments

Minto produced 41,299 wet metric tonnes of concentrate at 9.51% moisture content, which corresponds to 37,372 dmt. The average concentrate grades are listed in Table 2-7, above. 996 truckloads of concentrate were shipped from Minto in 2017: 534 via the winter ice bridge and 462 during the summer barge season.

2.4 Mine Access Road

2.4.1 Traffic

From December 27th, 2016 to April 9th, 2017, access across the Yukon River was over an ice bridge during which time, heavy trucks made 700 round trips, medium trucks made 148 round trips, and light vehicles made 386 round trips across the ice bridge. Between April 10th and June 17th, 2017 there was no land access to the mine site. On June 18th, 2017, the summer tug and barge operation started for the season. During the barge operating season, heavy trucks made 621 round trips, medium trucks made 299.5 round trips, and light vehicles made 556.5 round trips to the Minto Mine via the mine access road. The barge operating season ended November 7, 2017. Establishment of the 2018 ice bridge started in December 2017.

2.4.2 Access Control Issues

No access control issues were experienced in 2017.

2.4.3 Planned Access Road Maintenance for 2018

Beyond routine maintenance work, no major projects or upgrades are planned for 2018 regarding the access road.

2.5 Accidents and Incidents

2.5.1 Incidents

In 2017, Minto Mine experienced three lost time accidents, seven medical aids and seven serious incidents reported to the Yukon Workers Compensation Health and Safety Board for the reporting period. In order to respond to incidents on site, Minto maintains a current Emergency Response Plan supported by a complement of emergency response personnel trained and certified in advanced first aid, firefighting and mine rescue along with equipment required for all response types. In addition, reporting and investigation of incidents is standard practice at the site.

2.5.2 Wildlife Incidents

The Conservation Officer was made aware of two events at Minto in 2017. The first incident was an aggressive black bear initially encountered on the access road on June 25th, 2017, then again by two hikers walking after work on July 23rd, 2017. A temporary ban on recreational outdoor activities was put in place on July 24th, 2017 due to the presence of the aggressive bear. The bear eventually left the area and was not seen again, resulting in the recreation ban being lifted. The second communication with the Conservation Officer was due to a porcupine being run over and killed by a haul truck on the mine site on September 28th, 2017. The porcupine was disposed of in the onsite incinerator, a method supported by the Conservation Officer.

2.5.3 Reportable Spills

There was one reportable spill that occurred at Minto Mine during 2017. The volume and causes of the spill are summarized below in Table 2-8.

Table 2-8: Reportable Spills (2017)

| Date | Amount | Substance | Cause |
|----------|--------|---------------------|---|
| 8-Jul-17 | 50 kg | Potassium Hydroxide | A pallet containing potassium hydroxide flakes had multiple broken bags that had spilled contaminant onto the ground. During the investigation, it was determined that the pallets had been stored there for up to 4 years, however, it was difficult to determine at what time the packaging had become uncovered and degraded to the point that the material spilled to the ground. |

The spill in Table 2-8 was reported as per the *Spills Regulations* of the Yukon Environment Act. The follow up spill report was submitted within 10-days of the occurrence. Additionally, non-reportable spills were tracked internally as per the WUL. Spills on site were cleaned up with a variety of methods including, but not limited to, absorbent spills pads, soil excavation, soil treatment in the LTF, and disposal in the Main Pit dump.

2.5.4 Spill Contingency Plan Review

An update to the Minto Mine Spill Contingency Plan is required annually as part of the Annual Report and the updated 2018 Minto Mine Spill Contingency Plan is provided in Appendix B.

3 Proposed Mining for 2018

Section 3 discusses the proposed mining for 2018 at the Minto Mine, including open pit and underground mining.

3.1 Proposed Open Pit Mining for 2018

The Area 2 Stage 3 Expansion is expected to be completed in April 2018.

A program of infill drilling was completed in Q4-2017 at the Ridgetop North pit. These results will be used to create an updated block model and to better define the boundaries between partially oxidized and sulfide ore. These changes, along with current market conditions and an updated slope stability analysis, will be incorporated into a pit optimization for the Ridgetop North pit. The pit optimization work is expected to be completed in March 2018, with mining activities commencing shortly after if economics determine that it is feasible.

The mine plan will be revisited whenever key inputs such as copper price, exchange rate, or fuel price change significantly.

3.2 Proposed Underground Mining for 2018

Mining of the Area 2 zone will continue, with completion expected in Q1. Production will begin in the Minto East zone, continuing throughout the year. Development toward the next ore zone, Copper Keel, will begin in Q1 and continue throughout the year; first ore is expected in Q4.

The new Minto East exhaust raise will be commissioned, reversing the airflow direction in the main ramp and improving ventilation efficiency.

4 Mineral Resources and Reserves

Minto Mine's updated mineral resources and reserves are provided in Tables 4-1 and 4-2 respectively, below. The most recent update is from December 31, 2016. There were no updates in 2017.

Table 4-1: Updated Mineral Resources for Minto Mine (most recent Dec. 31, 2016)

| Classification | Tonnes (kt) | Copper (%) | Silver (g/t) | Gold (g/t) | Contained Copper (kt) | Contained Silver (koz) | Contained Gold (koz) |
|---|-------------|------------|--------------|------------|-----------------------|------------------------|----------------------|
| Minto South Deposit (MSD) (Open Pit and Underground) | | | | | | | |
| Measured | 3,466 | 1.09 | 3 | 0.41 | 38 | 374 | 45.2 |
| Indicated | 17,723 | 1.08 | 3 | 0.37 | 192 | 1,893 | 212 |
| Total Measured + Indicated | 21,189 | 1.09 | 3 | 0.38 | 230 | 2,268 | 257.2 |
| Inferred | 12,445 | 0.8 | 2 | 0.22 | 100 | 969 | 89.3 |
| Ridgetop (Open Pit) | | | | | | | |
| Measured | 1,531 | 0.98 | 2 | 0.25 | 15 | 105 | 12.3 |
| Indicated | 3,534 | 0.87 | 3 | 0.3 | 31 | 326 | 34.1 |
| Total Measured + Indicated | 5,065 | 0.9 | 3 | 0.28 | 46 | 431 | 46.4 |
| Inferred | 318 | 0.75 | 2 | 0.13 | 2 | 16 | 1.3 |
| Minto North (Open Pit) | | | | | | | |
| Measured | 221 | 0.94 | 3 | 0.21 | 2 | 20 | 1.5 |
| Indicated | 257 | 1 | 6 | 0.61 | 3 | 46 | 5 |
| Total Measured + Indicated | 477 | 0.97 | 4 | 0.42 | 5 | 67 | 6.5 |
| Inferred | 28 | 0.7 | 3 | 0.32 | 0 | 3 | 0.3 |
| Minto East (Underground) | | | | | | | |
| Measured | - | - | - | - | - | - | - |
| Indicated | 919 | 2.35 | 7 | 1.01 | 22 | 204 | 29.8 |
| Total Measured + Indicated | 919 | 2.35 | 7 | 1.01 | 22 | 204 | 29.8 |
| Inferred | 124 | 1.48 | 5 | 0.6 | 2 | 20 | 2.5 |
| Minto East 2 (Underground) | | | | | | | |
| Measured | - | - | - | - | - | - | - |
| Indicated | 2,778 | 1.72 | 7 | 0.8 | 48 | 629 | 71.8 |
| Total Measured + Indicated | 2,778 | 1.72 | 7 | 0.8 | 48 | 629 | 71.8 |
| Inferred | 1,889 | 1.38 | 4 | 0.5 | 26 | 247 | 30.1 |
| Minto North 2 (formerly Inferno North) | | | | | | | |
| Measured | - | - | - | - | - | - | - |
| Indicated | - | - | - | - | - | - | - |
| Total Measured + Indicated | - | - | - | - | - | - | - |

| Classification | Tonnes (kt) | Copper (%) | Silver (g/t) | Gold (g/t) | Contained Copper (kt) | Contained Silver (koz) | Contained Gold (koz) |
|---|---------------|-------------|--------------|-------------|-----------------------|------------------------|----------------------|
| Inferred | 1,419 | 1.42 | 5 | 0.51 | 20 | 214 | 23.3 |
| Stockpiles | | | | | | | |
| Measured | 489 | 1.42 | 5 | 0.41 | 7 | 92 | 6.4 |
| Total Mineral Resources | | | | | | | |
| Total Measured | 5,707 | 1.09 | 3 | 0.36 | 62 | 592 | 65.5 |
| Total Indicated | 25,211 | 1.17 | 4 | 0.44 | 295 | 3,098 | 352.7 |
| Total Measured + Indicated Resources | 30,918 | 1.15 | 4 | 0.42 | 357 | 3,690 | 418.2 |
| Total Inferred Resources | 16,223 | 0.93 | 3 | 0.28 | 150 | 1,470 | 146.8 |

Table 4-2: Updated Mineral Reserves for Minto Mine (most recent Dec. 31, 2016)

| Classification | Tonnes (kt) | Copper (%) | Silver (g/t) | Gold (g/t) | Contained Copper (kt) | Contained Silver (koz) | Contained Gold (koz) |
|--------------------------------------|--------------|-------------|--------------|-------------|-----------------------|------------------------|----------------------|
| Minto North Open Pit | | | | | | | |
| Proven | - | - | - | - | - | - | - |
| Probable | - | - | - | - | - | - | - |
| Total | - | - | - | - | - | - | - |
| MSD - Area 2 Open Pit | | | | | | | |
| Proven | - | - | - | - | - | - | - |
| Probable | 807 | 1.21 | 1 | 0.41 | 10 | 26 | 10.6 |
| Total | 807 | 1.21 | 1 | 0.41 | 10 | 26 | 10.6 |
| Minto East Underground | | | | | | | |
| Proven | - | - | - | - | - | - | - |
| Probable | 625 | 2.07 | 6 | 0.89 | 13 | 120 | 17.9 |
| Total | 625 | 2.07 | 6 | 0.89 | 13 | 120 | 17.9 |
| MSD - Area 2/118 Underground | | | | | | | |
| Proven | - | - | - | - | - | - | - |
| Probable | 381 | 2.06 | 8 | 0.87 | 8 | 103 | 10.7 |
| Total | 381 | 2.06 | 8 | 0.87 | 8 | 103 | 10.7 |
| MSD - Copper Keel Underground | | | | | | | |
| Proven | - | - | - | - | - | - | - |
| Probable | 1,616 | 1.73 | 6 | 0.63 | 28 | 315 | 32.5 |
| Total | 1,616 | 1.73 | 6 | 0.63 | 28 | 315 | 32.5 |

| Classification | Tonnes (kt) | Copper (%) | Silver (g/t) | Gold (g/t) | Contained Copper (kt) | Contained Silver (koz) | Contained Gold (koz) |
|----------------------------------|--------------|-------------|--------------|-------------|-----------------------|------------------------|----------------------|
| MSD -Wildfire Underground | | | | | | | |
| Proven | - | - | - | - | - | - | - |
| Probable | - | - | - | - | - | - | - |
| Total | - | - | - | - | - | - | - |
| Stockpiles | | | | | | | |
| Proven | 489 | 1.42 | 6 | 0.41 | 7 | 92 | 6.4 |
| Total | 489 | 1.42 | 6 | 0.41 | 7 | 92 | 6.4 |
| Total Mineral Reserves | | | | | | | |
| Proven | 489 | 1.42 | 6 | 0.41 | 7 | 92 | 6.4 |
| Probable | 3,429 | 1.71 | 5 | 0.65 | 59 | 563 | 71.7 |
| Total Mineral Reserves | 3,919 | 1.67 | 5 | 0.62 | 65 | 655 | 78.2 |

5 Surface Water Quality Monitoring

Environmental monitoring programs are outlined in the *Environmental Monitoring, Surveillance and Reporting Plan* (EMSRP2016-02) and the results for the surface water quality monitoring conducted in 2017 are provided in this section. Where possible, the 2017 results have been compared to historical results to identify trends and compare 2017 values with previous values.

5.1 Surface Water Quality Program

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

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

As water quality stations may be adjusted from year-to-year because of environmental changes or modifications to infrastructure, an update to the water quality station locations listed in the WUL is provided in Table 5-1 below. All surveillance monitoring sites in use in 2017 are confirmed with a Global Positioning System (GPS) unit to determine current UTM coordinates. Coordinates presented in Table 5-1 are associated with the World Geodetic System 1984 (WGS 84) coordinate system.

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

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

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

*Water quality sites not developed

5.1.1 Water Quality Monitoring Conformance

2017 conformance with the external water sampling requirements is summarized in Table 5-2, below. Flow monitoring at water quality surveillance sites is highly variable because of site and seasonal conditions and is not presented in Table 5-2, however, full details were provided in the Monthly Reports submitted to the YWB. Additionally, the specifics of non-conformance in relation to external and internal water sampling requirements are included in the Monthly Reports. Quality Assurance and Quality Control (QA/QC) sampling is not included in sampling events described in Table 5-2, but is provided in section 5.1.2.

Table 5-2: Water Quality Sampling Monitoring Conformance Summary (2017)

| Site Name | 2017 WQ sampling events | 2017 Reason(s) for non-conformance events |
|-----------|-------------------------|--|
| W1 | N/A | N/A |
| W2 | 37 | Site was frozen during the first and fourth quarter. Sampled as per schedule for remainder of 2017. |
| W3 | 56 | Sampled as per schedule. |
| W4 | 3 | Sampled as per schedule except for Q3 due to human error. |
| W5 | 2 | Inaccessible due to ice conditions in the first quarter. Sampled as per schedule for second and fourth quarter of 2017, but was missed in Q3 due to human error. |
| W6 | 6 | Site frozen for 6 months of the year. Sampled as per schedule for remainder of 2017. |
| W7 | 8 | Site frozen for 4 months of the year. Sampled as per schedule for remainder of 2017. |
| W8 | 0 | Site dry for all of 2017. |
| W8a | 45 | Weekly samples not collected once in March, all of May and once in June due to site being frozen. Sampled as per schedule otherwise. |
| W10 | 11 | Site frozen for March. Sampled as per schedule otherwise |
| W12 | 12 | Sampled as per schedule. |
| W12A | 0 | No discharge from W12A in 2017. |
| W14 | 12 | Sampled as per schedule. |
| W15 | 18 | Site frozen for March. Sampled as per schedule otherwise. |
| W16 | 37 | One weekly sample missed in June. Sampled as per schedule for remainder of 2017. |
| W16a | 12 | Sampled as per schedule. |
| W17 | 53 | Sampled as per schedule. |
| W30 | 8 | Site was frozen for first three months of 2017. Sampled as per schedule otherwise. |
| W33 | 7 | Site frozen for 5 months of the year. Sampled as per schedule otherwise. |
| W35 | 13 | Site frozen for 5 months of 2017. Sampled as per schedule otherwise. |
| W36 | 0 | Decommissioned in 2015. |
| W37 | 0 | Decommissioned in 2015. |
| W45 | 10 | Site was not sampled for two months due to pump being removed and unsafe access. Sampled as per schedule for remainder of 2017. |
| W46 | 8 | Site frozen for four months. Sampled as per schedule for remainder of 2017. |
| W47 | 0 | Decommissioned and backfilled in January 2017. |
| W50 | 12 | Site dry while not discharging. Sampled as per schedule during discharge in 2017. |
| MC-1 | 32 | Site frozen for 4 months. Sampled as per schedule for remainder of 2017. |
| WTP | 9 | Sampled as per schedule. |
| RO | | |
| W51 | 2 | Site sampled in September and October 2017. Was inaccessible the remainder of the year. |
| W52 | 0 | Site not established. |
| W53 | 0 | Site not established. |
| W54 | 0 | Site not established. |
| W55 | 4 | Flow present in April to July. Site dry for remainder of 2017. |

| Site Name | 2017 WQ sampling events | 2017 Reason(s) for non-conformance events |
|-----------|-------------------------|--|
| W62 | 14 | Sampled as per schedule. |
| C4 | 7 | Site frozen for 5 months. Sampled as per schedule for remainder of 2017. |
| C10 | 5 | Site frozen for 7 months. Sampled as per schedule for remainder of 2017. |
| MN | 1 | Sampled once during 2017. Access unsafe for remainder of 2017. |
| MN-0.2 | 6 | Site frozen for 6 months. Sampled as per schedule for remainder of 2017. |
| MN-0.5 | 7 | Site frozen for 5 months. Sampled as per schedule for remainder of 2017. |
| MN-1.5 | 6 | Site frozen for 6 months. Sampled as per schedule for remainder of 2017. |
| MN-2.5 | 7 | Site frozen for 5 months. Sampled as per schedule for remainder of 2017. |
| MN-4.5 | 7 | Site frozen for 5 months. Sampled as per schedule for remainder of 2017. |
| UG1 | 12 | Sampled as per schedule. |

5.1.2 Quality Assurance and Quality Control Program

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

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

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

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

5.1.2.1 Water Quality QA/QC

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

In 2017, 728 water quality samples (surface and groundwater) were collected for the water quality monitoring programs. QC samples represented 22.1% of the total number of samples collected in 2017, and included 85 field duplicates, 6 field blanks, 6 trip blanks, and 64 field splits. The Minto Mine Surface Water Quality Monitoring Standard Operating Procedure describes a 1:10 quality control to routine sampling ratio and this ratio was achieved in 2017.

5.1.2.2 External Laboratory QA/QC

The 2017 external laboratory water quality analysis were performed by ALS Environmental in Burnaby, BC. As described in the EMSRP, all results provided by the external laboratory were accompanied by a Quality Control Report. If procedural deviations or exceedances in standard holding time occurred, the details of such nonconformities were included in each report. Additionally, each report contained QC batch numbers enhancing sample result traceability.

5.1.2.3 On-site Laboratory QA/QC

Procedures for analyzing water samples at the on-site laboratory are detailed in a variety of SOPs such as, but not limited to: The Laboratory QA/QC Guidelines SOP; Preparation of Dissolved and Total Metals (Cu, Al, Cd) SOP; Preparation of Dissolved and Total Selenium SOP; and Total Dissolved Solids SOP. All on-site laboratory equipment was calibrated per the manufacturer's specifications in 2017.

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

The 2017 QC procedures performed by the on-site laboratory included spiked blanks and calibration checks. If two or more QC failures occurred, the 2017 QC procedures involved re-analyzing the entire batch of samples. Additionally, one replicate sample is analyzed for each batch analysis. In the event the replicate sample results do not match; the entire batch is reanalyzed.

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

5.2 Compliance

5.2.1 Discharge Compliance – WQ Effluent Standards

5.2.1.1 W16A – EQS Compliance Point

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

Table 5-3: W16A Water Quality Results Summary (2007-2017)

| W16A Parameters | Effluent Quality Standards (WUL Clause 9) | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--|--------------------------------|------------|-------------|-------------------------|-----------|-----------|
| | | Mean | Min | Max | Mean | Min | Max |
| pH | 6.0-9.0 | 7.99 | 6.86 | 8.32 | 8.17 | 7.87 | 8.33 |
| TSS (mg/L) | 15 | 5.12 | <1.0 | 55.1 | 2.25 | <3.0 | 5.4 |
| Nutrients (mg/L) | | | | | | | |
| Ammonia Nitrogen | 0.75 | 0.1055 | 0.0169 | 0.430 | 0.0461 | 0.0071 | 0.146 |
| Nitrite Nitrogen | 0.18 | 0.02414 | <0.0050 | 0.0920 | 0.0493 | 0.0111 | 0.0808 |
| Nitrate Nitrogen | 27.3 | 3.372 | 0.549 | 6.30 | 2.18 | 1.75 | 2.77 |
| Dissolved Metals (mg/L) | | | | | | | |
| Aluminum | 0.3 | 0.01139 | <0.0030 | 0.0732 | 0.0091 | 0.0045 | 0.0149 |
| Arsenic | 0.015 | 0.000346 | 0.00023 | 0.00059 | 0.00035 | 0.00024 | 0.00049 |
| Cadmium | 0.00015* | 0.00001396 | <0.0000050 | 0.000089 | 0.0000127 | 0.0000056 | 0.0000273 |
| Chromium | 0.003 | 0.000371 | <0.00010 | <0.0010 | 0.000136 | <0.00010 | 0.00022 |
| Copper | 0.039 | 0.02118 | 0.00793 | 0.0349 | 0.0276 | 0.0237 | 0.0326 |
| Iron | 3.3 | 0.0653 | 0.0105 | 0.301 | 0.084 | 0.053 | 0.139 |
| Lead | 0.012 | 0.0001369 | <0.000050 | 0.00159 | 0.0002544 | <0.000050 | 0.00173 |
| Molybdenum | 0.219 | 0.00463 | 0.001 | 0.0098 | 0.00250 | 0.00221 | 0.00277 |
| Nickel | 0.33 | 0.00077 | <0.0010 | <0.0050 | 0.00085 | 0.00050 | 0.00111 |
| Selenium | 0.006 | 0.001267 | 0.00019 | 0.0021 | 0.000665 | 0.000568 | 0.000777 |
| Zinc | 0.09 | 0.00216 | <0.0010 | 0.0059 | 0.00108 | <0.0010 | 0.0023 |

Bold values indicate exceedances of the WUL standards

*Based on measured hardness

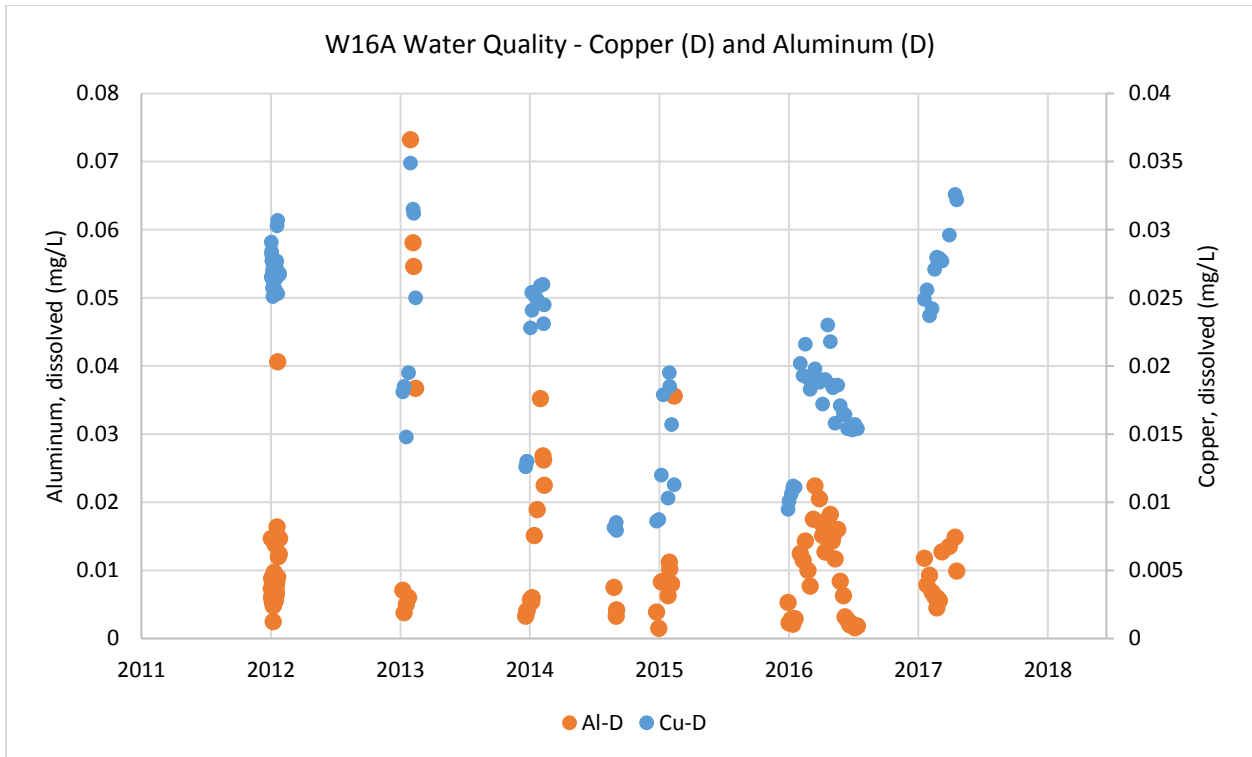
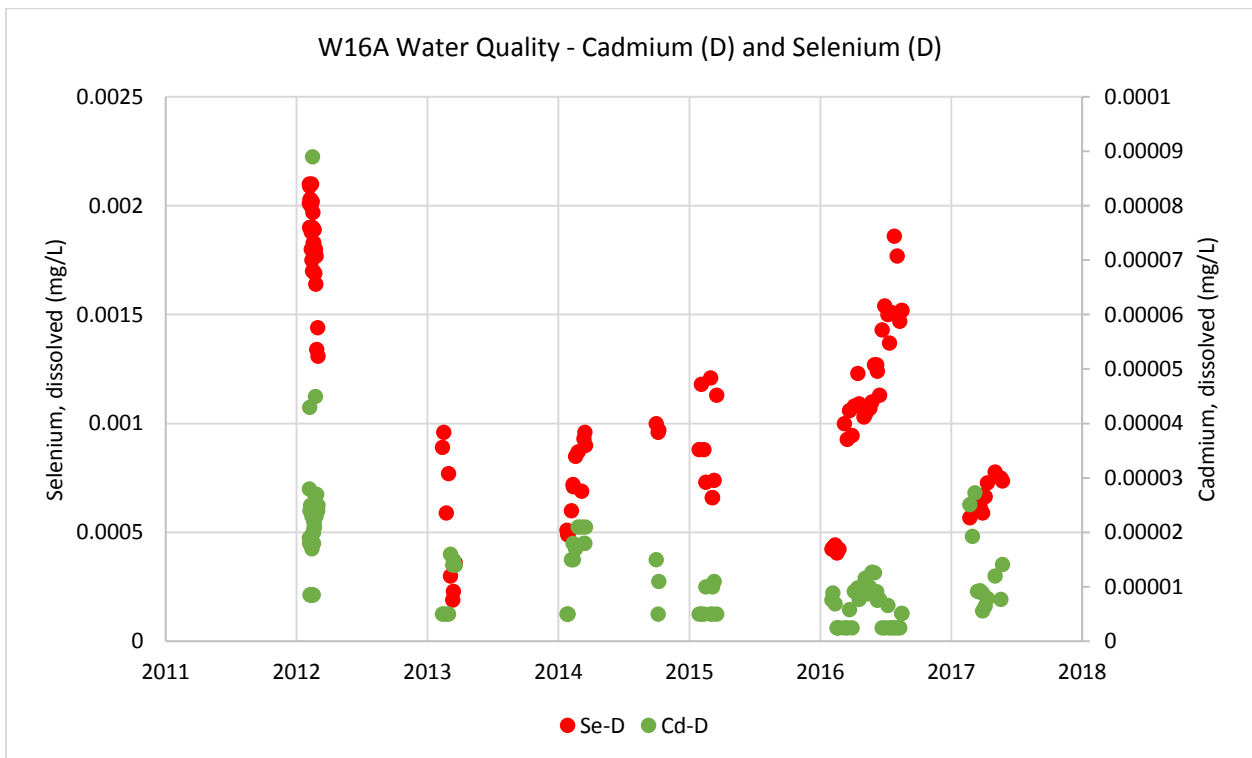


Figure 5-1: W16A Copper and Aluminum Concentrations (2012-2017)



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

Figure 5-2: W16A Cadmium and Selenium Concentrations (2012-2017)

5.2.1.2 W50 – EQS Compliance Point

The Effluent Quality Standards (EQS) (Clause 9 of the WUL) were applied and met at W50 from the period of May 2nd to August 1st 2017 when water was encountered. The water quality statistics for 2017 where W50 was the EQS compliance point are summarized below in Table 5-4. The summary from 2009 to 2016 has some exceeded parameters, those were triggered prior to 2015, with different standards. The summary for dissolved aluminum, copper, cadmium and selenium are also presented graphically in Figure 5-3 and 5-4 below.

Table 5-4: W50 Water Quality Results Summary (2009-2017)

| W50 Parameters | Effluent Quality Standard (WUL Clause 9) | 2009 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|------------------------------------|---|--------------------------------|-----------|----------------|-------------------------|-----------|-----------|
| | | Mean | Min | Max | Mean | Min | Max |
| pH | 6.0-9.0 | 8.03 | 6.82 | 8.4 | 8.16 | 7.99 | 8.29 |
| TSS (mg/L) | 15 | 5.14 | 0.5 | 42 | 2.92 | 1.5 | 6.6 |
| Nutrients (mg/L) | | | | | | | |
| Ammonia Nitrogen | 0.75 | 0.08750 | 0.0025 | 1 | 0.0400 | 0.0145 | 0.156 |
| Nitrite Nitrogen | 0.18 | 0.02405 | 0.0025 | 0.158 | 0.0412 | 0.0214 | 0.0717 |
| Nitrate Nitrogen | 27.3 | 3.8888 | 0.010 | 16.2 | 2.20 | 1.77 | 3.27 |
| Dissolved Metals (mg/L) | | | | | | | |
| Aluminum | 0.3 | 0.01605 | 0.0013 | 0.12 | 0.0078 | 0.0049 | 0.0125 |
| Arsenic | 0.015 | 0.000373 | 0.00012 | 0.0031 | 0.00036 | 0.00025 | 0.00050 |
| Cadmium | 0.00015* | 0.00001530 | 0.0000025 | 0.00028 | 0.00000841 | 0.0000025 | 0.0000239 |
| Chromium | 0.003 | 0.000467 | 0.00005 | 0.0017 | 0.000124 | 0.00005 | 0.00018 |
| Copper | 0.039 | 0.01529 | 0.0005 | 0.075 | 0.0249 | 0.0185 | 0.0281 |
| Iron | 3.3 | 0.05009 | 0.0025 | 0.3 | 0.067 | 0.048 | 0.095 |
| Lead | 0.012 | 0.0001317 | 0.000025 | 0.0008 | 0.0001499 | 0.000025 | 0.000593 |
| Molybdenum | 0.219 | 0.00609 | 0.0005 | 0.019 | 0.00262 | 0.00220 | 0.00336 |
| Nickel | 0.33 | 0.000894 | 0.00025 | 0.003 | 0.00080 | 0.00054 | 0.00110 |
| Selenium | 0.006 | 0.001200 | 0.00005 | 0.0049 | 0.000668 | 0.000567 | 0.000905 |
| Zinc | 0.09 | 0.00280 | 0.0005 | 0.018 | 0.00085 | 0.0005 | 0.0023 |

Bold values indicate exceedances of the current WUL standards

*Based on measured hardness

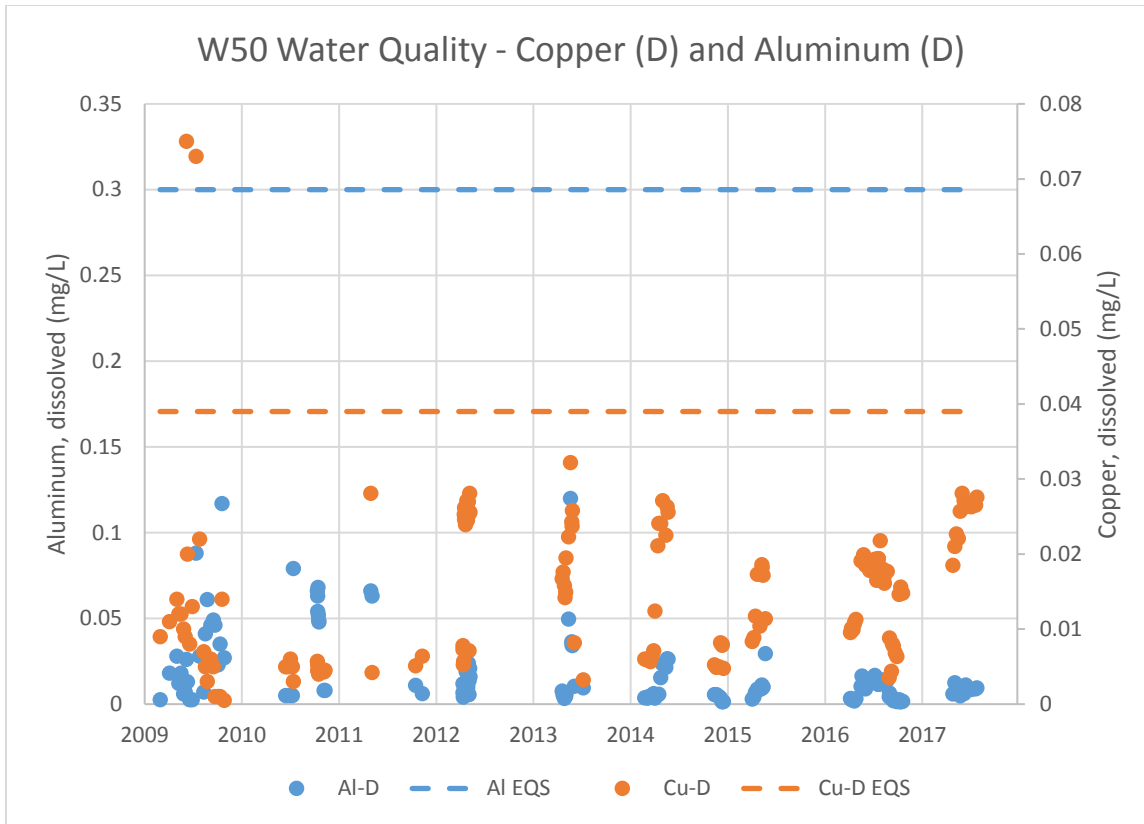
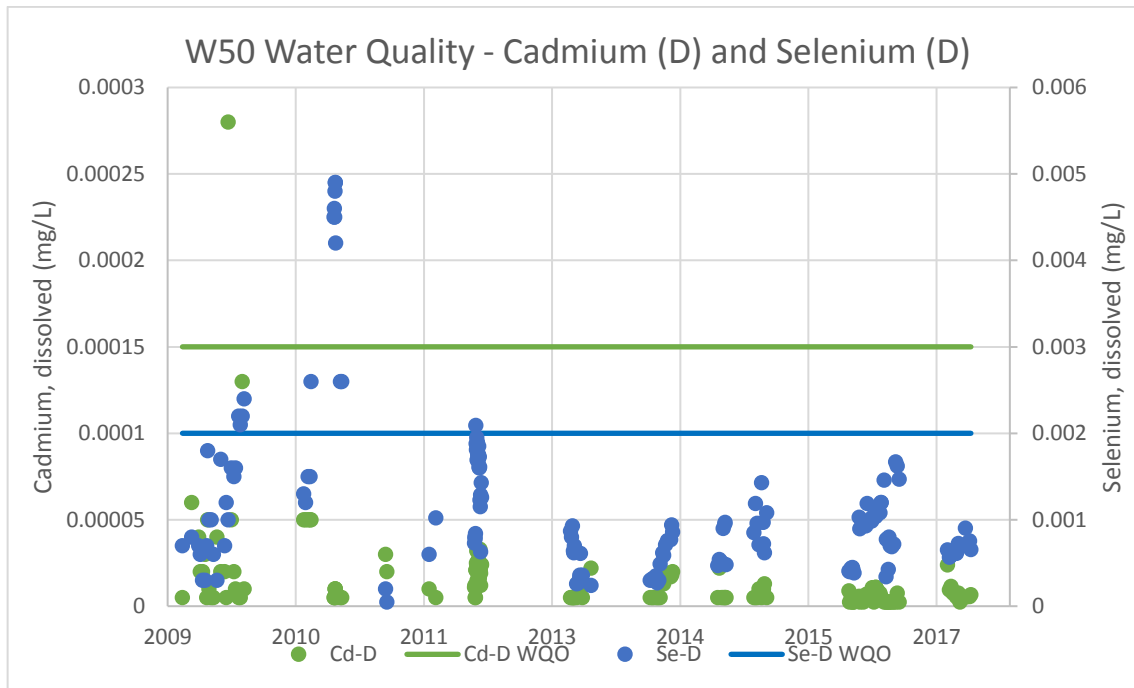


Figure 5-3: W50 Copper and Aluminum Concentrations (2009-2017)



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

Figure 5-4: W50 Cadmium and Selenium Concentrations (2009-2017)

5.2.1.3 W17 – EQS Compliance Point

During 2017, there was no water discharged from W17 to the Minto Creek, therefore EQS were not applied to this station.

5.2.2 Discharge Compliance – Bioassays

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

In August 2017, WUL bioassay sampling was scheduled with the external lab for August 8th, but unexpected low flows in Minto Creek discharge caused mine discharge to be stopped and Minto missed the opportunity to sample for LC50 tests within the 5 days of discharge at W16A, W50 and W3, this incident was discussed in the August Monthly Report. The remaining tests were conducted per the WUL requirements; and all tests passed in 2017 for all sample sites. Lab results were submitted with the monthly reports.

Bioassay compliance testing, as per the WUL requirements, were conducted at W3 during 2017. An LC50 bioassay was conducted at W3, 3 days after discharge stopped in August. All toxicity tests conducted in 2017 for W3 passed. Lab results were submitted with the respective monthly reports.

At W2 station, bioassay sampling was not completed in the first quarter of 2017, as the water quality station became ice-free with very low flows in the second week of April 2017, and hence did not allow for the monthly samples or the quarterly 30-day CT test to be conducted in Q1. In Q3, the W2 CT 30-day samples were collected and sent to the lab for testing; however, the lab cancelled the analysis after the second week due to a control failure. The test was re-started and cancelled again on the second week, the external lab was not ready to receive the samples, finally the Q3 CT 30-day test was completed mid-October. The Q4 CT 30-day analysis could not be completed due to no visible flow after October 31st, 2017. These incidents were discussed in the respective WUL monthly reports reflect the uncertainty around gamete availability and quality on a quarterly basis.

5.2.3 Water Quality Objectives Compliance – Minto Creek

5.2.3.1 W2 – WQO Compliance Point

As of April 11th, W15 and W35 were no longer frozen and W2 became the WQO station until W15 and W35 froze again on October 3rd, 2017. Following the date in October, W50 became the WQO station.

The Water Quality Objectives (WQO) (Clause 11 of the WUL) were met at the W2 during the period between April 11th and October 3rd, 2017. The water quality statistics during the period where W2 was the WQO compliance point are summarized below in Table 5-6. The maximum copper concentration was collected on April 30th 2017, the DOC for that sample was 32.3mg/L, and therefore did not exceed the WQO.

Table 5-5: W2 Water Quality Results Summary (2017)

| W2 Parameters | Water Quality Objective (WUL Clause 11) | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|------------------------------------|---|--------------------------------|----------------|---------------|-------------------------|------------|-----------|
| | | Mean | Min | Max | Mean | Min | Max |
| pH | 6.0-9.0 | 8.11 | 7.03 | 8.46 | 8.17 | 7.86 | 8.42 |
| TSS (mg/L) | | 52.5 | <1.0 | 2600 | 40.3 | <3.0 | 529 |
| Nutrients (mg/L) | | | | | | | |
| Ammonia Nitrogen | 0.25 | 0.04 | <.001 | 0.8300 | 0.0118 | <0.0050 | 0.0726 |
| Nitrite Nitrogen | 0.06 | 0.0118 | <0.0010 | 0.36 | 0.0014 | <0.0010 | 0.0047 |
| Nitrate Nitrogen | 9.1 | 1.5854 | <0.0050 | 9.4 | 0.1122 | <0.0050 | 0.365 |
| Dissolved Metals (mg/L) | | | | | | | |
| Aluminum | 0.1 | 0.0196 | 0.0028 | 0.201 | 0.0137 | 0.0029 | 0.0604 |
| Arsenic | 0.005 | 0.00053 | <0.0002 | 0.0018 | 0.00049 | 0.00035 | 0.00077 |
| Cadmium | 0.00015* | 0.0000393 | <0.0000050 | 0.00104 | 0.0000079 | <0.0000050 | 0.0000217 |
| Chromium | 0.001 | 0.00116 | 0.00012 | 0.0031 | 0.00023 | <0.00010 | 0.00051 |
| Copper | 0.013 ([DOC] ≤ 10mg/L) 0.02 ([DOC] > 10mg/L) | 0.00318 | 0.001 | 0.0227 | 0.00435 | 0.00145 | 0.0173 |
| Iron | 1.1 | 0.17 | 0.019 | 0.9050 | 0.098 | 0.028 | 0.338 |
| Lead | 0.004 | 0.000192 | <0.000050 | 0.0009 | 0.000058 | <0.000050 | 0.00023 |
| Molybdenum | 0.073 | 0.002835 | 0.00018 | 0.015 | 0.001216 | 0.000452 | 0.00175 |
| Nickel | 0.11 | 0.00122 | <0.0005 | 0.004 | 0.00113 | 0.00070 | 0.0017 |
| Selenium | 0.002 | 0.000658 | <0.00010 | 0.0026 | 0.000148 | 0.000074 | 0.00029 |
| Zinc | 0.03 | 0.006 | <0.0010 | 0.0200 | 0.0016 | <0.0010 | 0.0058 |

*Based on measured hardness

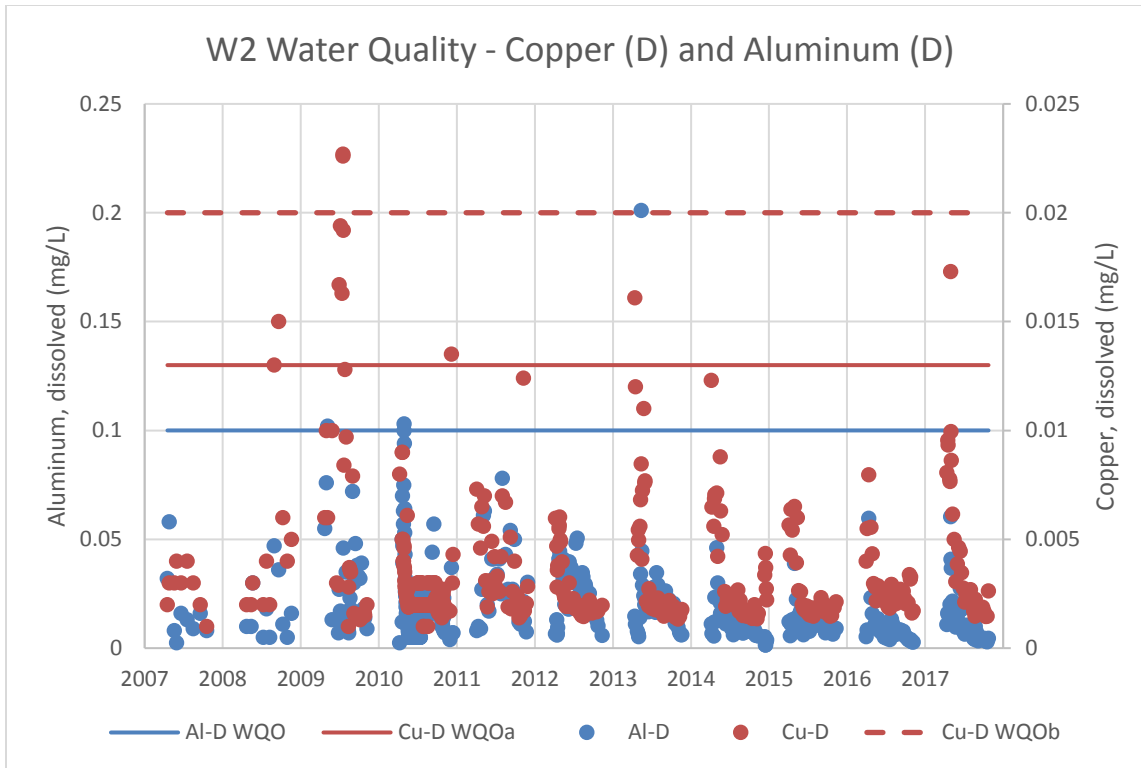


Figure 5-5: W2 Copper and Aluminum Concentrations (2007-2017)

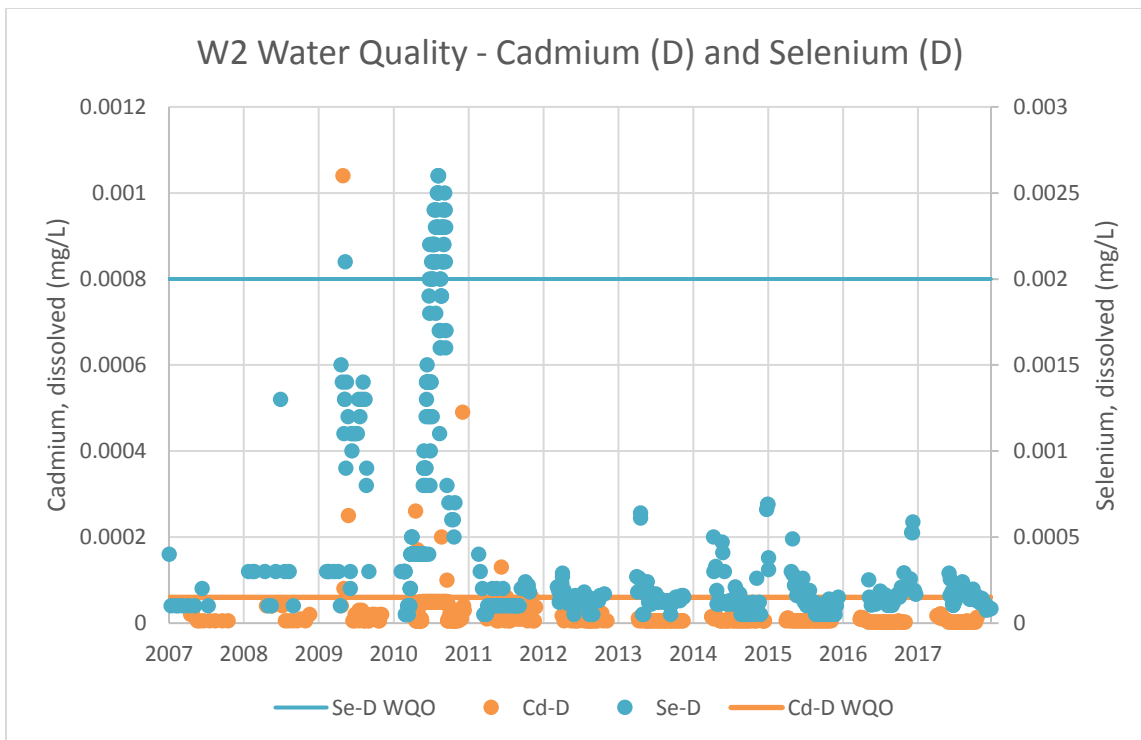


Figure 5-6: W2 Cadmium and Selenium Concentrations (2007-2017)

5.2.3.2 W50 – WQO Compliance Point

From January 1st until April 11th, W15 and W35 were frozen and W50 was the WQO station. Following April 11th until October 3rd, W2 was then the WQO station. After which, W15 and W35 froze and W50 once again became the WQO station. During the period that W50 was the WQO compliance point, no water samples were collected from the station as it was dry.

5.2.3.3 Discharge Compliance – RO

On April 16th 2017, there was a 7 m³ unplanned discharge from the RO directly to the Minto Creek. This event was discussed and resolved in the Monthly Report and subsequently with regulators, RO results for this incident are presented below in Table 5-5. The results are from the discharge collected April 16th, 2017.

Table 5-6: RO Water Quality Results from April 16, 2017

| RO | Water Quality Objectives (WUL Clause 11) | Date |
|------------------------------------|--|------------|
| Parameters | | 4/16/2017 |
| pH-L | 6.0-9.0 | 7.44 |
| TSS | | <3.0 |
| Nutrients (mg/L) | | |
| Ammonia | 0.25 | 0.193 |
| N-NO2 | 0.06 | 0.129 |
| N-NO3 | 9.1 | 1.78 |
| Dissolved Metals (mg/L) | | |
| Al-D | 0.1 | <0.0010 |
| As-D | 0.005 | <0.00010 |
| Cd-D | 0.00017348* | <0.0000050 |
| Cr-D | 0.001 | <0.00010 |
| Cu-D | [DOC] @W2 > 10 mg/L = 0.02; [DOC] @W2 < 10 mg/L = 0.013 | 0.00051 |
| Fe-D | 1.1 | <0.010 |
| Pb-D | 0.004 | <0.000050 |
| Mo-D | 0.073 | 0.000165 |
| Ni-D | 0.11 | <0.00050 |
| Se-D | 0.002 | 0.000183 |
| Zn-D | 0.03 | 0.0042 |

*value calculated from formula: $e^{(0.736(\ln(\text{hardness})4.943))}$

5.3 Surface Water Quality Surveillance Stations

5.3.1 W2 – Minto Creek at Lower Road Crossing Water Quality

The water quality statistics for W2 from 2007 to 2017 are presented in Section 5.2.3.1 above.

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

The water quality statistics for W3 from 2007 to 2017 are summarized below in Table 5-8. A total of 54 routine samples were collected from station W3 during the 2017 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W3 from 2007 to 2017 are also presented in Figure 5-7 and Figure 5-8 below. Three outlier data points dating from 2009 and early 2010 were removed from the W3 Cadmium and Selenium graph to better show the dataset on the graph (5/27/2009, 12/15/2009 and 1/11/2010).

Table 5-5: W3 Water Quality Results Summary (2007-2017)

| W3 Parameters | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|---------|-------------------------|------------|----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 8.09 | 7.4 | 8.6 | 8.2 | 7.92 | 8.5 |
| TSS (mg/L) | 7.4 | <1.0 | 985 | 3.9 | <3.0 | 17.7 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0558 | -0.01 | 0.6200 | 0.0167 | <0.0050 | 0.143 |
| Nitrite Nitrogen | 0.0442 | <0.0010 | 4.13 | 0.0032 | <0.0010 | 0.0511 |
| Nitrate Nitrogen | 2.874 | <0.020 | 18.7 | 0.431 | 0.105 | 1.91 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0207 | 0.0013 | 0.373 | 0.0038 | 0.001 | 0.0238 |
| Arsenic | 0.000346 | 0.00015 | 0.0014 | 0.00025 | 0.00012 | 0.00035 |
| Cadmium | 0.000847 | <0.0000050 | 0.565 | 7.7E-06 | <0.0000050 | 2.67E-05 |
| Chromium | 0.00106 | <0.00010 | <0.0040 | 0.00011 | <0.00010 | 0.00025 |
| Copper | 0.0054 | <0.001 | 0.067 | 0.00494 | 0.00167 | 0.022 |
| Iron | 0.0449 | <0.005 | 0.7500 | 0.031 | 0.01 | 0.068 |
| Lead | 0.00027 | 0.000009 | 0.0603 | 0.000051 | <0.000050 | 0.000135 |
| Molybdenum | 0.00568 | 0.00066 | 0.103 | 0.00418 | 0.00257 | 0.00529 |
| Nickel | 0.001141 | <0.00050 | 0.006 | 0.00093 | 0.00059 | 0.00132 |
| Selenium | 0.00103 | <0.00010 | 0.0348 | 0.000334 | <0.000050 | 0.000679 |
| Zinc | 0.00607 | 0.00067 | 0.1430 | 0.0013 | <0.0010 | 0.0054 |

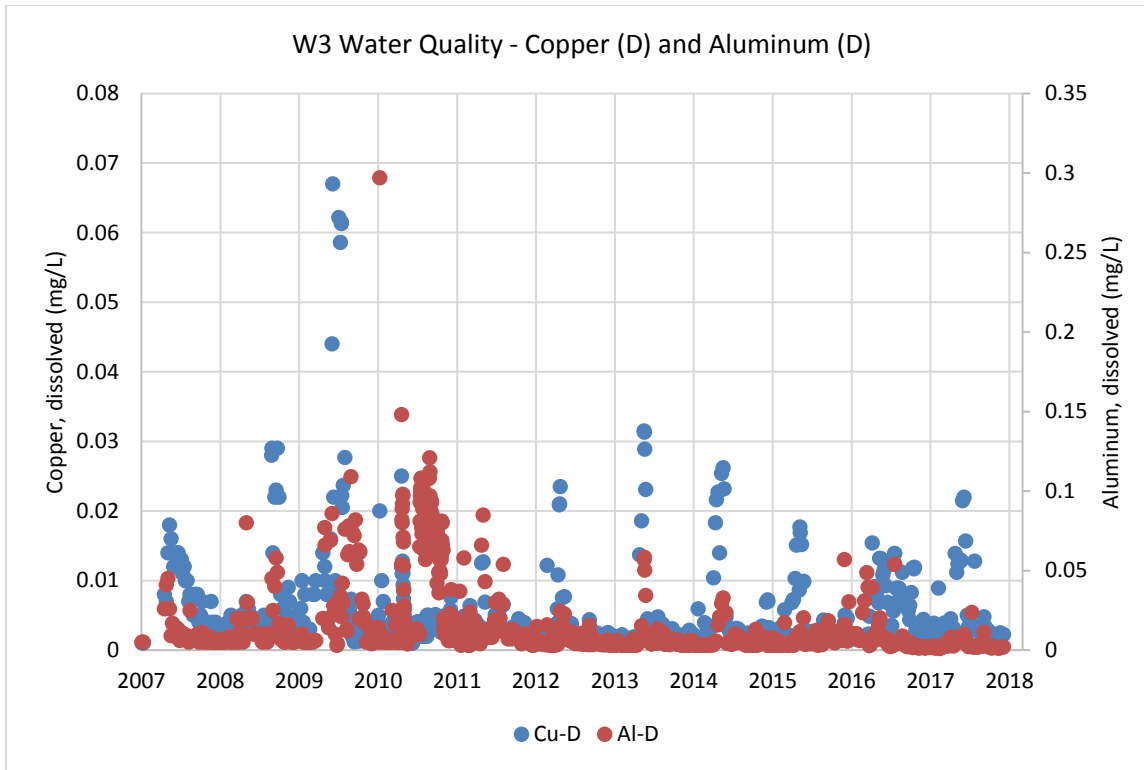


Figure 5-7: W3 Copper and Aluminum Concentrations (2007-2017)

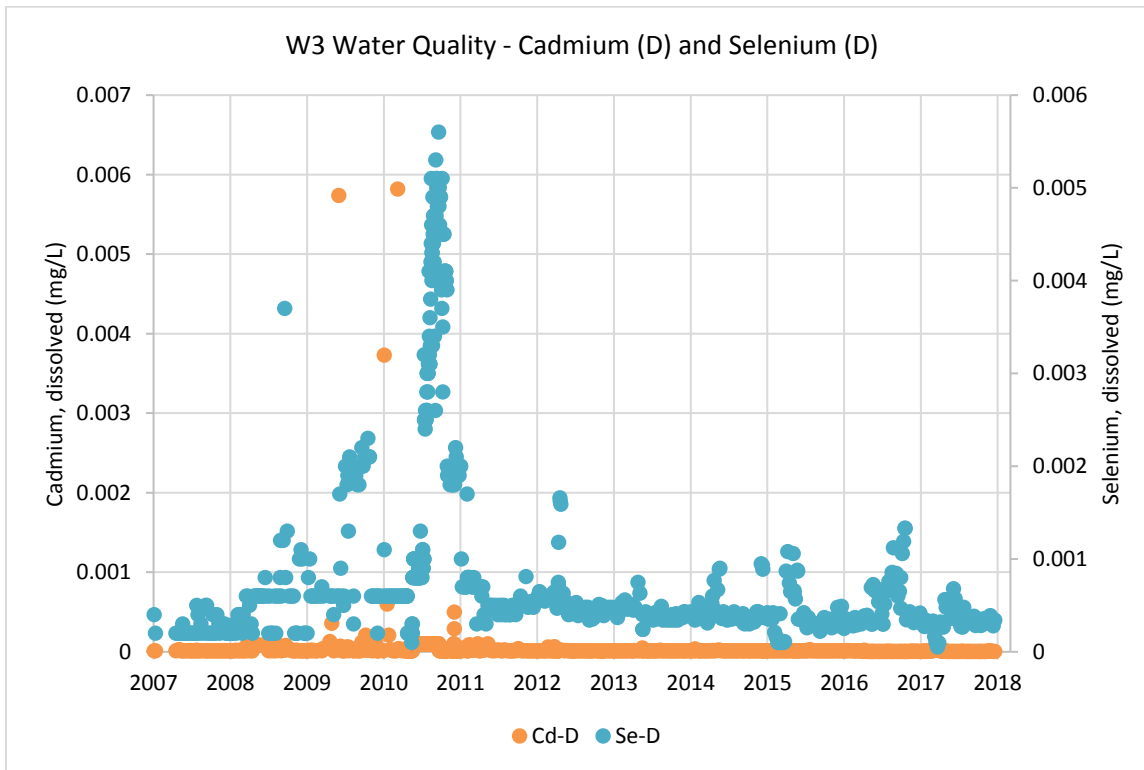


Figure 5-8: W3 Cadmium and Selenium Concentrations (2007-2017)

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

The water quality statistics for W4 from 2011 to 2017 are summarized below in Table 5-9. A total of three routine samples were collected from station W4 during the 2017 monitoring period. The Q3 sample was missed due to human error, resulting in changes to our management system to prevent recurrence.

Table 5-6: W4 Water Quality Results Summary (2011-2017)

| W4 Parameters | 2011 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 7.93 | 5.48 | 8.26 | 7.9 | 7.52 | 8.06 |
| TSS (mg/L) | 20.5 | <1.0 | 270 | 55.1 | <3.0 | 211 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0369 | <0.0050 | 2.4000 | 0.0075 | <0.0050 | 0.0148 |
| Nitrite Nitrogen | 0.0062 | <0.0010 | <0.050 | 0.001 | <0.0010 | <0.0010 |
| Nitrate Nitrogen | 0.0751 | 0.0099 | 0.849 | 0.058 | 0.0257 | 0.15 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0136 | 0.0017 | 0.167 | 0.0249 | 0.0025 | 0.088 |
| Arsenic | 0.00045 | <0.00010 | 0.00105 | 0.00053 | 0.00041 | 0.00086 |
| Cadmium | 1.72E-05 | <0.0000050 | 0.0014 | 7.1E-06 | <0.0000050 | 1.33E-05 |
| Chromium | 0.00099 | <0.00010 | <0.0020 | 0.00017 | <0.00010 | 0.00034 |
| Copper | 0.00106 | <0.00020 | 0.004 | 0.00308 | 0.00055 | 0.00819 |
| Iron | 0.036 | <0.0050 | 0.3070 | 0.064 | 0.011 | 0.219 |
| Lead | 0.000199 | <0.000050 | <0.00040 | 0.000058 | <0.000050 | 0.000081 |
| Molybdenum | 0.00109 | <0.0010 | 0.0021 | 0.000942 | 0.000684 | 0.00116 |
| Nickel | 0.00101 | <0.00050 | 0.002 | 0.00081 | <0.00050 | 0.00173 |
| Selenium | 0.000141 | <0.00010 | 0.00044 | 0.00014 | 0.000113 | 0.000165 |
| Zinc | 0.0051 | <0.0010 | 0.0278 | 0.001 | <0.0010 | 0.0012 |

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

The water quality statistics for W5 from 2011 to 2017 are summarized below in Table 5-10. A total of two routine samples were collected from station W5 during the 2017 monitoring period. The Q1 sample was inaccessible due to freezing conditions, and the Q3 sample was missed due to human error, resulting in changes to our management system to prevent recurrence.

Table 5-7: W5 Water Quality Results Summary (2011-2017)

| W5 Parameters | 2011 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 7.96 | 7.58 | 8.25 | 7.88 | 7.69 | 8.06 |
| TSS (mg/L) | 36.5 | <1.0 | 340 | 78 | <3.0 | 153 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0248 | <0.0050 | 0.3820 | 0.014 | <0.0050 | 0.0229 |
| Nitrite Nitrogen | 0.0063 | <0.0010 | <0.050 | 0.001 | <0.0010 | <0.0010 |
| Nitrate Nitrogen | 0.0595 | 0.0091 | <0.4 | 0.0573 | 0.0225 | 0.0921 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0141 | <0.0030 | 0.0588 | 0.0344 | 0.005 | 0.0637 |
| Arsenic | 0.0005 | 0.00036 | 0.00086 | 0.00058 | 0.00043 | 0.00072 |
| Cadmium | 1.09E-05 | <0.0000050 | 0.000031 | 9.2E-06 | <0.0000050 | 1.33E-05 |
| Chromium | 0.00098 | <0.00010 | <0.001 | 0.0002 | <0.00010 | 0.00031 |
| Copper | 0.00132 | 0.00047 | 0.00694 | 0.00244 | 0.00062 | 0.00426 |
| Iron | 0.0887 | 0.009 | 0.7120 | 0.113 | 0.023 | 0.203 |
| Lead | 0.000197 | <0.000050 | <0.0002 | 0.000066 | <0.000050 | 0.000083 |
| Molybdenum | 0.001151 | 0.000984 | 0.0018 | 0.001019 | 0.000868 | 0.00117 |
| Nickel | 0.00102 | <0.00050 | 0.002 | 0.00112 | <0.00050 | 0.00174 |
| Selenium | 0.00015 | <0.00010 | 0.00029 | 0.000128 | 0.000125 | 0.000132 |
| Zinc | 0.0052 | <0.0010 | 0.0355 | 0.0014 | <0.0010 | 0.0017 |

5.3.5 W6 – Tributary on the North side of Minto Creek

The water quality statistics for W6 from 2007 to 2017 are summarized below in Table 5-11. A total of six routine samples were collected from station W6 during the 2017 monitoring period.

Table 5-8: W6 Water Quality Results Summary (2007-2017)

| W6 Parameters | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|--------|-------------------------|------------|-----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 8.00 | 7.34 | 8.40 | 8.06 | 7.82 | 8.22 |
| TSS (mg/L) | 80.4 | <1.0 | 1160 | 60.5 | <3.0 | 294 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0488 | <0.0050 | <0.5 | 0.011 | <0.0050 | 0.0311 |
| Nitrite Nitrogen | 0.0077 | <0.0010 | 0.07 | 0.001 | <0.0010 | <0.0010 |
| Nitrate Nitrogen | 0.3333 | <0.0050 | 8.09 | 0.0081 | <0.0050 | 0.0165 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0134 | <0.0030 | 0.097 | 0.0101 | 0.0047 | 0.0194 |
| Arsenic | 0.00045 | 0.0002 | <0.001 | 0.00051 | 0.00046 | 0.00054 |
| Cadmium | 0.0000383 | <0.0000050 | 0.0002 | 0.0000052 | <0.0000050 | 0.0000064 |
| Chromium | 0.00118 | 0.00018 | <0.002 | 0.00022 | 0.00017 | 0.00028 |
| Copper | 0.00267 | 0.0008 | 0.043 | 0.00154 | 0.00092 | 0.00244 |
| Iron | 0.0672 | 0.01 | 0.2000 | 0.11 | 0.07 | 0.162 |
| Lead | 0.000188 | <0.000050 | 0.0005 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.001391 | 0.000247 | 0.015 | 0.000428 | 0.000364 | 0.000479 |
| Nickel | 0.00117 | <0.0010 | <0.003 | 0.00150 | 0.00128 | 0.00184 |
| Selenium | 0.000396 | 0.000057 | 0.002 | 0.000088 | 0.000061 | 0.000123 |
| Zinc | 0.0066 | <0.0010 | 0.0490 | 0.0011 | <0.0010 | 0.0015 |

5.3.6 W7 – North Flowing Tributary to Minto Creek

The water quality statistics for W7 from 2007 to 2017 are summarized below in Table 5-12. A total of eight routine samples were collected from station W7 during the 2017 monitoring period.

Table 5-9: W7 Water Quality Results Summary (2007-2017)

| W7 Parameters | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|---------|-------------------------|------------|-----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 7.97 | 5.51 | 8.41 | 8.11 | 7.96 | 8.28 |
| TSS (mg/L) | 33.7 | <1.0 | 400 | 14.3 | <3.0 | 50.7 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0354 | <0.0050 | 0.3400 | 0.0151 | 0.007 | 0.0443 |
| Nitrite Nitrogen | 0.0162 | <0.0010 | 0.14 | 0.0011 | <0.0010 | 0.0017 |
| Nitrate Nitrogen | 0.1112 | 0.0063 | 0.324 | 0.0934 | 0.005 | 0.155 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0193 | <0.0030 | 0.096 | 0.01 | 0.0041 | 0.0279 |
| Arsenic | 0.00045 | <0.0002 | 0.001 | 0.00046 | 0.00039 | 0.00055 |
| Cadmium | 0.0000304 | <0.0000050 | <0.0001 | 0.0000073 | <0.0000050 | 0.0000208 |
| Chromium | 0.0011 | 0.00013 | 0.002 | 0.00025 | 0.00017 | 0.00038 |
| Copper | 0.00202 | 0.00063 | 0.0154 | 0.00184 | 0.00087 | 0.00568 |
| Iron | 0.1967 | 0.0102 | 1.0600 | 0.1 | 0.02 | 0.185 |
| Lead | 0.000194 | <0.000050 | 0.0017 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.001285 | 0.00013 | 0.002 | 0.001328 | 0.000846 | 0.00161 |
| Nickel | 0.00124 | <0.0005 | 0.004 | 0.00113 | 0.00083 | 0.00175 |
| Selenium | 0.000335 | 0.000092 | 0.0022 | 0.000152 | 0.000119 | 0.000174 |
| Zinc | 0.0054 | <0.0010 | 0.0100 | 0.0042 | <0.0010 | 0.0302 |

5.3.7 W8 – Western Collection Sump from DSTSF

W8 sump was dry throughout 2017 and was destroyed in mid-December during normal operations, buried under waste material. Water quality statistics for W8 from 2009 to 2013 are presented in Table 5-13 below. Trend analyses for seepage parameters results are presented in the Seepage section 7.1.

Table 5-10: Water Quality Result Summary (2009-2013)

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

5.3.8 W8A – Eastern Collection Sump from DSTSF

W8A was collected on a weekly basis per WUL requirements, a total of 46 samples were collected during the 2017 monitoring period; the sump was briefly frozen in March 2017 and dry in May 2017 for a 5-week period. Water quality statistics from 2009 to 2017 are summarized below in Table 5-14. Furthermore, trend analyses for seepage parameters results are presented in the Seepage section 7.1.

Table 5-11: Water Quality Result Summary (2009-2017)

| Station Name | 2009 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|-----------|--------|-------------------------|-----------|----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.00 | 5.04 | 8.6 | 7.85 | 7.31 | 8.36 |
| TSS (mg/L) | 45.9 | <1.0 | 6540 | 37.7 | 4.0 | 106 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.1148 | 0.007 | 1.6 | 0.2541 | 0.0362 | 0.477 |
| Nitrite Nitrogen | 0.0728 | <0.0010 | 0.61 | 0.2138 | 0.0125 | 1.18 |
| Nitrate Nitrogen | 10.0570 | <0.0050 | 72 | 3.957 | 0.126 | 7.20 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.01223 | 0.00262 | 0.157 | 0.0129 | 0.0044 | 0.143 |
| Arsenic | 0.000539 | <0.00010 | 0.0066 | 0.00066 | 0.00038 | 0.00145 |
| Cadmium | 0.000179 | <0.000010 | 0.0013 | 0.000205 | 7.91E-05 | 0.000518 |
| Chromium | 0.00100 | 0.0001 | 0.002 | 0.00063 | 0.00027 | 0.00151 |
| Copper | 0.10888 | <0.00020 | 0.272 | 0.0705 | 0.0278 | 0.126 |
| Iron | 0.1502 | <0.0050 | 0.648 | 0.926 | 0.147 | 7.00 |
| Lead | 0.000188 | 0.000013 | 0.0005 | 0.000079 | <0.000050 | 0.00102 |
| Molybdenum | 0.01051 | <0.0010 | 0.049 | 0.01084 | 0.00410 | 0.0172 |
| Nickel | 0.001454 | 0.000677 | 0.006 | 0.00173 | 0.00099 | 0.00289 |
| Selenium | 0.00639 | <0.00010 | 0.018 | 0.00563 | 0.00101 | 0.0104 |
| Zinc | 0.6483 | <0.001 | 5.17 | 0.2247 | 0.0927 | 0.559 |

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

The water quality statistics for W10 from 2007 to 2017 are summarized below in Table 5-15. A total of eleven routine samples were collected from station W10 during the 2017 monitoring period.

Table 5-12: W10 Water Quality Results Summary (2007-2017)

| W10 | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|---------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.43 | 6.00 | 8.57 | 7.54 | 6.95 | 8.01 |
| TSS (mg/L) | 15.3 | <1.0 | 366 | 82.1 | <3.0 | 390 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.1314 | <0.0050 | 1.3000 | 0.6399 | 0.0067 | 3.25 |
| Nitrite Nitrogen | 0.0163 | <0.0010 | 0.148 | 0.02 | <0.0010 | 0.0723 |
| Nitrate Nitrogen | 0.3669 | <0.0050 | 6.59 | 5.1412 | <0.0050 | 19.8 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.1231 | <0.0030 | 0.418 | 0.0562 | 0.0025 | 0.235 |
| Arsenic | 0.00049 | <0.00010 | 0.00248 | 0.00062 | <0.00010 | 0.00268 |
| Cadmium | 0.0000432 | <0.0000050 | 0.0007 | 0.0000065 | <0.0000050 | 0.0000136 |
| Chromium | 0.00097 | <0.00010 | <0.002 | 0.00043 | <0.00010 | 0.00241 |
| Copper | 0.033 | <0.00020 | 0.138 | 0.01609 | 0.00067 | 0.0876 |
| Iron | 2.6593 | <0.0050 | 41.7000 | 10.143 | 0.013 | 76.5 |
| Lead | 0.000203 | <0.000050 | 0.0022 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.000843 | 0.00003 | 0.0015 | 0.000511 | 0.000084 | 0.00123 |
| Nickel | 0.00156 | <0.00050 | 0.00395 | 0.00149 | <0.00050 | 0.00573 |
| Selenium | 0.000265 | <0.000050 | <0.001 | 0.00017 | <0.000050 | 0.000735 |
| Zinc | 0.0077 | <0.0010 | 0.0620 | 0.0029 | <0.0010 | 0.0101 |

5.3.10 W12 – Water in the Main Pit

The water quality statistics for W12 from 2007 to 2017 are summarized below in Table 5-16. A total of twelve routine samples were collected from station W12 during the 2017 monitoring period.

Table 5-13: W12 Water Quality Results Summary (2007-2017)

| W12 Parameters | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|---------|-------------------------|-----------|----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 8.07 | 6.20 | 10.60 | 7.81 | 5.37 | 8.14 |
| TSS (mg/L) | 18.5 | <1.0 | 251 | 10.8 | <3.0 | 36.2 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 2.3176 | <0.0050 | 24.0000 | 4.28 | <0.015 | 6.94 |
| Nitrite Nitrogen | 0.7844 | <0.0050 | 8.78 | 3.6067 | <0.0010 | 6.71 |
| Nitrate Nitrogen | 20.728 | <0.01 | 141 | 17.1737 | <0.0050 | 28.9 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0226 | 0.0016 | 0.124 | 0.0062 | 0.0036 | 0.0124 |
| Arsenic | 0.00069 | <0.00010 | 0.003 | 0.00044 | 0.00039 | 0.00054 |
| Cadmium | 0.0000484 | <0.0000050 | 0.0005 | 0.0001342 | 0.0000142 | 0.000205 |
| Chromium | 0.00092 | <0.00010 | 0.0025 | 0.00018 | <0.00010 | <0.00020 |
| Copper | 0.05656 | 0.00046 | 0.476 | 0.0412 | 0.0117 | 0.074 |
| Iron | 0.0411 | <0.0050 | 0.3860 | 0.022 | <0.010 | 0.047 |
| Lead | 0.0002 | <0.000050 | 0.0005 | 0.000106 | <0.000050 | 0.00021 |
| Molybdenum | 0.04448 | <0.0010 | 0.0972 | 0.0775 | 0.0645 | 0.0847 |
| Nickel | 0.00158 | <0.0005 | 0.0038 | 0.00353 | 0.00262 | 0.0046 |
| Selenium | 0.00723 | <0.00010 | 0.0207 | 0.0127 | 0.010800 | 0.0153 |
| Zinc | 0.0056 | 0.001 | 0.0310 | 0.0061 | 0.0022 | <0.0090 |

5.3.11 W12A – Discharge in the Main Pit

There was no discharge from the Main Pit in 2017 and no discharge from the Main Pit in previous years.

5.3.12 W14 – Tailings Thickener Overflow

The water quality statistics for W14 from 2007 to 2017 are summarized below in Table 5-17. A total of twelve routine samples were collected from station W14 during the 2017 monitoring period.

Table 5-14: W14 Water Quality Results Summary (2007-2017)

| W14 | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|---------|-------------------------|-----------|----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.99 | 7.29 | 8.69 | 8.07 | 7.79 | 8.19 |
| TSS (mg/L) | 122.7 | <5 | 1120 | 60.3 | 18 | 155 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 3.19 | <0.05 | 13.0000 | 4.93 | 2.9 | 9.69 |
| Nitrite Nitrogen | 0.9966 | 0.0183 | 4.3 | 4.03 | 1.89 | 6.19 |
| Nitrate Nitrogen | 35.8 | 12.3 | 86.7 | 28.9 | 18.9 | 46.7 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.1231 | 0.0078 | 1.91 | 0.0281 | 0.0102 | 0.0377 |
| Arsenic | 0.00061 | <0.0002 | 0.0052 | 0.00036 | 0.00021 | 0.00056 |
| Cadmium | 0.0000444 | <0.0000050 | 0.0003 | 0.0000701 | <0.000010 | <0.00015 |
| Chromium | 0.00091 | <0.00010 | 0.0036 | 0.00017 | <0.00010 | <0.00020 |
| Copper | 0.01461 | 0.0002 | 0.723 | 0.00597 | 0.00066 | 0.02 |
| Iron | 0.0906 | <0.0050 | 4.8000 | 0.017 | <0.010 | <0.020 |
| Lead | 0.000207 | <0.000050 | 0.0011 | 0.000083 | <0.000050 | <0.00010 |
| Molybdenum | 0.0969 | 0.0458 | 0.181 | 0.1216 | 0.048 | 0.17 |
| Nickel | 0.00141 | <0.0005 | 0.0082 | 0.00241 | 0.00160 | 0.00364 |
| Selenium | 0.03288 | 0.00166 | 0.229 | 0.0189 | 0.014100 | 0.023 |
| Zinc | 0.0051 | <0.0010 | 0.0280 | 0.0017 | <0.0010 | <0.0020 |

5.3.13 W15 – Upper Minto Creek Stormwater Collection Point

The water quality statistics for W15 from 2007 to 2017 are summarized below in Table 5-18. A total of eighteen routine samples were collected from station W15 during the 2017 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W15 from 2007 to 2017 are also presented in Figure 5-9 and Figure 5-10 below.

Table 5-15: W15 Water Quality Results Summary (2007-2017)

| W15 Parameters | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|---------|-------------------------|------------|----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 7.93 | 6.11 | 8.48 | 8.16 | 7.84 | 8.45 |
| TSS (mg/L) | 17.3 | <1.0 | 370 | 19.6 | <3.0 | 291 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.1193 | <0.0050 | 5.3000 | 0.1436 | 0.0095 | 1.03 |
| Nitrite Nitrogen | 0.0983 | <0.0050 | 3.78 | 0.1301 | 0.0055 | 0.548 |
| Nitrate Nitrogen | 12.096 | <0.01 | 265 | 13.83 | 4.24 | 58.8 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0528 | 0.0019 | 2.65 | 0.0202 | 0.004 | 0.0712 |
| Arsenic | 0.000536 | <0.00010 | 0.0022 | 0.00043 | 0.00026 | 0.00068 |
| Cadmium | 0.0000432 | <0.0000050 | 0.00234 | 0.000015 | <0.0000050 | 0.000068 |
| Chromium | 0.00105 | <0.00010 | 0.0053 | 0.00019 | <0.00010 | 0.00032 |
| Copper | 0.0236 | <0.00020 | 0.415 | 0.0248 | 0.00719 | 0.0401 |
| Iron | 0.4015 | <0.0050 | 6.4800 | 0.122 | 0.01 | 0.28 |
| Lead | 0.000208 | 3.1E-05 | 0.0027 | 0.000052 | <0.000050 | <0.00010 |
| Molybdenum | 0.00406 | 0.0001 | 0.113 | 0.00328 | 0.00194 | 0.0126 |
| Nickel | 0.001309 | <0.00050 | 0.008 | 0.00099 | <0.00050 | 0.0017 |
| Selenium | 0.00269 | <0.00010 | 0.0504 | 0.00389 | 0.001230 | 0.0132 |
| Zinc | 0.00573 | <0.0010 | 0.0410 | 0.0041 | <0.0010 | 0.0231 |

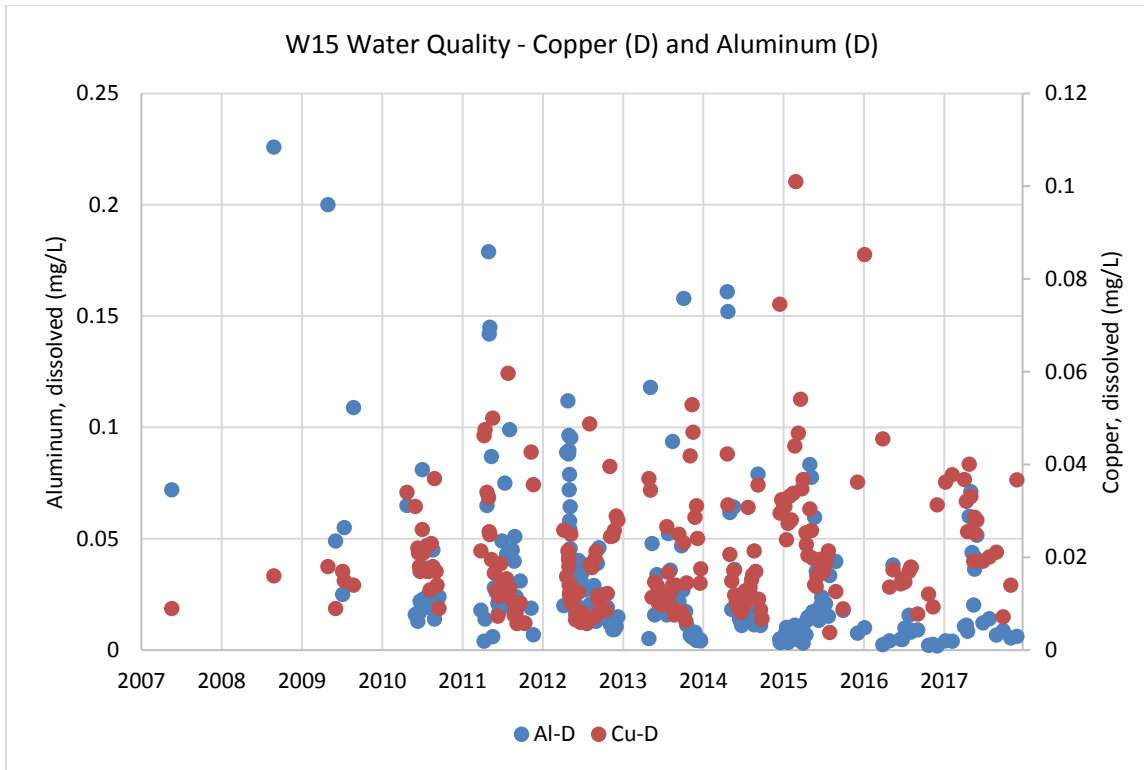


Figure 5-9: W15 Copper and Aluminum Concentrations (2007-2017)

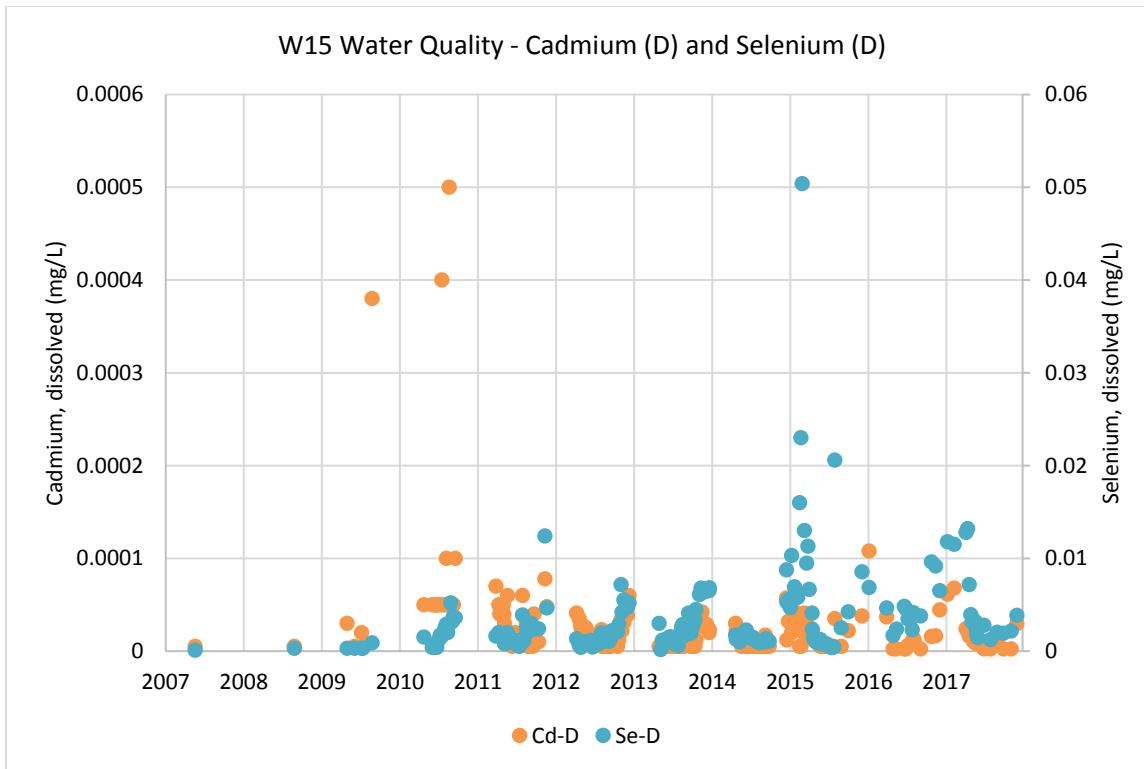


Figure 5-10: W15 Cadmium and Selenium Concentrations (2007-2017)

5.3.14 W16 – Water Storage Pond

The water quality statistics for W16 from 2007 to 2017 are summarized below in Table 5-19. A total of 37 routine samples were collected from station W16 during the 2017 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W16 from 2007 to 2017 are also presented in Figure 5-11 and Figure 5-12 below. An outlier in cadmium concentration for W16 collected on 5/5/2009 was removed for presenting the dataset in Figure 5-12.

Table 5-16: W16 Water Quality Results Summary (2007-2017)

| W16 Parameters | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|---------|-------------------------|------------|-----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 7.99 | 6.74 | 8.81 | 8.14 | 7.55 | 8.41 |
| TSS (mg/L) | 7.6 | <1.0 | 181 | 9.6 | <3.0 | 63.5 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.1441 | <0.0050 | 2.0000 | 0.0622 | <0.0050 | 0.163 |
| Nitrite Nitrogen | 0.1041 | 0.0012 | 8.62 | 0.037 | <0.0010 | 0.118 |
| Nitrate Nitrogen | 3.571 | 0.01 | 35 | 2.25 | 0.252 | 4.86 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.01759 | 0.0013 | 0.234 | 0.0095 | 0.0019 | 0.0341 |
| Arsenic | 0.000413 | <0.00010 | 0.0015 | 0.00036 | <0.00010 | 0.00048 |
| Cadmium | 0.0000416 | <0.0000050 | 0.00557 | 0.0000133 | <0.0000050 | 0.0000485 |
| Chromium | 0.00104 | <0.00010 | 0.0172 | 0.00012 | <0.00010 | 0.00022 |
| Copper | 0.02384 | 0.00158 | 0.123 | 0.02465 | 0.00643 | 0.047 |
| Iron | 0.1201 | 0.0066 | 1.3600 | 0.071 | <0.010 | 0.141 |
| Lead | 0.000207 | 0.00002 | <0.0010 | 0.000051 | <0.000050 | 0.000096 |
| Molybdenum | 0.00586 | 0.00074 | 0.0271 | 0.002782 | 0.000653 | 0.00511 |
| Nickel | 0.001275 | <0.00050 | 0.009 | 0.00080 | <0.00050 | 0.00127 |
| Selenium | 0.001205 | <0.00010 | 0.0064 | 0.000748 | 0.000145 | 0.0015 |
| Zinc | 0.00654 | <0.0010 | 0.0828 | 0.002 | <0.0010 | 0.0105 |

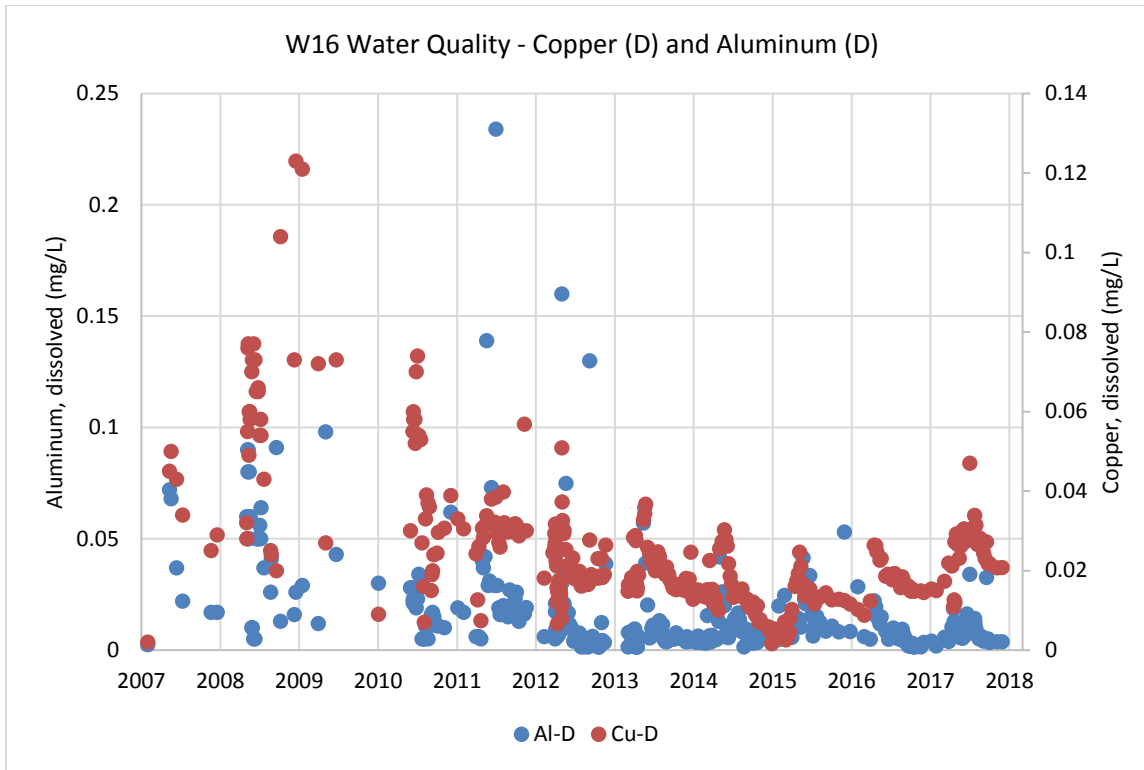


Figure 5-11: W16 Copper and Aluminum Concentrations (2007-2017)

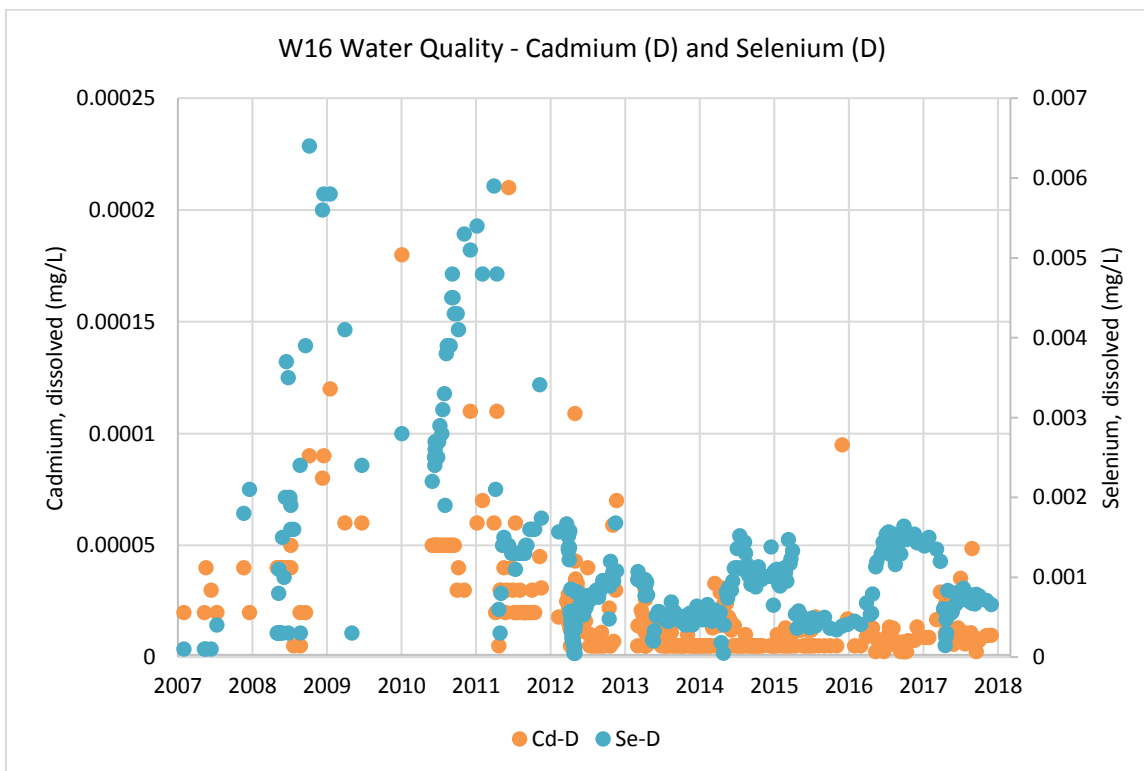


Figure 5-12: W16 Cadmium and Selenium Concentrations (2007-2017)

5.3.15 W17 – Water Storage Pond Dam Seepage

The summary results for this station are presented in the seepage section 7.4 along with trend analyses for dissolved copper, aluminum, cadmium and selenium concentrations throughout the years. A total of 54 samples were collected at this station during the 2017 monitoring period.

5.3.16 W30 – Headwaters Minto Creek (northwest fork)

The water quality statistics for W30 from 2009 to 2017 are summarized below in Table 5-20. A total of eight routine samples were collected from station W30 during the 2017 monitoring period.

Table 5-17: W30 Water Quality Results Summary (2009-2017)

| W30 | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|--------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.76 | 6.15 | 8.43 | 8.22 | 8.02 | 8.32 |
| TSS (mg/L) | 18.3 | <1.0 | 1110 | 7.3 | <3.0 | 16 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.1182 | <0.005 | 0.8500 | 0.1035 | 0.0201 | 0.599 |
| Nitrite Nitrogen | 0.0325 | <0.0010 | 0.579 | 0.0148 | 0.0014 | 0.0564 |
| Nitrate Nitrogen | 3.737 | <0.01 | 78.6 | 0.625 | 0.163 | 2.17 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0604 | <0.001 | 0.217 | 0.0054 | 0.0014 | 0.0098 |
| Arsenic | 0.00111 | 0.00024 | 0.054 | 0.00074 | 0.00044 | 0.00132 |
| Cadmium | 0.0015038 | <0.0000050 | 0.143 | 0.0000066 | <0.0000050 | 0.0000154 |
| Chromium | 0.00112 | <0.00010 | 0.0149 | 0.0001 | <0.00010 | <0.00010 |
| Copper | 0.0345 | 0.0067 | 0.179 | 0.01657 | 0.00835 | 0.0248 |
| Iron | 0.2196 | <0.001 | 0.7830 | 0.067 | 0.012 | 0.146 |
| Lead | 0.0002 | <0.000050 | 0.001 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.00211 | <0.0002 | 0.0098 | 0.00241 | 0.00137 | 0.00408 |
| Nickel | 0.00126 | <0.00050 | 0.024 | 0.00054 | <0.00050 | 0.00093 |
| Selenium | 0.00551 | 0.0004 | 0.343 | 0.001678 | 0.000665 | 0.00515 |
| Zinc | 0.0057 | <0.0010 | 0.0164 | 0.0015 | <0.0010 | <0.0050 |

5.3.17 W33 – Above Tailings Diversion Ditches

The water quality statistics for W33 from 2009 to 2017 are summarized below in Table 5-21. A total of seven routine samples were collected from station W33 during the 2017 monitoring period. W33 was buried during construction at the end of December.

Table 5-18: W33 Water Quality Results Summary (2009-2017)

| W33 Parameters | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|---------|-------------------------|------------|-----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 7.64 | 5.98 | 8.25 | 7.78 | 7.52 | 8.06 |
| TSS (mg/L) | 10.3 | <1.0 | 218 | 6 | <3.0 | 23 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0578 | <0.0050 | <0.5 | 0.0118 | 0.0087 | 0.0167 |
| Nitrite Nitrogen | 0.0163 | <0.0010 | 0.251 | 0.0102 | <0.0010 | 0.0544 |
| Nitrate Nitrogen | 2.86 | <0.01 | 60.4 | 7.979 | 0.442 | 40.7 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0472 | <0.0030 | 0.31 | 0.0315 | 0.016 | 0.0501 |
| Arsenic | 0.00036 | <0.00010 | <0.001 | 0.00039 | 0.0003 | 0.00043 |
| Cadmium | 0.0000312 | <0.0000050 | <0.0001 | 0.0000066 | <0.0000050 | 0.0000127 |
| Chromium | 0.00114 | 0.00039 | 0.0022 | 0.00041 | 0.00027 | 0.00051 |
| Copper | 0.01348 | <0.00020 | 0.106 | 0.01542 | 0.00761 | 0.0348 |
| Iron | 0.1561 | <0.0050 | 0.9560 | 0.127 | 0.079 | 0.205 |
| Lead | 0.000194 | <0.000050 | 0.0007 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.000977 | 0.0002 | 0.003 | 0.000584 | 0.000348 | 0.000725 |
| Nickel | 0.00149 | <0.0010 | 0.003 | 0.00149 | 0.00104 | 0.00192 |
| Selenium | 0.000414 | <0.00010 | 0.006 | 0.000189 | 0.000120 | 0.000429 |
| Zinc | 0.0058 | <0.0010 | <0.01 | 0.0013 | <0.0010 | 0.0025 |

5.3.18 W35 – Storm Water Collection Point – South Diversion Ditch

The water quality statistics for W35 from 2012 to 2017 are summarized below in Table 5-22. A total of thirteen routine samples were collected from station W35 during the 2017 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W35 from 2012 to 2017 are also presented in Figure 5-13 and Figure 5-14 below. In September 2017, the SDD was removed due to changes in the construction of the A2S3 expansion. New conveyance infrastructure was installed to reroute water from W35 to the TDD or A2 Pit depending on water quality.

Table 5-19: W35 Water Quality Results Summary (2012-2017)

| W35 | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.90 | 6.77 | 8.26 | 7.91 | 7.56 | 8.14 |
| TSS (mg/L) | 24.1 | <1.0 | 465 | 12.9 | <3.0 | 63.2 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0506 | 0.0059 | 0.3030 | 0.0273 | 0.0105 | 0.098 |
| Nitrite Nitrogen | 0.0367 | 0.0025 | 0.335 | 0.017 | 0.0017 | 0.0851 |
| Nitrate Nitrogen | 5.32 | <0.020 | 28.7 | 5.878 | 0.709 | 25.1 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0273 | 0.0061 | 0.104 | 0.0255 | 0.0107 | 0.0411 |
| Arsenic | 0.00034 | 0.00023 | 0.0005 | 0.00039 | 0.00029 | 0.00056 |
| Cadmium | 0.0000124 | <0.0000050 | 5E-05 | 0.0000121 | <0.0000050 | 0.0000288 |
| Chromium | 0.00086 | 0.00021 | <0.0010 | 0.00033 | 0.00018 | 0.00061 |
| Copper | 0.0332 | 0.017 | 0.0551 | 0.0427 | 0.0194 | 0.0836 |
| Iron | 0.0894 | 0.0144 | 0.3230 | 0.084 | 0.025 | 0.15 |
| Lead | 0.000171 | <0.000050 | <0.00020 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.001425 | 0.000783 | 0.0055 | 0.000896 | 0.000485 | 0.00183 |
| Nickel | 0.00117 | 0.00064 | 0.0016 | 0.00135 | 0.00090 | 0.00173 |
| Selenium | 0.000245 | <0.00010 | 0.0005 | 0.00018 | 0.000105 | 0.000466 |
| Zinc | 0.0046 | <0.0010 | 0.0068 | 0.0014 | <0.0010 | 0.0028 |

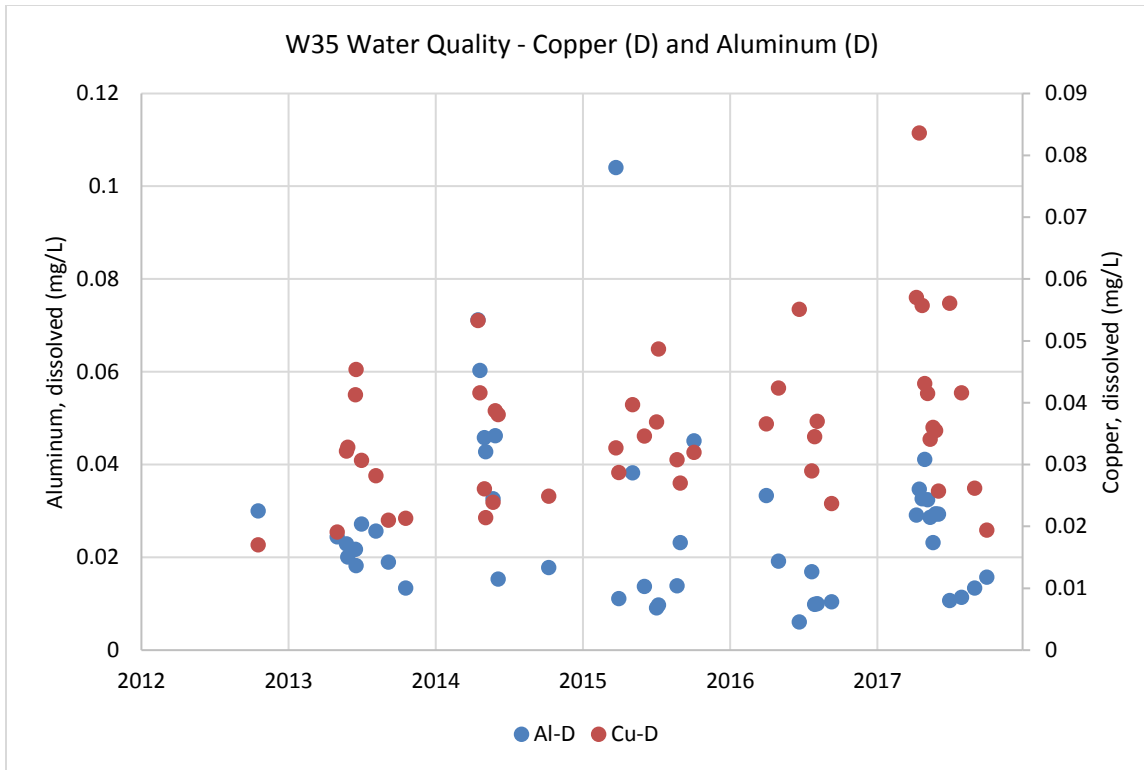


Figure 5-13: W35 Copper and Aluminum Concentrations (2012-2017)

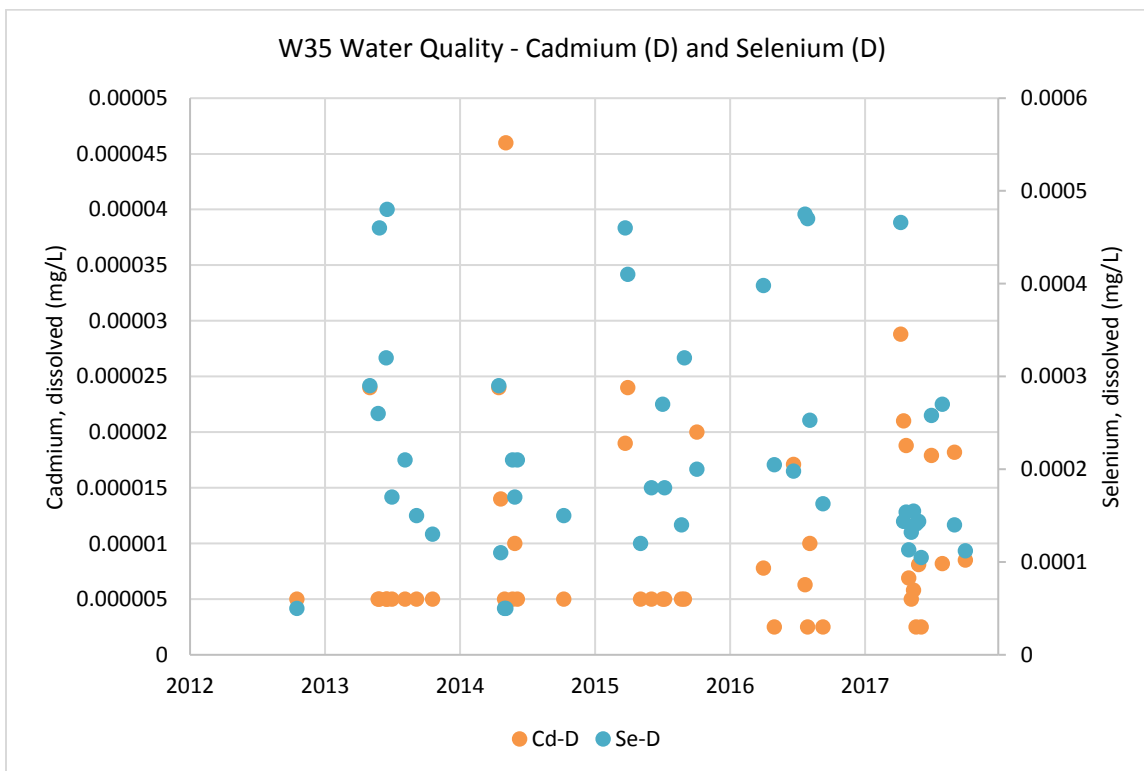


Figure 5-14: W35 Cadmium and Selenium Concentrations (2012-2017)

5.3.19 W36 – Minto Creek Detention Structure Pond

W36 was decommissioned during the construction of the Mill Valley Fill Extension Phase 2 (MVFE2) in 2015. As such, no samples were taken in 2017.

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

W37 was decommissioned during the construction of the Mill Valley Fill Extension Phase 2 (MVFE2) in 2015 and replaced by W62. As such, no samples were taken in 2017.

5.3.21 W45– Area 2 Pit

The water quality statistics for W45 from 2012 to 2017 are summarized below in Table 5-23. A total of ten routine samples were collected from station W45 during the 2017 monitoring period. Access was not permitted for two months when the pump was removed, due to safety reasons.

Table 5-20: W45 Water Quality Results Summary (2012-2017)

| W45 Parameters | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|-----------|---------|-------------------------|----------|----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 8.06 | 7.86 | 8.27 | 7.90 | 7.76 | 8.03 |
| TSS (mg/L) | 27.8 | <1.0 | 291 | 51.6 | 12.3 | 139 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 5.739 | 0.072 | 37.0000 | 5.81 | 3.33 | 9.02 |
| Nitrite Nitrogen | 1.7216 | 0.0223 | 7.6 | 4.308 | 0.433 | 11.4 |
| Nitrate Nitrogen | 23.31 | 1.65 | 77.2 | 22.97 | 9.6 | 35.5 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0202 | 0.0032 | 0.337 | 0.012 | 0.0083 | 0.0148 |
| Arsenic | 0.00102 | 0.00032 | 0.0023 | 0.00042 | 0.00034 | 0.00056 |
| Cadmium | 0.0001138 | <0.000050 | 0.0005 | 0.000104 | 0.000028 | 0.00018 |
| Chromium | 0.0008 | <0.00010 | <0.0010 | 0.0002 | <0.00020 | <0.00020 |
| Copper | 0.06354 | 0.00025 | 0.276 | 0.00685 | 0.001 | 0.0208 |
| Iron | 0.068 | <0.0050 | 0.7260 | 0.058 | <0.020 | 0.172 |
| Lead | 0.000183 | <0.000050 | 0.0007 | 0.0001 | <0.00010 | 0.00014 |
| Molybdenum | 0.0516 | 0.0033 | 0.117 | 0.101 | 0.0851 | 0.121 |
| Nickel | 0.00184 | <0.0010 | 0.0047 | 0.00590 | 0.00440 | 0.0082 |
| Selenium | 0.00906 | 0.00048 | 0.0298 | 0.016 | 0.014000 | 0.0181 |
| Zinc | 0.0109 | <0.0010 | 0.0673 | 0.0022 | <0.0020 | 0.003 |

5.3.22 W46 – Minto Creek, Downstream of W7 and W6

The water quality statistics for W46 from 2012 to 2017 are summarized below in Table 5-24. A total of eight routine samples were collected from station W46 during the 2017 monitoring period.

Table 5-21: W46 Water Quality Results Summary (2012-2017)

| W46 Parameters | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|---------|-------------------------|------------|-----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 8.08 | 7.49 | 8.33 | 8.14 | 8.01 | 8.35 |
| TSS (mg/L) | 21.7 | <1.0 | 175 | 182.6 | <3.0 | 693 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0292 | 0.0062 | 0.1600 | 0.0273 | 0.0081 | 0.069 |
| Nitrite Nitrogen | 0.005 | <0.0010 | 0.0242 | 0.0015 | <0.0010 | 0.0023 |
| Nitrate Nitrogen | 0.3835 | <0.020 | 3.28 | 0.1333 | 0.013 | 0.245 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0098 | <0.0030 | 0.0449 | 0.0086 | 0.0043 | 0.0136 |
| Arsenic | 0.00046 | 0.0003 | 0.0008 | 0.0005 | 0.00039 | 0.00061 |
| Cadmium | 0.0000099 | <0.0000050 | 2E-05 | 0.0000084 | <0.0000050 | 0.0000217 |
| Chromium | 0.00083 | 0.00011 | <0.0010 | 0.00018 | 0.00011 | 0.00022 |
| Copper | 0.00268 | 0.00089 | 0.0108 | 0.0029 | 0.0014 | 0.00483 |
| Iron | 0.1753 | 0.0183 | 0.6460 | 0.153 | 0.059 | 0.34 |
| Lead | 0.000169 | <0.000050 | 0.0002 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.0021 | <0.0010 | 0.007 | 0.0018 | 0.00157 | 0.00208 |
| Nickel | 0.00112 | 0.00068 | 0.0021 | 0.00111 | 0.00095 | 0.00135 |
| Selenium | 0.000232 | <0.00010 | 0.0009 | 0.000183 | 0.000115 | 0.000216 |
| Zinc | 0.0046 | <0.0010 | 0.0150 | 0.0021 | <0.0010 | <0.0050 |

5.3.23 W47 – Area 118 Pit Water

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

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

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

5.3.25 W51 – Area 2 Stage 3 Pit

The water quality statistics for W51 from 2017 are summarized below in Table 5-26. W51 was developed in 2017 with the mining activities in the Area 2 Stage 3 pit. A total of two routine samples were collected from station W51 during the 2017 monitoring period. No other samples were collected because the sump was inaccessible for safety reasons.

Table 5-22: W51 Water Quality Results Summary (2017)

| W51 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.27 | 8.12 | 8.41 |
| TSS (mg/L) | 36.9 | 3.1 | 70.7 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 1.284 | 0.627 | 1.94 |
| Nitrite Nitrogen | 0.341 | 0.126 | 0.555 |
| Nitrate Nitrogen | 7.96 | 4.13 | 11.8 |
| Dissolved Metals (mg/L) | | | |
| Aluminum | 0.0034 | 0.0024 | 0.0045 |
| Arsenic | 0.00084 | 0.00083 | 0.00084 |
| Cadmium | 0.000038 | <0.000025 | <0.000050 |
| Chromium | 0.0001 | <0.00010 | <0.00010 |
| Copper | 0.0626 | 0.0354 | 0.0898 |
| Iron | 0.01 | <0.010 | <0.010 |
| Lead | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.0301 | 0.0269 | 0.0333 |
| Nickel | 0.00050 | <0.00050 | <0.00050 |
| Selenium | 0.00296 | 0.002730 | 0.00319 |
| Zinc | 0.0014 | <0.0010 | 0.0017 |

5.3.26 W52 – Ridgetop North Pit

The Ridgetop North Pit was not developed in 2017; therefore, water quality results are not available.

5.3.27 W53 – Ridgetop South Pit

The Ridgetop South Pit was not developed in 2017; therefore, water quality results are not available.

5.3.28 W54 – Main Pit Dam Seepage

The Main Pit Dam was not developed in 2017; therefore, water quality results are not available.

5.3.29 W55 – Tailings Diversion Ditch

The water quality statistics for W55 from 2016 and 2017 are summarized below in Table 5-27. Four routine sample were collected from station W55 during the 2017 monitoring period.

Table 5-23: W55 Water Quality Results Summary (2016-2017)

| W55 Parameters | 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|-------------------------|-----------|-----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 7.63 | 7.52 | 7.74 | 7.91 | 7.71 | 8.10 |
| TSS (mg/L) | 4.2 | <3.0 | 5.3 | 18.3 | 4.4 | 43.3 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0155 | 0.0131 | 0.0178 | 0.0207 | 0.0134 | 0.039 |
| Nitrite Nitrogen | 0.0015 | <0.0010 | 0.0021 | 0.0033 | <0.0010 | 0.006 |
| Nitrate Nitrogen | 0.0126 | 0.0065 | 0.0187 | 0.089 | <0.0050 | 0.221 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0612 | 0.0585 | 0.064 | 0.0525 | 0.0265 | 0.0691 |
| Arsenic | 0.0006 | 0.0006 | 0.00061 | 0.00082 | 0.00068 | 0.00114 |
| Cadmium | 0.0000175 | 0.0000132 | 0.0000219 | 0.0000181 | 0.0000056 | 0.0000339 |
| Chromium | 0.00034 | 0.00033 | 0.00034 | 0.00038 | 0.00029 | 0.00047 |
| Copper | 0.0743 | 0.0567 | 0.092 | 0.0768 | 0.0149 | 0.14 |
| Iron | 0.128 | 0.128 | 0.128 | 0.181 | 0.114 | 0.338 |
| Lead | 0.000065 | <0.000050 | 0.00008 | 0.000063 | <0.000050 | 0.000104 |
| Molybdenum | 0.001047 | 0.000784 | 0.00131 | 0.001426 | 0.000633 | 0.00297 |
| Nickel | 0.00205 | 0.00192 | 0.00219 | 0.00180 | 0.00140 | 0.00219 |
| Selenium | 0.000202 | 0.000185 | 0.000219 | 0.000418 | 0.000158 | 0.000675 |
| Zinc | 0.0013 | 0.0011 | 0.0014 | 0.0015 | <0.0010 | 0.002 |

5.3.30 W62 – Mill Valley Fill Extension Phase 2 Collection Sump

The water quality statistics for W62 from 2016 and 2017 are summarized below in Table 5-28. A total of thirteen routine samples were collected from station W62 during the 2017 monitoring period.

Table 5-24: W62 Water Quality Results Summary (2016-2017)

| W62 | 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|------------|-----------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.18 | 7.90 | 8.37 | 8.31 | 8.21 | 8.42 |
| TSS (mg/L) | 12.1 | <3.0 | 58 | 4.4 | <3.0 | 11.3 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0354 | <0.0050 | 0.23 | 0.0148 | <0.0050 | 0.0563 |
| Nitrite Nitrogen | 0.0298 | <0.0010 | 0.119 | 0.0353 | <0.0050 | 0.0546 |
| Nitrate Nitrogen | 7.6491 | 0.0084 | 11.3 | 6.04 | 4.17 | 7.35 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.005 | 0.0022 | 0.0144 | 0.0055 | 0.0022 | 0.0308 |
| Arsenic | 0.00036 | 0.00011 | 0.00044 | 0.00038 | 0.00034 | 0.00042 |
| Cadmium | 0.0000207 | <0.0000050 | 0.0000383 | 0.0000173 | 0.0000117 | 0.0000312 |
| Chromium | 0.00028 | <0.00010 | <0.0010 | 0.00017 | <0.00010 | 0.00023 |
| Copper | 0.04048 | 0.00195 | 0.0629 | 0.0518 | 0.0422 | 0.0633 |
| Iron | 0.0436 | 0.0113 | 0.072 | 0.03 | 0.014 | 0.057 |
| Lead | 0.000073 | <0.000050 | <0.00020 | 0.000054 | <0.000050 | 0.000092 |
| Molybdenum | 0.006067 | 0.00042 | 0.00822 | 0.00648 | 0.00525 | 0.00811 |
| Nickel | 0.00109 | 0.00082 | 0.00161 | 0.00102 | 0.00088 | 0.00124 |
| Selenium | 0.003461 | 0.000095 | 0.00485 | 0.003 | 0.001980 | 0.00393 |
| Zinc | 0.2251 | 0.0018 | 0.799 | 0.0967 | 0.032 | 0.193 |

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

The water quality statistics for MC-1 from 2009 to 2017 are summarized below in Table 5-29. A total of 32 routine samples were collected from station MC-1 during the 2017 monitoring period.

Table 5-25: MC-1 Water Quality Results Summary (2009-2017)

| MC1 | 2009 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.14 | 5.27 | 8.54 | 8.23 | 7.84 | 8.43 |
| TSS (mg/L) | 54 | <1.0 | 727 | 50.7 | <3.0 | 793 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0328 | <0.0050 | 0.36 | 0.0132 | <0.0050 | 0.0838 |
| Nitrite Nitrogen | 0.0073 | <0.0010 | <0.05 | 0.0013 | <0.0010 | 0.0056 |
| Nitrate Nitrogen | 0.4529 | <0.0050 | 7.3 | 0.1262 | <0.0050 | 0.444 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0162 | <0.0010 | 0.07 | 0.012 | 0.0029 | 0.0412 |
| Arsenic | 0.00058 | <0.00010 | 0.00125 | 0.00053 | 0.00034 | 0.00076 |
| Cadmium | 0.000023 | <0.0000050 | 0.0002 | 0.0000074 | <0.0000050 | 0.0000221 |
| Chromium | 0.001 | <0.00010 | 0.0021 | 0.00021 | 0.0001 | 0.00039 |
| Copper | 0.00275 | <0.00020 | 0.00992 | 0.00363 | 0.00121 | 0.0106 |
| Iron | 0.231 | <0.010 | 1.11 | 0.103 | 0.027 | 0.322 |
| Lead | 0.000186 | <0.000050 | <0.00050 | 0.000051 | <0.000050 | 0.000077 |
| Molybdenum | 0.001773 | <0.000050 | 0.008 | 0.001471 | 0.000615 | 0.00198 |
| Nickel | 0.00127 | <0.00050 | 0.004 | 0.00108 | 0.00064 | 0.00173 |
| Selenium | 0.000314 | <0.000050 | 0.0022 | 0.000177 | 0.000091 | 0.000715 |
| Zinc | 0.0053 | <0.0010 | 0.0334 | 0.0015 | <0.0010 | 0.0064 |

5.3.32 WTP and RO – Treated Water

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

5.3.33 C4 – Tributary on the south side of Minto Creek

The water quality statistics for C4 from 2012 to 2017 are summarized below in Table 5-31. A total of seven routine samples were collected from station C4 during the 2017 monitoring period.

Table 5-26: C4 Water Quality Results Summary (2012-2017)

| C4 Parameters | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|-----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 8.03 | 7.59 | 8.29 | 8.14 | 7.95 | 8.31 |
| TSS (mg/L) | 212.1 | 2.3 | 1260 | 4.3 | <3.0 | 9 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0923 | 0.005 | 0.36 | 0.0132 | 0.0079 | 0.0225 |
| Nitrite Nitrogen | 0.0071 | <0.0010 | <0.050 | 0.0013 | <0.0010 | 0.0019 |
| Nitrate Nitrogen | 0.1265 | <0.0050 | 2.31 | 0.0375 | <0.0050 | 0.0568 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0251 | 0.0085 | 0.0622 | 0.0115 | 0.0048 | 0.0298 |
| Arsenic | 0.00141 | 0.00029 | 0.00559 | 0.00083 | 0.00064 | 0.00104 |
| Cadmium | 0.0000107 | <0.0000050 | 0.000029 | 0.0000088 | <0.0000050 | 0.0000337 |
| Chromium | 0.00087 | 0.00037 | 0.0013 | 0.00034 | 0.00022 | 0.00045 |
| Copper | 0.00184 | 0.00095 | 0.00952 | 0.00243 | 0.00087 | 0.0102 |
| Iron | 1.465 | 0.056 | 14.2 | 0.405 | 0.146 | 0.606 |
| Lead | 0.000161 | <0.000050 | 0.00022 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.001214 | 0.000379 | 0.0068 | 0.000764 | 0.00062 | 0.000823 |
| Nickel | 0.00236 | <0.0010 | 0.0061 | 0.00191 | 0.00151 | 0.00211 |
| Selenium | 0.000125 | 0.000076 | 0.00068 | 0.000108 | 0.000076 | 0.000164 |
| Zinc | 0.0041 | <0.0010 | <0.0050 | 0.0014 | <0.0010 | 0.0031 |

5.3.34 C10 – Tributary on the south side of Minto Creek

The water quality statistics for C10 from 2012 to 2017 are summarized below in Table 5-32. A total of five routine samples were collected from station C10 during the 2017 monitoring period.

Table 5-27: C10 Water Quality Results Summary (2012-2017)

| C10 Parameters | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|-----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 8.13 | 7.73 | 8.37 | 8.25 | 8.16 | 8.39 |
| TSS (mg/L) | 335.1 | <1.0 | 2210 | 19.7 | <3.0 | 66 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0748 | <0.0050 | 0.2 | 0.0118 | 0.005 | 0.0289 |
| Nitrite Nitrogen | 0.011 | <0.0010 | <0.050 | 0.0022 | <0.0010 | 0.0066 |
| Nitrate Nitrogen | 0.1294 | 0.0178 | 0.417 | 0.1119 | <0.0050 | 0.226 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.2893 | 0.0091 | 5.84 | 0.0084 | 0.0075 | 0.01 |
| Arsenic | 0.00132 | 0.0004 | 0.00551 | 0.00059 | 0.00048 | 0.00071 |
| Cadmium | 0.0000255 | <0.0000050 | 0.000344 | 0.0000077 | <0.0000050 | 0.0000187 |
| Chromium | 0.0013 | 0.00028 | 0.0093 | 0.00022 | 0.00017 | 0.0003 |
| Copper | 0.003 | 0.00091 | 0.0339 | 0.002 | 0.00142 | 0.00263 |
| Iron | 1.7 | 0.141 | 19.9 | 0.31 | 0.033 | 0.94 |
| Lead | 0.000538 | <0.000050 | 0.00772 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.001059 | 0.000697 | 0.0019 | 0.001043 | 0.000384 | 0.00184 |
| Nickel | 0.00289 | <0.0010 | 0.0215 | 0.00130 | 0.00096 | 0.00166 |
| Selenium | 0.000102 | 0.000066 | 0.00014 | 0.000117 | 0.000063 | 0.00021 |
| Zinc | 0.0071 | <0.0010 | 0.0603 | 0.0013 | <0.0010 | 0.0024 |

5.3.35 MN – Minto North Pit Water

The water quality statistics for MN from 2015 to 2017 are summarized below in Table 5-33. One routine sample was collected from station MN during the 2017 monitoring period, once safe access to the pit water could be established. The water was frozen at the end of the year.

Table 5-28: MN Water Quality Results Summary (2015-2017)

| MN | 2015 - 2016 Summary Statistics | | | 2017 Summary Statistics |
|--------------------------------|--------------------------------|-----------|----------|-------------------------|
| Parameters | Mean | Min | Max | Result |
| pH | 7.84 | 7.56 | 8.16 | 8.05 |
| TSS (mg/L) | 62.2 | <3.0 | 142 | 29.7 |
| Nutrients (mg/L) | | | | |
| Ammonia Nitrogen | 13.8 | 1.45 | 51 | 0.612 |
| Nitrite Nitrogen | 5.391 | 0.345 | 14.7 | 0.105 |
| Nitrate Nitrogen | 149.6 | 14.2 | 342 | 25.9 |
| Dissolved Metals (mg/L) | | | | |
| Aluminum | 0.0087 | 0.0025 | 0.0266 | 0.0031 |
| Arsenic | 0.00064 | 0.0002 | 0.00142 | 0.00043 |
| Cadmium | 0.0000609 | <0.000010 | 0.000283 | 0.0000733 |
| Chromium | 0.00036 | <0.00010 | <0.0010 | 0.00047 |
| Copper | 0.1608 | 0.0119 | 0.562 | 0.0314 |
| Iron | 0.1045 | <0.010 | 0.449 | <0.010 |
| Lead | 0.0001 | <0.000050 | <0.00020 | <0.000050 |
| Molybdenum | 0.0207 | 0.0077 | 0.0384 | 0.0228 |
| Nickel | 0.00136 | <0.00050 | 0.0041 | <0.00050 |
| Selenium | 0.01517 | 0.003850 | 0.0627 | 0.0199 |
| Zinc | 0.005 | <0.0010 | 0.0159 | 0.0027 |

5.3.36 MN-0.2 – Upper West Arm of McGinty Creek

The water quality statistics for MN-0.2 from 2011 to 2017 are summarized below in Table 5-34. A total of six routine samples were collected from station MN-0.2 during the 2017 monitoring period.

Table 5-29: MN-0.2 Water Quality Results Summary (2011-2017)

| MN-0.2 | 2011 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.32 | 6.55 | 7.69 | 7.55 | 7.19 | 7.85 |
| TSS (mg/L) | 20.4 | <1.0 | 300 | 9 | <3.0 | 50.7 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0239 | <0.005 | 0.11 | 0.0106 | 0.0057 | 0.0187 |
| Nitrite Nitrogen | 0.0096 | <0.0010 | <0.050 | 0.001 | <0.0010 | <0.0010 |
| Nitrate Nitrogen | 0.0389 | <0.0020 | 0.23 | 0.0084 | <0.0050 | 0.0176 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0743 | 0.0337 | 0.199 | 0.0827 | 0.0492 | 0.152 |
| Arsenic | 0.000552 | 0.00025 | 0.00388 | 0.00061 | 0.0004 | 0.00081 |
| Cadmium | 0.0000134 | <0.0000050 | 0.000053 | 0.000005 | <0.0000050 | 5.4E-06 |
| Chromium | 0.0007 | 0.0002 | 0.0011 | 0.00056 | 0.00046 | 0.00068 |
| Copper | 0.00273 | 0.00142 | 0.00527 | 0.00221 | 0.00128 | 0.00465 |
| Iron | 0.614 | 0.084 | 10.3 | 0.682 | 0.363 | 0.995 |
| Lead | 0.0001158 | 0.000009 | 0.000271 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.000553 | <0.00005 | <0.0010 | 0.000219 | 0.000154 | 0.000243 |
| Nickel | 0.00165 | 0.00104 | 0.00272 | 0.00142 | 0.00109 | 0.00177 |
| Selenium | 0.000083 | <0.000040 | 0.00012 | 0.000075 | <0.000050 | 0.000096 |
| Zinc | 0.0036 | 0.0001 | 0.0131 | 0.0027 | <0.0010 | <0.0060 |

5.3.37 MN-0.5 – West Arm of McGinty Creek

The water quality statistics for MN-0.5 from 2010 to 2017 are summarized below in Table 5-35. A total of seven routine samples were collected from station MN-0.5 during the 2017 monitoring period.

Table 5-30: MN-0.5 Water Quality Results Summary (2010-2017)

| MN-0.5 | 2010 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.86 | 7.10 | 8.25 | 8.05 | 7.74 | 8.27 |
| TSS (mg/L) | 73.7 | <1.0 | 737 | 19.8 | <3.0 | 64.7 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0297 | <0.0050 | 0.33 | 0.0062 | <0.0050 | 0.0115 |
| Nitrite Nitrogen | 0.0079 | <0.0010 | <0.050 | 0.001 | <0.0010 | <0.0010 |
| Nitrate Nitrogen | 0.0872 | <0.0050 | 1.69 | 0.0718 | <0.0050 | 0.159 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.032 | <0.0030 | 0.191 | 0.0848 | 0.0041 | 0.58 |
| Arsenic | 0.000444 | 0.00026 | 0.000713 | 0.00042 | 0.00026 | 0.00089 |
| Cadmium | 0.0000129 | <0.0000050 | 0.000076 | 0.0000279 | <0.0000050 | 0.000186 |
| Chromium | 0.00059 | <0.0001 | 0.0016 | 0.00034 | 0.00012 | 0.00126 |
| Copper | 0.00186 | 0.00071 | 0.00441 | 0.00464 | 0.00095 | 0.0264 |
| Iron | 0.1698 | 0.0062 | 0.716 | 0.164 | 0.014 | 0.929 |
| Lead | 0.000113 | 0.000006 | <0.00020 | 0.000168 | <0.000050 | 0.000991 |
| Molybdenum | 0.000922 | 0.00011 | 0.00143 | 0.000997 | 0.000423 | 0.00125 |
| Nickel | 0.00116 | 0.00048 | 0.00205 | 0.00140 | 0.00063 | 0.00432 |
| Selenium | 0.000193 | 0.000050 | 0.00063 | 0.000187 | 0.000097 | 0.000249 |
| Zinc | 0.00329 | 0.00016 | 0.0121 | 0.0068 | <0.0010 | 0.0459 |

5.3.38 MN-1.5 – Upper East Arm of McGinty Creek

The water quality statistics for MN-1.5 from 2010 to 2017 are summarized below in Table 5-36. A total of six routine samples were collected from station MN-1.5 during the 2017 monitoring period.

Table 5-31: MN-1.5 Water Quality Results Summary (2010-2017)

| MN-1.5 | 2010 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.34 | 6.00 | 8.10 | 7.75 | 7.36 | 7.93 |
| TSS (mg/L) | 280.2 | <1 | 8200 | 11.9 | <3.0 | 56.7 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0579 | <0.0050 | 0.66 | 0.0131 | 0.0068 | 0.0239 |
| Nitrite Nitrogen | 0.01 | <0.0010 | 0.053 | 0.001 | <0.0010 | <0.0010 |
| Nitrate Nitrogen | 0.0506 | <0.0050 | 0.2 | 0.0171 | <0.0050 | 0.0434 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.1101 | 0.0309 | 0.259 | 0.0534 | 0.0282 | 0.129 |
| Arsenic | 0.000501 | 0.00015 | 0.00113 | 0.00047 | 0.00032 | 0.00057 |
| Cadmium | 0.0000187 | <0.0000050 | 0.000106 | 0.0000057 | <0.0000050 | 1.03E-05 |
| Chromium | 0.00068 | 0.0002 | <0.0010 | 0.00047 | 0.00036 | 0.00062 |
| Copper | 0.00619 | 0.00302 | 0.00983 | 0.00444 | 0.00278 | 0.00918 |
| Iron | 0.606 | 0.126 | 1.62 | 0.508 | 0.413 | 0.568 |
| Lead | 0.00011 | 0.000008 | 0.000527 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.000571 | 0.00008 | <0.0010 | 0.000364 | 0.000218 | 0.000426 |
| Nickel | 0.00127 | 0.00078 | 0.00233 | 0.00111 | 0.00084 | 0.00139 |
| Selenium | 0.000087 | <0.00004 | 0.00015 | 0.000072 | 0.000051 | 0.000122 |
| Zinc | 0.00375 | 0.0003 | 0.012 | 0.0011 | <0.0010 | 0.0017 |

5.3.39 MN-2.5 – East Arm of McGinty Creek

The water quality statistics for MN-2.5 from 2010 to 2017 are summarized below in Table 5-37. A total of seven routine samples were collected from station MN-2.5 during the 2017 monitoring period.

Table 5-32: MN-2.5 Water Quality Results Summary (2010-2017)

| MN-2.5 | 2010 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.85 | 7.10 | 8.50 | 8.07 | 7.80 | 8.17 |
| TSS (mg/L) | 38.4 | <1.0 | 350 | 38.7 | <3.0 | 226 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0322 | <0.005 | 0.3 | 0.0096 | <0.0050 | 0.0248 |
| Nitrite Nitrogen | 0.0076 | <0.0010 | <0.050 | 0.001 | <0.0010 | <0.0010 |
| Nitrate Nitrogen | 0.0447 | <0.0050 | <0.20 | 0.025 | <0.0050 | 0.0455 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0241 | 0.0059 | 0.112 | 0.0105 | 0.005 | 0.028 |
| Arsenic | 0.000428 | 0.0002 | 0.00149 | 0.00032 | 0.00016 | 0.00044 |
| Cadmium | 0.000014 | <0.0000050 | 0.000075 | 0.0000064 | <0.0000050 | 0.00001 |
| Chromium | 0.00053 | <0.0001 | <0.0010 | 0.00022 | 0.00013 | 0.00032 |
| Copper | 0.00211 | 0.00071 | 0.00463 | 0.00179 | 0.00117 | 0.00341 |
| Iron | 0.22 | 0.0225 | 0.867 | 0.067 | 0.032 | 0.208 |
| Lead | 0.0001105 | <0.000005 | 0.000822 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.00074 | 0.00011 | 0.00117 | 0.000671 | 0.000417 | 0.000865 |
| Nickel | 0.00127 | 0.00073 | 0.00376 | 0.00114 | 0.00085 | 0.00171 |
| Selenium | 0.000093 | 0.000040 | 0.00038 | 0.000076 | <0.000050 | 0.000102 |
| Zinc | 0.00306 | 0.0004 | 0.0061 | 0.0012 | <0.0010 | 0.0019 |

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

The water quality statistics for MN-4.5 from 2010 to 2017 are summarized below in Table 5-38. A total of seven routine samples were collected from station MN-4.5 during the 2017 monitoring period.

Table 5-33: MN-4.5 Water Quality Results Summary (2010-2017)

| MN-4.5 | 2010 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.87 | 7.10 | 8.18 | 8.07 | 7.80 | 8.26 |
| TSS (mg/L) | 39.6 | <1.0 | 570 | 31.5 | <3.0 | 201 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.026 | <0.0050 | 0.27 | 0.0072 | <0.0050 | 0.0167 |
| Nitrite Nitrogen | 0.008 | <0.0010 | <0.050 | 0.001 | <0.0010 | <0.0010 |
| Nitrate Nitrogen | 0.0823 | <0.0050 | 0.323 | 0.1004 | <0.0050 | 0.262 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.0281 | 0.0044 | 0.174 | 0.0134 | 0.0044 | 0.0363 |
| Arsenic | 0.000408 | 0.00025 | 0.00065 | 0.00035 | 0.00019 | 0.00046 |
| Cadmium | 0.0000139 | <0.0000050 | 0.000135 | 0.0000075 | <0.0000050 | 1.72E-05 |
| Chromium | 0.00052 | <0.0001 | <0.0010 | 0.00021 | <0.00010 | 0.00032 |
| Copper | 0.00209 | 0.00113 | 0.00471 | 0.00201 | 0.00132 | 0.00333 |
| Iron | 0.1471 | <0.010 | 0.562 | 0.05 | 0.011 | 0.179 |
| Lead | 0.000108 | <0.000005 | 0.000467 | 0.00005 | <0.000050 | <0.000050 |
| Molybdenum | 0.000841 | 0.00017 | 0.00122 | 0.000892 | 0.000474 | 0.00102 |
| Nickel | 0.00117 | 0.00054 | 0.00188 | 0.00099 | 0.00062 | 0.00182 |
| Selenium | 0.000148 | 0.000060 | 0.00023 | 0.000193 | 0.000130 | 0.000366 |
| Zinc | 0.00308 | 0.0002 | 0.0144 | 0.0016 | <0.0010 | 0.0037 |

5.3.41 UG1 – Minto South Underground Mine Dewatering

The water quality statistics for UG1 from 2015 to 2017 are summarized below in Table 5-39. A total of 12 routine samples were collected from station UG1 during the 2017 monitoring period.

Table 5-34: UG1 Water Quality Results Summary (2015-2017)

| UG1 | 2015 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|-----------|---------|-------------------------|-----------|----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.89 | 7.70 | 8.14 | 7.89 | 7.79 | 8.06 |
| TSS (mg/L) | 96.3 | 3.8 | 477 | 151.4 | 21.5 | 545 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 25.05 | 8.1 | 75 | 14.21 | 6.01 | 32.2 |
| Nitrite Nitrogen | 1.225 | 0.344 | 3.18 | 1.647 | 0.856 | 2.53 |
| Nitrate Nitrogen | 39.7 | 13.2 | 81.9 | 34 | 22.5 | 59.6 |
| Dissolved Metals (mg/L) | | | | | | |
| Aluminum | 0.043 | 0.007 | 0.51 | 0.0114 | 0.0067 | 0.0261 |
| Arsenic | 0.0013 | 0.0006 | 0.0026 | 0.001 | 0.00056 | 0.00146 |
| Cadmium | 0.000107 | <0.000010 | 0.00038 | 0.000225 | 0.000059 | 0.000398 |
| Chromium | 0.00056 | <0.00020 | <0.0010 | 0.00042 | 0.00012 | 0.00228 |
| Copper | 0.02778 | 0.00374 | 0.178 | 0.01432 | 0.0043 | 0.0254 |
| Iron | 0.0763 | 0.0052 | 1.16 | 0.02 | <0.010 | 0.036 |
| Lead | 0.00017 | <0.00010 | 0.00063 | 0.000092 | <0.000050 | <0.00010 |
| Molybdenum | 0.0186 | 0.0083 | 0.0394 | 0.0227 | 0.0157 | 0.0302 |
| Nickel | 0.00280 | 0.00110 | 0.007 | 0.00305 | 0.00200 | 0.0056 |
| Selenium | 0.00122 | 0.000220 | 0.00557 | 0.00105 | 0.000760 | 0.00193 |
| Zinc | 0.022 | <0.0020 | 0.134 | 0.0105 | 0.006 | 0.0223 |

5.3.42 UG2 – Wildfire Underground Mine Dewatering

This station was not established in 2017.

5.3.43 UG3 – Copper Keel Underground Mine Dewatering

This station was not established in 2017.

5.3.44 UG4 – Minto East Underground Mine Dewatering

This station was not established in 2017.

6 Groundwater Monitoring Program

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

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

In 2017, five new West-bay multi-port groundwater monitoring wells, and three new drive point wells were installed and developed. Groundwater samples were collected and the data analysis was conducted by an external lab.

Also in 2017, four Lysimeter installations were completed within each of the following facilities: Main Waste Dump, Southwest Dump, Dry Stack Tailings Storage Facility, and Mill Valley Fill. The Lysimeters record temperature and groundwater infiltration on a continual basis, with first results expected in spring of 2018. Additionally, water samples can be collected from the DSTSF Lysimeter.

6.1 Groundwater Quality Monitoring Conformance

Minto's 2017 conformance with groundwater sampling requirements is summarized in Table 6-1, below. Quality Assurance and Quality Control (QA/QC) sampling is not included in Table 6-1, but is described in Section 6-2.

Sampling of wells MW17-08, MW17-09, MW17-10, MW17-11, and MW17-12 was completed in Q3 and Q4 only since the wells were installed during July 2017. All other groundwater wells were sampled quarterly, as per the EMSRP and GW Plan 2016-02 requirements, which has been in effect since July 2016.

Table 6-1: Groundwater Quality Monitoring Conformance Summary (2017)

| Mine Project Component | Monitoring Installation | Quality | Level | Monitoring Frequency | 2017 Groundwater Compliance |
|--|-------------------------|---------|-------|----------------------|---|
| Up-gradient of Mine Activities | MW17-08-01 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-08-02 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-08-03 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-08-04 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| Southwest Waste Dump | MW12-DP1 | X | X | Quarterly | Sampled as per schedule. Well was destroyed in August 2017. |
| | MW12-DP2 | X | X | Quarterly | Sampled as per schedule. |
| | MW12-DP3 | X | X | Quarterly | Sampled as per schedule. |
| | MW17-09-01 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| Main Waste Dump | MW09-01-01 | X | X | Quarterly | Sampled in Q1 and Q2. Since MW09-01 has been dry since October 2014 it was replaced by MW17-10. |
| | MW09-01-02 | X | X | Quarterly | Sampled in Q1 and Q2. Since MW09-01 has been dry since October 2014 it was replaced by MW17-10. |
| | MW09-01-03 | X | X | Quarterly | Sampled in Q1 and Q2. Since MW09-01 has been dry since October 2014 it was replaced by MW17-10. |
| | MW17-10-1 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-10-2 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-10-3 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-10-4 | X | X | Quarterly | Q3 sample was missed due to human error. Well was established in July 2017. |
| Dry Stack Tailings Storage Facility and Mill Valley Fill Expansion | MW12-06-01 | | X | Quarterly | Sampled as per schedule. |
| | MW12-06-02 | X | X | Quarterly | Sampled as per schedule. |
| | MW12-06-03 | | X | Quarterly | Sampled as per schedule. |
| | MW12-06-04 | X | X | Quarterly | Sampled as per schedule. |
| | MW12-06-05 | | X | Quarterly | Sampled as per schedule. |
| | MW12-06-06 | X | X | Quarterly | Sampled as per schedule. |
| Main Pit | MW12-07-01 | X | X | Quarterly | Sampled as per schedule. |
| | MW12-07-02 | X | X | Quarterly | Sampled as per schedule. |
| | MW12-07-03 | | X | Quarterly | Sampled as per schedule. |

| Mine Project Component | Monitoring Installation | Quality | Level | Monitoring Frequency | 2017 Groundwater Compliance |
|------------------------|-------------------------|---------|-------|----------------------|---|
| Minto North Pit | MW09-03-01 | X | X | Quarterly | Sampled as per schedule. |
| | MW09-03-02 | X | X | Quarterly | Sampled as per schedule. |
| | MW09-03-03 | X | X | Quarterly | Sampled as per schedule. Port was dry during 2017 |
| | MW17-11-01 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-11-02 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-11-03 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-11-04 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-11-05 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| Water Storage Pond | MW12-05-01 | X | X | Quarterly | Sampled as per schedule. |
| | MW12-05-02 | X | X | Quarterly | Sampled as per schedule. |
| | MW12-05-03 | X | X | Quarterly | Sampled as per schedule. |
| | MW12-05-04 | X | X | Quarterly | Sampled as per schedule. |
| | MW12-05-05 | X | X | Quarterly | Sampled as per schedule. |
| | MW12-05-06 | X | X | Quarterly | Sampled as per schedule. |
| | MW12-05-07 | X | X | Quarterly | Sampled as per schedule. |
| | MW17-12-01 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-12-02 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-12-03 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-12-04 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-12-05 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-12-06 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-12-07 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |
| | MW17-12-08 | X | X | Quarterly | Sampled as per schedule. Well was established in July 2017. |

6.2 Groundwater Quality Control and Assurance

In 2017, 143 groundwater samples were taken at Minto. A total of 26 duplicate QC samples were taken from groundwater sampling sites, representing 18.2% of the total number of samples collected in 2017.

The EMSRP recommends field duplicate sampling be conducted at a frequency of one field duplicate sample per ten groundwater monitoring samples. The recommended rate of field duplicate sampling was achieved in 2017.

Minto currently employs compliance management system software to track programs and actions that meet licence requirements. To achieve the QA/QC objective of 1:10 samples, the compliance system was updated in 2016 and used successfully in 2017 to ensure that environmental staff completed the required field duplicates.

6.3 Groundwater Monitoring Stations

The EMSRP details the groundwater wells at the Minto Mine, including operative and inoperative wells. Figure 6-1 shows a location map of the operative wells, including new wells that were established in 2017. Stations that were collected more than three times in 2017 have results presented as follows: Mean, Minimum and Maximum values.

Wells MW09-01, MW11-02, MW11-03, MW12-DP1, MW12-DP2, and MW12-DP3 did not produce enough water during 2017 sampling events to sample, thus no results are presented.

Complete results for the 2017 Groundwater Monitoring Program groundwater wells are presented in [Appendix C](#).



Figure 6-1: Minto Mine Groundwater Well Locations (2017)

6.3.1 MW09-01

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

6.3.2 MW09-03

Groundwater well MW09-03 water quality results from 2017 are summarized in Table 6-2 and Table 6-3, and compared to historical data. MW09-03 produced results from sampling zones 01 and 02, while zone 03 produced no water during 2017. As such, only results for zones 01 and 02 are presented.

Table 6-2: MW09-03-01 Water Quality Results Summary (2009 - 2017)

| MW09-03-01 | 2009 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.18 | 7.94 | 8.86 | 8.19 | 8.11 | 8.28 |
| TDS (mg/L) | 216.30 | 146 | 652 | 179.6 | 169 | 202 |
| Sulfate-dissolved (mg/L) | 25.07 | 0.53 | 117 | 20.4 | 19.4 | 21.9 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.058 | 0.024 | 0.17 | 0.0435 | 0.0327 | 0.0853 |
| Nitrate Nitrogen | 0.10 | 0.0089 | 0.669 | 0.0112 | <0.0050 | 0.0231 |
| Nitrite Nitrogen | 0.82 | 0.0742 | 9.27 | 0.2764 | 0.0654 | 0.944 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.0000185 | <0.0000050 | 0.00005 | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.00494 | 0.0014 | 0.0105 | 0.0028 | 0.0021 | 0.0044 |
| Arsenic | 0.000312 | 0.000037 | 0.00097 | 0.00080 | 0.00020 | 0.00109 |
| Cadmium | 0.0000685 | <0.0000050 | 0.000683 | 0.0000168 | <0.0000050 | 0.0000890 |
| Chromium | 0.00075 | <0.00010 | 0.001 | 0.00021 | <0.00010 | 0.00111 |
| Copper | 0.00166 | <0.00020 | 0.019 | 0.00047 | <0.00020 | 0.00133 |
| Lead | 0.000202 | 0.000036 | 0.0011 | 0.000052 | <0.000050 | 0.000070 |
| Molybdenum | 0.00981 | 0.0035 | 0.0806 | 0.00625 | 0.00441 | 0.0158 |
| Nickel | 0.00208 | <0.0010 | 0.008 | 0.00105 | 0.00073 | 0.00130 |
| Selenium | 0.000493 | <0.000050 | 0.008 | 0.000109 | <0.000050 | 0.000418 |
| Zinc | 0.0105 | <0.0050 | 0.0268 | 0.0203 | 0.0057 | 0.0593 |

Table 6-3: MW09-03-02 Water Quality Results Summary (2009-2017)

| MW09-03-02 | 2009 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|---------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.98 | 7.59 | 8.2 | 8.17 | 8.03 | 8.32 |
| TDS (mg/L) | 482.25 | 172 | 716 | 203.2 | 177 | 225 |
| Sulfate-dissolved (mg/L) | 11.653 | 0.25 | 110 | 9.37 | 6.4 | 19.5 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.171 | 0.0116 | 0.33 | 0.0140 | <0.0050 | 0.0422 |
| Nitrate Nitrogen | 0.254 | 0.01 | 1.77 | 2.4335 | <0.0050 | 3.72 |
| Nitrite Nitrogen | 0.156 | 0.0429 | 0.776 | 0.4412 | 0.0596 | 1.93 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.000020 | <0.000010 | 0.00004 | <0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.0051 | 0.0011 | 0.013 | 0.0022 | <0.0010 | 0.0040 |
| Arsenic | 0.00055 | <0.00010 | 0.0012 | 0.00024 | <0.00010 | 0.00078 |
| Cadmium | 0.0000582 | <0.0000050 | 0.00072 | 0.0000327 | 0.0000070 | 0.0000916 |
| Chromium | 0.00074 | <0.00010 | 0.0013 | 0.00014 | <0.00010 | 0.00026 |
| Copper | 0.00274 | <0.00020 | 0.022 | 0.00215 | <0.00020 | 0.00340 |
| Lead | 0.000160 | <0.000050 | 0.0003 | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.02118 | 0.0041 | 0.101 | 0.00605 | 0.00329 | 0.0118 |
| Nickel | 0.00126 | <0.00050 | 0.004 | 0.00064 | <0.00050 | 0.00107 |
| Selenium | 0.000698 | 0.000060 | 0.0067 | 0.000197 | <0.000050 | 0.000254 |
| Zinc | 0.01273 | <0.0050 | 0.0563 | 0.0257 | 0.0067 | 0.0727 |

6.3.3 MW11-02

MW11-02 was dry during the 2017 sampling events, thus water quality results are not presented.

6.3.4 MW11-03

MW11-03 was dry during the 2017 sampling events, thus water quality results are not presented.

6.3.5 MW11-04A

One full suite sample was collected in March 2017 and one partial suite (Total Organic Nutrients and Dissolved Metal) in May 2017. The results presented below in Table 6-4 are the outcomes of the 2017 sampling season.

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

| MW11-04A | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|---------|---------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 11.20 | 10.3 | 11.7 | 11.11 | | |
| TDS (mg/L) | 203 | 148 | 396 | 148.0 | | |
| Sulfate-dissolved (mg/L) | 5.39 | 3.47 | 7.7 | 5.49 | | |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.3445 | 0.0265 | 1.5 | 0.0246 | 0.0191 | 0.0302 |
| Nitrate Nitrogen | 1.30 | 1 | 1.64 | 1.10 | | |
| Nitrite Nitrogen | 0.0145 | 0.0071 | 0.0234 | 0.0085 | | |
| Dissolved Metals (mg/L) | | | | | | |
| Calcium | 78.7 | 49.6 | 170 | 56.0 | 53.8 | 58.1 |
| Cadmium | 0.0000123 | <0.0000050 | 0.000045 | 7.4E-06 | 6.3E-06 | 8.5E-06 |
| Copper | 0.0705 | 0.0119 | 0.137 | 0.0607 | 0.0362 | 0.0852 |
| Iron | 0.0092 | <0.0050 | 0.0198 | 0.016 | <0.010 | 0.021 |
| Selenium | 0.00235 | 0.00175 | 0.00334 | 0.00256 | 0.00250 | 0.00261 |

6.3.6 MW12-DP1

Drivepoint well MW12-DP1 was dry or frozen during the 2017 Q1 and Q2 sampling events. The well was destroyed during Q3 when the permafrost into which the well had been installed, degraded; compromising the ground integrity and the well. As such, water quality results are not presented.

6.3.7 MW12-DP2

Drivepoint well MW12-DP2 was dry or frozen during the 2017 sampling events, thus water quality results are not presented.

6.3.8 MW12-DP3

Drivepoint well MW12-DP3 was dry or frozen during the 2017 sampling events, thus water quality results are not presented.

6.3.9 MW12-05

Groundwater well MW12-05 water quality results from 2017 are summarized in Table 6-5 through Table 6-11, and compared to historical data. Zones 02, 04, and 06 were not sampled prior to 2016, thus instead of presenting historical data, 2016 is presented next to 2017 for those zones. All zones (01 through 07) were sampled during 2017.

Table 6-5: MW12-05-01 Water Quality Results Summary (2012 - 2017)

| MW12-05-01 Parameters | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|-----------|-------------------------|------------|-----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 8.02 | 7.69 | 8.31 | 7.99 | 7.88 | 8.15 |
| TDS (mg/L) | 1339 | 706 | 1700 | 1775.0 | 1740 | 1820 |
| Sulfate-dissolved (mg/L) | 797 | 350 | 1090 | 1165.0 | 1120 | 1200 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.1230 | <0.0050 | 0.602 | 0.0298 | 0.0110 | 0.0447 |
| Nitrate Nitrogen | 0.041 | <0.010 | 0.368 | 0.044 | <0.025 | <0.050 |
| Nitrite Nitrogen | 0.0910 | 0.0277 | 0.427 | 0.0435 | 0.0309 | 0.068 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.000018 | <0.000010 | <0.000020 | 0.000015 | <0.000010 | <0.000020 |
| Aluminum | 0.0072 | 0.0031 | 0.0182 | 0.0040 | 0.0032 | 0.0054 |
| Arsenic | 0.00098 | 0.00059 | 0.00216 | 0.00068 | 0.00060 | 0.00079 |
| Cadmium | 0.0000177 | <0.0000050 | 0.00014 | 0.0000104 | <0.0000050 | 0.0000165 |
| Chromium | 0.00083 | 0.00037 | <0.0010 | 0.00032 | 0.00023 | 0.00045 |
| Copper | 0.00097 | <0.00020 | 0.00836 | 0.00030 | <0.00020 | <0.00040 |
| Lead | 0.000162 | <0.000050 | <0.00020 | 0.000075 | <0.000050 | <0.00010 |
| Molybdenum | 0.001373 | 0.000227 | 0.012 | 0.000196 | 0.000125 | 0.00031 |
| Nickel | 0.00107 | <0.00050 | 0.0043 | 0.00075 | <0.00050 | <0.0010 |
| Selenium | 0.000328 | 0.000083 | 0.00144 | 0.000790 | 0.000275 | 0.00225 |
| Zinc | 0.0056 | <0.0010 | 0.0402 | 0.0023 | <0.0020 | <0.0030 |

Table 6-6: MW12-05-02 Water Quality Results Summary 2016 & 2017

| MW12-05-02 | 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|------------|-----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.18 | 7.9 | 8.43 | 8.14 | 8.06 | 8.22 |
| TDS (mg/L) | 1147 | 389 | 1750 | 1770 | 1700 | 1870 |
| Sulfate-dissolved (mg/L) | 622.8 | 41.2 | 1090 | 1120.0 | 1070 | 1160 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.1512 | 0.0095 | 0.642 | 0.0249 | 0.0121 | 0.0367 |
| Nitrate Nitrogen | 0.0135 | 0.0025 | 0.025 | 0.044 | <0.025 | <0.050 |
| Nitrite Nitrogen | 0.1352 | 0.02 | 0.377 | 0.0323 | 0.0162 | 0.0531 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.000012 | <0.000010 | <0.000020 | 0.000015 | <0.000010 | <0.000020 |
| Aluminum | 0.0049 | 0.0036 | 0.0061 | 0.0045 | 0.0043 | 0.0048 |
| Arsenic | 0.00041 | 0.00023 | 0.00063 | 0.00027 | <0.00020 | 0.00030 |
| Cadmium | 0.0000060 | <0.0000050 | <0.000010 | 0.0000075 | <0.0000050 | <0.000010 |
| Chromium | 0.00047 | 0.00025 | 0.00093 | 0.00031 | 0.00029 | 0.00033 |
| Copper | 0.00024 | <0.00020 | <0.00040 | 0.00035 | <0.00020 | 0.00060 |
| Lead | 0.000060 | <0.000050 | <0.00010 | 0.000075 | <0.000050 | <0.00010 |
| Molybdenum | 0.000838 | 0.00041 | 0.00112 | 0.000245 | 0.000147 | 0.00039 |
| Nickel | 0.00060 | <0.00050 | <0.0010 | 0.00075 | <0.00050 | <0.0010 |
| Selenium | 0.000197 | <0.000050 | 0.000610 | 0.000815 | <0.00010 | 0.00275 |
| Zinc | 0.0111 | 0.0011 | 0.0261 | 0.0025 | <0.0010 | <0.0045 |

Table 6-7: MW12-05-03 Water Quality Results Summary (2012 - 2017)

| MW12-05-03 | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|-----------|-------------------------|------------|----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.06 | 7.72 | 8.22 | 8.08 | 7.92 | 8.31 |
| TDS (mg/L) | 1322 | 880 | 1570 | 1372 | 1270 | 1440 |
| Sulfate-dissolved (mg/L) | 726 | 456 | 828 | 815 | 749 | 883 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0426 | <0.0050 | 0.11 | 0.0213 | 0.0122 | 0.0296 |
| Nitrate Nitrogen | 0.027 | <0.010 | 0.068 | 0.044 | <0.025 | <0.050 |
| Nitrite Nitrogen | 0.0852 | 0.0252 | 0.372 | 0.0331 | 0.0193 | 0.049 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.000016 | 0.000005 | <0.000020 | 0.000015 | <0.000010 | 0.000021 |
| Aluminum | 0.0072 | 0.0011 | 0.0233 | 0.0030 | 0.0025 | 0.0034 |
| Arsenic | 0.000335 | 0.00017 | 0.00077 | 0.00024 | 0.00021 | 0.00029 |
| Cadmium | 0.0000322 | <0.0000050 | 0.000324 | 0.0000072 | <0.0000050 | 0.000014 |
| Chromium | 0.00068 | <0.00010 | <0.0010 | 0.00015 | <0.00010 | <0.00020 |
| Copper | 0.00052 | <0.00020 | 0.00266 | 0.00164 | <0.00020 | 0.00579 |
| Lead | 0.000183 | <0.000050 | 0.000665 | 0.000062 | <0.000050 | <0.00010 |
| Molybdenum | 0.002213 | 0.000430 | 0.0121 | 0.000556 | 0.000229 | 0.000832 |
| Nickel | 0.00108 | <0.00050 | 0.00328 | 0.00062 | <0.00050 | <0.0010 |
| Selenium | 0.000121 | 0.000057 | 0.000364 | 0.000209 | <0.000050 | 0.000562 |
| Zinc | 0.0075 | <0.0010 | 0.0312 | 0.0024 | 0.0015 | <0.0040 |

Table 6-8: MW12-05-04 Water Quality Results Summary (2016 & 2017)

| MW12-05-04 | 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|------------|-----------|-------------------------|------------|------------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.06 | 7.87 | 8.21 | 8.24 | 8.14 | 8.32 |
| TDS (mg/L) | 286 | 280 | 290 | 280.6 | 262 | 296 |
| Sulfate-dissolved (mg/L) | 39.6 | 32.5 | 47.3 | 28.4 | 25.2 | 34.6 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0349 | 0.0025 | 0.144 | 0.0231 | 0.0107 | 0.0352 |
| Nitrate Nitrogen | 0.0301 | 0.0025 | 0.0569 | 0.0050 | <0.0050 | <0.0050 |
| Nitrite Nitrogen | 0.1218 | 0.0309 | 0.32 | 0.0320 | 0.0124 | 0.0677 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.000010 | <0.000010 | <0.000010 | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.0027 | 0.0021 | 0.0033 | 0.0041 | 0.0034 | 0.0049 |
| Arsenic | 0.00014 | <0.00010 | 0.00024 | 0.00013 | <0.00010 | 0.00017 |
| Cadmium | 0.0000052 | <0.0000050 | 0.0000063 | 0.0000050 | <0.0000050 | <0.0000050 |
| Chromium | 0.00011 | <0.00010 | 0.00014 | 0.00018 | <0.00010 | 0.00023 |
| Copper | 0.00025 | <0.00020 | 0.00048 | 0.00021 | <0.00020 | 0.00026 |
| Lead | 0.000050 | <0.000050 | <0.000050 | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00463 | 0.00411 | 0.00508 | 0.00273 | 0.00142 | 0.00406 |
| Nickel | 0.00050 | <0.00050 | <0.00050 | 0.00050 | <0.00050 | <0.00050 |
| Selenium | 0.000080 | <0.000050 | 0.000127 | 0.000665 | 0.000056 | 0.00171 |
| Zinc | 0.0068 | 0.0011 | 0.0141 | 0.0019 | <0.0010 | <0.0035 |

Table 6-9: MW12-05-05 Water Quality Results Summary (2012 - 2017)

| MW12-05-05 | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|-----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.12 | 7.82 | 8.35 | 8.11 | 8.05 | 8.15 |
| TDS (mg/L) | 285.1 | 252 | 338 | 279.6 | 264 | 287 |
| Sulfate-dissolved (mg/L) | 45.2 | 33.3 | 62.4 | 46.8 | 43.5 | 49.0 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0193 | <0.0050 | 0.054 | 0.0181 | 0.0082 | 0.0479 |
| Nitrate Nitrogen | 0.377 | 0.196 | 0.817 | 0.276 | 0.194 | 0.334 |
| Nitrite Nitrogen | 0.1310 | 0.03 | 0.398 | 0.0438 | 0.0355 | 0.0606 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.0000154 | <0.0000050 | <0.000020 | 0.000011 | <0.000010 | 0.000017 |
| Aluminum | 0.00482 | 0.0023 | 0.0106 | 0.0027 | 0.0024 | 0.0034 |
| Arsenic | 0.000263 | 0.00012 | 0.00122 | 0.00023 | <0.00010 | 0.00061 |
| Cadmium | 0.0000109 | <0.0000050 | 0.00003 | 0.0000062 | <0.0000050 | 0.0000081 |
| Chromium | 0.00061 | <0.00010 | <0.0010 | 0.00010 | <0.00010 | <0.00010 |
| Copper | 0.00099 | 0.00034 | 0.00360 | 0.00121 | 0.00082 | 0.00178 |
| Lead | 0.000136 | <0.000050 | <0.00020 | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00490 | 0.0035 | 0.0153 | 0.00375 | 0.00365 | 0.00393 |
| Nickel | 0.000955 | 0.00052 | 0.0019 | 0.00057 | <0.00050 | 0.00065 |
| Selenium | 0.000115 | 0.000072 | 0.00017 | 0.000112 | <0.000050 | 0.000173 |
| Zinc | 0.02175 | 0.0032 | 0.118 | 0.0183 | 0.0060 | 0.0457 |

Table 6-10: MW12-05-06 Water Quality Results Summary 2016 & 2017

| MW12-05-06 | 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.08 | 7.98 | 8.2 | 8.11 | 7.99 | 8.18 |
| TDS (mg/L) | 277 | 268 | 302 | 278.5 | 265 | 293 |
| Sulfate-dissolved (mg/L) | 43.1 | 41.9 | 45 | 47.0 | 44.4 | 49.5 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0025 | 0.0025 | 0.0025 | 0.0083 | <0.0050 | 0.0181 |
| Nitrate Nitrogen | 0.341 | 0.271 | 0.433 | 0.357 | 0.229 | 0.463 |
| Nitrite Nitrogen | 0.0388 | 0.023 | 0.0663 | 0.0353 | 0.0297 | 0.0470 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.000010 | <0.000010 | <0.000010 | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.0023 | 0.0022 | 0.0024 | 0.0028 | 0.0021 | 0.0042 |
| Arsenic | 0.00013 | 0.00012 | 0.00013 | 0.00022 | 0.00011 | 0.00047 |
| Cadmium | 0.0000133 | 0.0000076 | 0.0000179 | 0.0000120 | <0.0000050 | 0.0000158 |
| Chromium | 0.00010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | 0.00015 |
| Copper | 0.00102 | 0.00087 | 0.00121 | 0.00154 | 0.00130 | 0.00197 |
| Lead | 0.000050 | <0.000050 | <0.000050 | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00350 | 0.00331 | 0.00373 | 0.00367 | 0.00347 | 0.00379 |
| Nickel | 0.00064 | 0.00055 | 0.00073 | 0.00062 | 0.00054 | 0.00067 |
| Selenium | 0.000136 | 0.000100 | 0.000176 | 0.000143 | 0.000070 | 0.000190 |
| Zinc | 0.0528 | 0.0073 | 0.115 | 0.0315 | 0.0118 | 0.0613 |

Table 6-11: MW12-05-07 Water Quality Results Summary (2012 - 2017)

| MW12-05-07 | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|-----------|-------------------------|------------|------------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.20 | 7.76 | 8.45 | 8.15 | 7.98 | 8.26 |
| TDS (mg/L) | 294 | 252 | 362 | 286.2 | 270 | 306 |
| Sulfate-dissolved (mg/L) | 29.1 | 11.4 | 45.2 | 33.0 | 28.5 | 38.7 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.1049 | <0.0050 | 0.465 | 0.0196 | 0.0146 | 0.0248 |
| Nitrate Nitrogen | 0.0383 | <0.0050 | <0.20 | 0.0060 | <0.0050 | 0.0090 |
| Nitrite Nitrogen | 0.2566 | <0.0010 | 2.91 | 0.0105 | 0.0057 | 0.0177 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.0000150 | <0.0000050 | <0.000020 | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.00514 | 0.0022 | 0.0127 | 0.0028 | 0.0018 | 0.0038 |
| Arsenic | 0.000390 | 0.00022 | 0.000917 | 0.00032 | 0.00023 | 0.00044 |
| Cadmium | 0.0000083 | <0.0000050 | 0.000019 | 0.0000050 | <0.0000050 | <0.0000050 |
| Chromium | 0.00062 | <0.00010 | <0.0010 | 0.00020 | <0.00010 | 0.00036 |
| Copper | 0.000348 | <0.00020 | 0.00158 | 0.00021 | <0.00020 | 0.00025 |
| Lead | 0.000156 | 0.000039 | 0.00055 | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00247 | 0.00124 | 0.0038 | 0.00200 | 0.00109 | 0.00246 |
| Nickel | 0.00083 | <0.00050 | 0.0015 | 0.00052 | <0.00050 | 0.00057 |
| Selenium | 0.000255 | <0.000050 | 0.000750 | 0.000652 | 0.000129 | 0.00168 |
| Zinc | 0.00450 | <0.0010 | 0.0136 | 0.0016 | <0.0010 | 0.0025 |

6.3.10 MW12-06

Groundwater well MW12-06 water quality results from 2017 are summarized in Table 6-12 through Table 6-17, and compared to historical data. Zones 02, 04, and 06 were sampled and analyzed during 2017 under the Groundwater Monitoring Plan, while Zones 01, 03, and 05 were also sampled in response to the Adaptive Management Plan.

Table 6-12: MW12-06-01 Water Quality Results Summary (2016 & 2017)

| MW12-06-01 | 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|------------|-----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.94 | 7.93 | 7.95 | 7.97 | 7.60 | 8.33 |
| TDS (mg/L) | 409.5 | 401 | 418 | 423 | 387 | 499 |
| Sulfate-dissolved (mg/L) | 3.3 | 2.3 | 4.3 | 3.16 | 1.14 | <5.0 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.5046 | 0.0542 | 0.955 | 0.1824 | 0.0067 | 0.612 |
| Nitrate Nitrogen | 0.536 | 0.252 | 0.820 | 0.0827 | 0.0139 | 0.251 |
| Nitrite Nitrogen | 2.131 | 0.952 | 3.31 | 0.2955 | 0.0379 | 0.936 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.000010 | <0.000010 | <0.000010 | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.0158 | 0.0148 | 0.0169 | 0.0164 | 0.0150 | 0.0182 |
| Arsenic | 0.00700 | 0.00640 | 0.00759 | 0.00663 | 0.00571 | 0.00828 |
| Cadmium | 0.0000067 | <0.0000050 | 0.0000085 | 0.0000079 | <0.0000050 | 0.0000112 |
| Chromium | 0.00326 | 0.00318 | 0.00333 | 0.00347 | 0.00312 | 0.00402 |
| Copper | 0.00036 | 0.00034 | 0.00038 | 0.00146 | 0.00057 | 0.00337 |
| Lead | 0.000053 | <0.000050 | 0.000056 | 0.000063 | <0.000050 | 0.000085 |
| Molybdenum | 0.001293 | 0.000867 | 0.00172 | 0.001007 | 0.000954 | 0.00104 |
| Nickel | 0.00055 | <0.00050 | 0.00060 | 0.00056 | <0.00050 | 0.00073 |
| Selenium | 0.001108 | 0.000327 | 0.00189 | 0.001273 | 0.000170 | 0.00374 |
| Zinc | 0.0036 | 0.0027 | 0.0044 | 0.0042 | 0.0025 | 0.0066 |

Table 6-13: MW12-06-02 Water Quality Results Summary (2012 - 2017)

| MW12-06-02 Parameters | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|-----------|-------------------------|------------|-----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 8.02 | 7.65 | 8.2 | 7.99 | 7.66 | 8.20 |
| TDS (mg/L) | 647.8 | 612 | 693 | 644.2 | 637 | 649 |
| Sulfate-dissolved (mg/L) | 205.1 | 177 | 227 | 215.5 | 211 | 224 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0380 | 0.0074 | 0.075 | 0.0434 | 0.0261 | 0.0528 |
| Nitrate Nitrogen | 0.218 | 0.025 | 1.83 | 0.0727 | 0.035 | 0.106 |
| Nitrite Nitrogen | 0.8325 | 0.0882 | 7.21 | 0.266 | 0.126 | 0.413 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.000016 | 0.000008 | <0.000020 | 0.000010 | <0.000010 | 0.000011 |
| Aluminum | 0.00383 | <0.0010 | 0.0102 | 0.0018 | 0.0011 | 0.0037 |
| Arsenic | 0.00456 | 0.00227 | 0.00664 | 0.00381 | 0.00362 | 0.00403 |
| Cadmium | 0.0000139 | <0.0000050 | 0.000047 | 0.0000055 | <0.0000050 | 0.0000076 |
| Chromium | 0.00061 | <0.00010 | <0.0010 | 0.00011 | <0.00010 | 0.00017 |
| Copper | 0.000348 | <0.00020 | 0.00115 | 0.00424 | <0.00020 | 0.0202 |
| Lead | 0.000136 | 0.000029 | <0.00020 | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00807 | 0.0051 | 0.0164 | 0.00746 | 0.00695 | 0.00791 |
| Nickel | 0.000854 | <0.00050 | 0.00121 | 0.00087 | <0.00050 | 0.00235 |
| Selenium | 0.000168 | <0.000050 | 0.000740 | 0.000304 | <0.000050 | 0.000721 |
| Zinc | 0.00607 | 0.0028 | 0.0111 | 0.0037 | 0.0016 | 0.0058 |

Table 6-14: MW12-06-03 Water Quality Results Summary (2016 & 2017)

| MW12-06-03 | 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|------------|------------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.02 | 7.77 | 8.20 | 8.01 | 7.74 | 8.25 |
| TDS (mg/L) | 642.7 | 615 | 661 | 640.0 | 619 | 671 |
| Sulfate-dissolved (mg/L) | 201.0 | 175 | 214 | 208.5 | 202 | 221 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0250 | 0.0076 | 0.0367 | 0.0438 | 0.0150 | 0.0673 |
| Nitrate Nitrogen | 0.234 | 0.198 | 0.269 | 0.0444 | 0.028 | 0.077 |
| Nitrite Nitrogen | 0.953 | 0.769 | 1.07 | 0.173 | 0.115 | 0.314 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.000010 | <0.000010 | <0.000010 | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.0014 | <0.0010 | 0.0018 | 0.0018 | 0.0010 | 0.0028 |
| Arsenic | 0.00077 | 0.00060 | 0.00092 | 0.00057 | 0.00052 | 0.00062 |
| Cadmium | 0.0000050 | <0.0000050 | <0.0000050 | 0.0000099 | <0.0000050 | 0.0000247 |
| Chromium | 0.00027 | 0.00011 | 0.00039 | 0.00021 | <0.00010 | 0.00030 |
| Copper | 0.00020 | <0.00020 | <0.00020 | 0.00020 | <0.00020 | <0.00020 |
| Lead | 0.000050 | <0.000050 | <0.000050 | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00209 | 0.00189 | 0.00238 | 0.00281 | 0.00174 | 0.00400 |
| Nickel | 0.00050 | <0.00050 | <0.00050 | 0.00050 | <0.00050 | <0.00050 |
| Selenium | 0.000192 | 0.000052 | 0.000447 | 0.000143 | <0.000050 | 0.000422 |
| Zinc | 0.0061 | 0.0035 | 0.0083 | 0.0062 | 0.0020 | 0.0096 |

Table 6-15: MW12-06-04 Water Quality Results Summary (2012 - 2017)

| MW12-06-04 Parameters | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|-----------|-------------------------|------------|-----------|
| | Mean | Min | Max | Mean | Min | Max |
| pH | 8.09 | 7.76 | 8.23 | 8.12 | 7.83 | 8.29 |
| TDS (mg/L) | 629 | 594 | 735 | 630.7 | 614 | 639 |
| Sulfate-dissolved (mg/L) | 169.5 | 159 | 182 | 183.0 | 180 | 190 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0159 | <0.0050 | 0.028 | 0.0081 | 0.0064 | 0.0110 |
| Nitrate Nitrogen | 0.302 | 0.022 | 2.00 | 0.0852 | 0.0089 | 0.220 |
| Nitrite Nitrogen | 1.1819 | 0.0998 | 7.92 | 0.3584 | 0.0352 | 0.940 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.0000186 | <0.0000050 | <0.000020 | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.0046 | 0.0018 | 0.012 | 0.0018 | 0.0014 | 0.0024 |
| Arsenic | 0.00242 | 0.00163 | 0.00515 | 0.00243 | 0.00227 | 0.00267 |
| Cadmium | 0.0000128 | <0.0000050 | 0.000039 | 0.0000053 | <0.0000050 | 0.0000067 |
| Chromium | 0.00076 | <0.00010 | <0.0010 | 0.00011 | <0.00010 | 0.00014 |
| Copper | 0.004326 | 0.000106 | 0.0722 | 0.00021 | <0.00020 | 0.00030 |
| Lead | 0.000160 | 0.000031 | <0.00020 | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00841 | 0.0074 | 0.0102 | 0.00841 | 0.00771 | 0.00906 |
| Nickel | 0.000895 | <0.00050 | 0.0011 | 0.00050 | <0.00050 | <0.00050 |
| Selenium | 0.000233 | 0.000083 | 0.00101 | 0.000187 | <0.000050 | 0.000569 |
| Zinc | 0.01355 | <0.0050 | 0.0686 | 0.0223 | 0.0065 | 0.0667 |

Table 6-16: MW12-06-05 Water Quality Results Summary (2016 & 2017)

| MW12-06-05 | 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|------------|-----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 7.98 | 7.73 | 8.14 | 8.03 | 7.81 | 8.21 |
| TDS (mg/L) | 637.0 | 624 | 646 | 625.3 | 610 | 640 |
| Sulfate-dissolved (mg/L) | 180.7 | 176 | 185 | 183.0 | 177 | 190 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0057 | <0.0050 | 0.0070 | 0.0066 | <0.0050 | 0.0131 |
| Nitrate Nitrogen | 0.111 | 0.038 | 0.255 | 0.0252 | 0.0155 | 0.034 |
| Nitrite Nitrogen | 0.426 | 0.125 | 1.00 | 0.0764 | 0.0252 | 0.117 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.000010 | <0.000010 | <0.000010 | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.0018 | <0.0010 | 0.0029 | 0.0017 | <0.0010 | 0.0026 |
| Arsenic | 0.00094 | 0.00085 | 0.00110 | 0.00072 | 0.00058 | 0.00077 |
| Cadmium | 0.0000057 | <0.0000050 | 0.0000070 | 0.0000077 | <0.0000050 | 0.0000112 |
| Chromium | 0.00010 | <0.00010 | <0.00010 | 0.00010 | <0.00010 | <0.00010 |
| Copper | 0.00027 | <0.00020 | 0.00041 | 0.00023 | <0.00020 | 0.00033 |
| Lead | 0.000050 | <0.000050 | <0.000050 | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00859 | 0.00833 | 0.00880 | 0.00931 | 0.00850 | 0.00993 |
| Nickel | 0.00061 | 0.00057 | 0.00067 | 0.00062 | <0.00050 | 0.00083 |
| Selenium | 0.000094 | <0.000050 | 0.000183 | 0.000070 | <0.000050 | 0.000168 |
| Zinc | 0.0396 | 0.0145 | 0.0637 | 0.0146 | 0.0094 | 0.0236 |

Table 6-17: MW12-06-06 Water Quality Results Summary (2012 - 2017)

| MW12-06-06 | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|-----------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max | Mean | Min | Max |
| pH | 8.12 | 7.75 | 8.26 | 8.06 | 7.84 | 8.30 |
| TDS (mg/L) | 512.1 | 472 | 538 | 523.8 | 519 | 529 |
| Sulfate-dissolved (mg/L) | 152.6 | 143 | 171 | 154.4 | 153 | 155 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.0187 | <0.0050 | 0.085 | 0.0050 | <0.0050 | 0.0050 |
| Nitrate Nitrogen | 1.012 | 0.45 | 1.31 | 1.08 | 1.05 | 1.10 |
| Nitrite Nitrogen | 0.1175 | 0.0521 | 0.499 | 0.0980 | 0.0455 | 0.221 |
| Dissolved Metals (mg/L) | | | | | | |
| Silver | 0.0000154 | <0.0000050 | <0.000020 | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.00434 | <0.0010 | 0.0142 | 0.0015 | <0.0010 | 0.0027 |
| Arsenic | 0.00012 | 0.00009 | 0.00019 | 0.00011 | <0.00010 | 0.00016 |
| Cadmium | 0.0000197 | <0.0000050 | 0.000124 | 0.0000125 | <0.0000050 | 0.0000423 |
| Chromium | 0.00061 | <0.00010 | <0.0010 | 0.00012 | <0.00010 | 0.00022 |
| Copper | 0.000379 | <0.00020 | 0.00155 | 0.00039 | <0.00020 | 0.00060 |
| Lead | 0.000136 | <0.000050 | <0.00020 | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00569 | 0.0048 | 0.0066 | 0.00563 | 0.00514 | 0.00607 |
| Nickel | 0.000787 | <0.00050 | <0.0010 | 0.00050 | <0.00050 | <0.00050 |
| Selenium | 0.000264 | 0.00015 | 0.000511 | 0.000333 | 0.000280 | 0.000487 |
| Zinc | 0.02214 | 0.00312 | 0.0827 | 0.0230 | 0.0116 | 0.0488 |

6.3.11 MW12-07

Groundwater well MW12-07 water quality results from 2017 are summarized in Table 6-18 and Table 6-19, and compared to historical data. Both zones (01 and 02) were sampled and analyzed during 2017.

Table 6-18: MW12-07-01 Water Quality Results Summary (2012 - 2017)

| MW12-07-01 | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|-----------|
| | Parameters | Mean | Min | Max | Mean | Min |
| pH | 7.98 | 7.38 | 8.38 | 7.97 | 7.59 | 8.23 |
| TDS (mg/L) | 976.05 | 763 | 1400 | 727 | 599 | 921 |
| Sulfate-dissolved (mg/L) | 316.18 | 105 | 640 | 78.2 | 12.4 | 311 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.46 | <0.0050 | 1.6 | 0.359 | 0.218 | 0.604 |
| Nitrate Nitrogen | 7.11 | 0.088 | 53.5 | 0.161 | 0.044 | 0.623 |
| Nitrite Nitrogen | 1.46 | <0.050 | 4.96 | 0.3718 | 0.0891 | 1.47 |
| Dissolved Metals (mg/L) | | | | | | |
| Calcium | 200.26 | 154 | 266 | 171.2 | 155 | 188 |
| Cadmium | 0.000072 | <0.0000050 | 0.000633 | 0.0000150 | <0.0000050 | 0.0000876 |
| Copper | 0.0073 | <0.00020 | 0.077 | 0.00034 | <0.00020 | 0.00139 |
| Iron | 0.252 | 0.022 | 0.705 | 0.032 | <0.010 | 0.060 |
| Selenium | 0.00512 | <0.00010 | 0.0347 | 0.002039 | 0.000271 | 0.00850 |

Table 6-19: MW12-07-02 Water Quality Results Summary (2012 - 2017)

| MW12-07-02 | 2012 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|--------------------------------|--------------------------------|------------|----------|-------------------------|------------|-----------|
| | Parameters | Mean | Min | Max | Mean | Min |
| pH | 7.96 | 7.68 | 8.11 | 7.92 | 7.79 | 8.05 |
| TDS (mg/L) | 1080 | 748 | 1160 | 1138 | 1080 | 1180 |
| Sulfate-dissolved (mg/L) | 642 | 283 | 733 | 733.5 | 687 | 756 |
| Nutrients (mg/L) | | | | | | |
| Ammonia Nitrogen | 0.1339 | <0.0050 | 0.61 | 0.0363 | 0.0220 | 0.0594 |
| Nitrate Nitrogen | 0.724 | 0.075 | 21.3 | 0.103 | 0.060 | 0.212 |
| Nitrite Nitrogen | 0.491 | 0.148 | 1.47 | 0.293 | 0.140 | 1.00 |
| Dissolved Metals (mg/L) | | | | | | |
| Calcium | 203.3 | 140 | 232 | 217.8 | 207 | 228 |
| Cadmium | 0.0000161 | <0.0000050 | 0.000269 | 0.0000182 | <0.0000050 | 0.0000865 |
| Copper | 0.00110 | <0.00020 | 0.0217 | 0.00053 | <0.00020 | 0.00123 |
| Iron | 0.2587 | 0.0069 | 1.3 | 0.124 | <0.010 | 0.151 |
| Selenium | 0.000549 | 0.000055 | 0.0148 | 0.000219 | 0.000073 | 0.00072 |

6.3.12 MW17-08

This well was installed in July 2017 to monitor groundwater up-gradient of the Southwest Waste Dump and other mine activities. Four zones were sampled and analyzed in 2017 on two occasions, the results are summarized in Table 6-20 to 6-23 below. Well 17-08 was installed to monitor the background water quality as such, additional parameters are presented in the result summary tables. On November 20th, 2017, MW17-08-04 was sampled but the port had very little water, only dissolved metal analysis could be conducted.

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

| MW17-08-01 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.12 | 8.10 | 8.15 |
| TDS (mg/L) | 275.0 | 269 | 281 |
| Sulfate-dissolved (mg/L) | 42.4 | 41.7 | 43.1 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0062 | <0.0050 | 0.0073 |
| Nitrate Nitrogen | 0.347 | 0.329 | 0.365 |
| Nitrite Nitrogen | 0.0074 | 0.0012 | 0.0136 |
| Dissolved Metals (mg/L) | | | |
| Silver | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.0022 | 0.0014 | 0.0029 |
| Arsenic | 0.00023 | 0.00020 | 0.00026 |
| Cadmium | 0.0000516 | 0.0000396 | 0.0000635 |
| Chromium | 0.00014 | <0.00010 | 0.00019 |
| Copper | 0.00064 | 0.00061 | 0.00068 |
| Lead | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00716 | 0.00525 | 0.00908 |
| Nickel | 0.00068 | <0.00050 | 0.00087 |
| Selenium | 0.000912 | 0.000665 | 0.00116 |
| Zinc | 0.0316 | 0.0297 | 0.0336 |

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

| MW17-08-02 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.12 | 8.12 | 8.13 |
| TDS (mg/L) | 171.0 | 162 | 180 |
| Sulfate-dissolved (mg/L) | 11.6 | 11.4 | 11.7 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0050 | <0.0050 | <0.0050 |
| Nitrate Nitrogen | 0.681 | 0.678 | 0.684 |
| Nitrite Nitrogen | 0.0028 | <0.0010 | 0.0045 |
| Dissolved Metals (mg/L) | | | |
| Silver | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.0032 | 0.0027 | 0.0038 |
| Arsenic | 0.00030 | 0.00028 | 0.00033 |
| Cadmium | 0.0000196 | 0.0000133 | 0.0000258 |
| Chromium | 0.00046 | <0.00010 | 0.00082 |
| Copper | 0.00208 | 0.00175 | 0.00240 |
| Lead | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00354 | 0.00336 | 0.00372 |
| Nickel | 0.00060 | <0.00050 | 0.00070 |
| Selenium | 0.001000 | 0.000729 | 0.00127 |
| Zinc | 0.0190 | 0.0155 | 0.0224 |

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

| MW17-08-03 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.15 | 8.11 | 8.17 |
| TDS (mg/L) | 148.3 | 142 | 160 |
| Sulfate-dissolved (mg/L) | 5.4 | 5.3 | 5.7 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0050 | <0.0050 | <0.0050 |
| Nitrate Nitrogen | 0.822 | 0.806 | 0.851 |
| Nitrite Nitrogen | 0.0027 | <0.0010 | 0.0042 |
| Dissolved Metals (mg/L) | | | |
| Silver | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.0043 | 0.0036 | 0.0048 |
| Arsenic | 0.00018 | 0.00015 | 0.00023 |
| Cadmium | 0.0000077 | <0.0000050 | 0.0000131 |
| Chromium | 0.00010 | <0.00010 | <0.00010 |
| Copper | 0.00064 | 0.00061 | 0.00069 |
| Lead | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.00115 | 0.00114 | 0.00116 |
| Nickel | 0.00050 | <0.00050 | <0.00050 |
| Selenium | 0.000509 | 0.000372 | 0.000682 |
| Zinc | 0.0117 | 0.0068 | 0.0209 |

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

| MW17-08-03 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.07 | | |
| TDS (mg/L) | 71.2 | | |
| Sulfate-dissolved (mg/L) | <5.0 | | |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | <0.0050 | | |
| Nitrate Nitrogen | 0.618 | | |
| Nitrite Nitrogen | 0.0051 | | |
| Dissolved Metals (mg/L) | | | |
| Silver | 0.000010 | <0.000010 | <0.000010 |
| Aluminum | 0.0047 | 0.0038 | 0.0056 |
| Arsenic | 0.00020 | 0.00013 | 0.00028 |
| Cadmium | 0.0000480 | <0.0000050 | 0.0000910 |
| Chromium | 0.00014 | <0.00010 | 0.00017 |
| Copper | 0.00046 | 0.00038 | 0.00053 |
| Lead | 0.000050 | <0.000050 | <0.000050 |
| Molybdenum | 0.000607 | 0.000500 | 0.000714 |
| Nickel | 0.00075 | <0.00050 | 0.00100 |
| Selenium | 0.000436 | 0.000213 | 0.000659 |
| Zinc | 0.0708 | 0.0045 | 0.137 |

6.3.13 MW17-09

This well was installed in July 2017 to monitor groundwater down-gradient of the Southwest Waste Dump. One zone was identified below an ice-rich layer, it was sampled and analyzed once in 2017, and was found frozen in November 2017 during the Q4 sampling event; the results are summarized in Table 6-24 below.

Table 6-24: MW17-09-01 Water Quality Results Summary (2017)

| MW17-09-01 | 2017 Summary Statistics |
|--------------------------------|-------------------------|
| Parameters | Mean |
| pH | 8.15 |
| TDS (mg/L) | 621 |
| Sulfate-dissolved (mg/L) | 56.8 |
| Nutrients (mg/L) | |
| Ammonia Nitrogen | 0.120 |
| Nitrate Nitrogen | 1.11 |
| Nitrite Nitrogen | 0.0653 |
| Dissolved Metals (mg/L) | |
| Calcium | 198 |
| Cadmium | <0.00025 |
| Copper | 0.00459 |
| Iron | 1.41 |
| Selenium | 0.0111 |

6.3.14 MW17-10

This well was installed in July 2017 to monitor groundwater down-gradient of the Main Waste Dump. Three zones were identified, sampled and analyzed in 2017 on two occasions, the results are summarized in Table 6-25 to 6-27 below.

Table 6-25: MW17-10-01 Water Quality Results Summary (2017)

| MW17-10-01 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.10 | 8.10 | 8.10 |
| TDS (mg/L) | 212.0 | 191 | 233 |
| Sulfate-dissolved (mg/L) | 60.1 | 58.3 | 61.9 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0182 | 0.0088 | 0.0275 |
| Nitrate Nitrogen | 2.53 | 1.96 | 3.10 |
| Nitrite Nitrogen | 0.0656 | 0.0484 | 0.0827 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 44.1 | 37.9 | 50.3 |
| Cadmium | 0.0000556 | 0.0000229 | 0.0000884 |
| Copper | 0.00376 | 0.00321 | 0.00430 |
| Iron | 0.010 | <0.010 | <0.010 |
| Selenium | 0.001891 | 0.000882 | 0.00290 |

Table 6-26: MW17-10-02 Water Quality Results Summary (2017)

| MW17-10-02 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.08 | 8.07 | 8.09 |
| TDS (mg/L) | 248.3 | 234 | 256 |
| Sulfate-dissolved (mg/L) | 25.2 | 24.8 | 25.9 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0052 | <0.0050 | 0.0055 |
| Nitrate Nitrogen | 17.0 | 15.6 | 17.7 |
| Nitrite Nitrogen | 0.0028 | 0.0016 | 0.0045 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 52.9 | 46.2 | 56.7 |
| Cadmium | 0.0000290 | 0.0000136 | 0.0000369 |
| Copper | 0.00372 | 0.00343 | 0.00419 |
| Iron | 0.010 | <0.010 | <0.010 |
| Selenium | 0.00137 | 0.00118 | 0.00153 |

Table 6-27: MW17-10-03 Water Quality Results Summary (2017)

| MW17-10-03 | 2017 Summary Statistics | | |
|--------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.10 | 8.09 | 8.10 |
| TDS (mg/L) | 247.3 | 240 | 262 |
| Sulfate-dissolved (mg/L) | 23.3 | 23.2 | 23.3 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0104 | <0.0050 | 0.0172 |
| Nitrate Nitrogen | 18.2 | 17.4 | 19.9 |
| Nitrite Nitrogen | 0.0050 | 0.0036 | 0.0062 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 51.3 | 48.9 | 55.9 |
| Cadmium | 0.0000257 | 0.0000092 | 0.0000561 |
| Copper | 0.00341 | 0.00295 | 0.00371 |
| Iron | 0.010 | <0.010 | <0.010 |
| Selenium | 0.00128 | 0.00119 | 0.00145 |

6.3.15 MW17-11

This well was installed in July 2017 to monitor groundwater down-gradient of the Minto North Pit. Five zones were identified, sampled and analyzed in 2017 on two occasions, the results are summarized in Table 6-28 to 6-32 below. Zone 5, was only sampled in November 2017.

Table 6-28: MW17-11-01 Water Quality Results Summary (2017)

| MW17-11-01 | 2017 Summary Statistics | | |
|--------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.18 | 8.08 | 8.27 |
| TDS (mg/L) | 177.0 | 171 | 183 |
| Sulfate-dissolved (mg/L) | 38.8 | 38.7 | 39.0 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0058 | <0.0050 | 0.0067 |
| Nitrate Nitrogen | 0.2032 | 0.0674 | 0.339 |
| Nitrite Nitrogen | 0.0311 | 0.0187 | 0.0435 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 34.0 | 32.1 | 36.0 |
| Cadmium | 0.0000576 | 0.0000538 | 0.0000614 |
| Copper | 0.00074 | 0.00052 | 0.00095 |
| Iron | 0.018 | <0.010 | 0.026 |
| Selenium | 0.000366 | 0.000137 | 0.000596 |

Table 6-29: MW17-11-02 Water Quality Results Summary (2017)

| MW17-11-02 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.21 | 8.10 | 8.27 |
| TDS (mg/L) | 188.7 | 178 | 196 |
| Sulfate-dissolved (mg/L) | 29.8 | 28.7 | 31.3 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0050 | <0.0050 | <0.0050 |
| Nitrate Nitrogen | 0.0308 | <0.0050 | 0.0748 |
| Nitrite Nitrogen | 0.0031 | 0.0020 | 0.0053 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 37.7 | 32.5 | 43.4 |
| Cadmium | 0.0000203 | 0.0000073 | 0.0000348 |
| Copper | 0.00043 | <0.00020 | 0.00061 |
| Iron | 0.061 | 0.028 | 0.085 |
| Selenium | 0.001065 | 0.000202 | 0.00261 |

Table 6-30: MW17-11-03 Water Quality Results Summary (2017)

| MW17-11-03 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.25 | 8.18 | 8.32 |
| TDS (mg/L) | 188.5 | 183 | 194 |
| Sulfate-dissolved (mg/L) | 22.5 | 21.1 | 23.8 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0050 | <0.0050 | <0.0050 |
| Nitrate Nitrogen | 0.333 | 0.331 | 0.335 |
| Nitrite Nitrogen | 0.0712 | 0.0395 | 0.103 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 41.8 | 39.5 | 44.1 |
| Cadmium | 0.0000058 | <0.0000050 | 0.0000065 |
| Copper | 0.00035 | 0.00033 | 0.00036 |
| Iron | 0.010 | <0.010 | <0.010 |
| Selenium | 0.000330 | 0.000075 | 0.000586 |

Table 6-31: MW17-11-04 Water Quality Results Summary (2017)

| MW17-11-04 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.03 | 7.84 | 8.27 |
| TDS (mg/L) | 347.0 | 313 | 367 |
| Sulfate-dissolved (mg/L) | 7.5 | 6.3 | 8.1 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0175 | 0.0145 | 0.0202 |
| Nitrate Nitrogen | 9.18 | 9.10 | 9.23 |
| Nitrite Nitrogen | 0.0264 | 0.0181 | 0.0316 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 107.1 | 95.3 | 113 |
| Cadmium | 0.0000417 | 0.0000375 | 0.0000491 |
| Copper | 0.00891 | 0.00674 | 0.0100 |
| Iron | 0.010 | <0.010 | <0.010 |
| Selenium | 0.000303 | 0.000182 | 0.000502 |

Table 6-32: MW17-11-05 Water Quality Results Summary (2017)

| MW17-11-05 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----|-----|
| Parameters | Mean | Min | Max |
| pH | 8.28 | | |
| TDS (mg/L) | 305 | | |
| Sulfate-dissolved (mg/L) | 4.7 | | |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | <0.0050 | | |
| Nitrate Nitrogen | 9.23 | | |
| Nitrite Nitrogen | 0.0045 | | |
| Dissolved Metals (mg/L) | | | |
| Calcium | 96.2 | | |
| Cadmium | 0.0000083 | | |
| Copper | 0.00229 | | |
| Iron | <0.010 | | |
| Selenium | 0.000349 | | |

6.3.16 MW17-12

This well was installed in July 2017 to monitor groundwater down-gradient of the Dry Stack Tailing Storage Facility (DSTSF) and all other mine activities. Eight zones were identified, sampled and analyzed in 2017 on two occasions, the results are summarized in Table 6-33 to 6-40 below.

Table 6-33: MW17-12-01 Water Quality Results Summary (2017)

| MW17-12-01 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 7.80 | 7.68 | 7.93 |
| TDS (mg/L) | 2165.0 | 2160 | 2170 |
| Sulfate-dissolved (mg/L) | 1390.0 | 1370 | 1410 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0050 | <0.0050 | <0.0050 |
| Nitrate Nitrogen | 0.075 | <0.050 | <0.10 |
| Nitrite Nitrogen | 0.017 | 0.014 | <0.020 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 334.0 | 326 | 342 |
| Cadmium | 0.0000107 | 0.0000087 | 0.0000127 |
| Copper | 0.00020 | <0.00020 | <0.00020 |
| Iron | 3.00 | 2.93 | 3.08 |
| Selenium | 0.000072 | 0.000060 | 0.000083 |

Table 6-34: MW17-12-02 Water Quality Results Summary (2017)

| MW17-12-02 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 7.89 | 7.80 | 7.98 |
| TDS (mg/L) | 1810.0 | 1780 | 1840 |
| Sulfate-dissolved (mg/L) | 1125.0 | 1110 | 1140 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0050 | <0.0050 | <0.0050 |
| Nitrate Nitrogen | 0.075 | <0.050 | <0.10 |
| Nitrite Nitrogen | 0.015 | <0.010 | <0.020 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 267.5 | 266 | 269 |
| Cadmium | 0.0000080 | 0.0000060 | <0.000010 |
| Copper | 0.00030 | <0.00020 | <0.00040 |
| Iron | 2.32 | 2.29 | 2.35 |
| Selenium | 0.000075 | <0.000050 | <0.00010 |

Table 6-35: MW17-12-03 Water Quality Results Summary (2017)

| MW17-12-03 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.04 | 7.87 | 8.21 |
| TDS (mg/L) | 551.0 | 541 | 561 |
| Sulfate-dissolved (mg/L) | 137.5 | 133 | 142 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0050 | <0.0050 | <0.0050 |
| Nitrate Nitrogen | 0.1481 | 0.0221 | 0.274 |
| Nitrite Nitrogen | 0.0070 | <0.0050 | 0.0091 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 82.4 | 80.1 | 84.8 |
| Cadmium | 0.0000065 | <0.0000050 | 0.0000080 |
| Copper | 0.00020 | <0.00020 | <0.00020 |
| Iron | 0.370 | 0.270 | 0.470 |
| Selenium | 0.000050 | <0.000050 | <0.000050 |

Table 6-36: MW17-12-04 Water Quality Results Summary (2017)

| MW17-12-04 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.08 | 7.97 | 8.19 |
| TDS (mg/L) | 474.5 | 469 | 480 |
| Sulfate-dissolved (mg/L) | 120.5 | 115 | 126 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0050 | <0.0050 | <0.0050 |
| Nitrate Nitrogen | 0.252 | 0.242 | 0.261 |
| Nitrite Nitrogen | 0.0043 | 0.0036 | <0.0050 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 68.7 | 67.5 | 69.9 |
| Cadmium | 0.0000151 | 0.0000113 | 0.0000189 |
| Copper | 0.00360 | 0.00347 | 0.00374 |
| Iron | 0.010 | <0.010 | <0.010 |
| Selenium | 0.000622 | 0.000569 | 0.000674 |

Table 6-37: MW17-12-05 Water Quality Results Summary (2017)

| MW17-12-05 | 2017 Summary Statistics | | |
|-------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.11 | 8.01 | 8.21 |
| TDS (mg/L) | 480.0 | 474 | 486 |
| Sulfate-dissolved (mg/L) | 111.0 | 102 | 120 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0055 | <0.0050 | 0.0060 |
| Nitrate Nitrogen | 0.308 | 0.279 | 0.336 |
| Nitrite Nitrogen | 0.0108 | <0.0050 | 0.0165 |
| Dissolved Metal (mg/L) | | | |
| Calcium | 70.4 | 69.2 | 71.7 |
| Cadmium | 0.0000250 | 0.0000151 | 0.0000348 |
| Copper | 0.00123 | 0.00086 | 0.00160 |
| Iron | 0.014 | <0.010 | 0.018 |
| Selenium | 0.000575 | 0.000562 | 0.000588 |

Table 6-38: MW17-12-06 Water Quality Results Summary (2017)

| MW17-12-06 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.18 | 8.10 | 8.27 |
| TDS (mg/L) | 442.0 | 422 | 462 |
| Sulfate-dissolved (mg/L) | 91.2 | 88.2 | 94.1 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0152 | <0.0050 | 0.0253 |
| Nitrate Nitrogen | 0.0255 | <0.0050 | 0.046 |
| Nitrite Nitrogen | 0.0032 | 0.0015 | <0.0050 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 65.2 | 62.9 | 67.6 |
| Cadmium | 0.0000312 | 0.0000223 | <0.000040 |
| Copper | 0.00070 | 0.00062 | 0.00077 |
| Iron | 0.775 | <0.010 | 1.54 |
| Selenium | 0.000538 | 0.000532 | 0.000544 |

Table 6-39: MW17-12-07 Water Quality Results Summary (2017)

| MW17-12-07 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|------------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.12 | 8.02 | 8.23 |
| TDS (mg/L) | 318.5 | 304 | 333 |
| Sulfate-dissolved (mg/L) | 62.1 | 60.9 | 63.3 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0050 | <0.0050 | <0.0050 |
| Nitrate Nitrogen | 0.984 | 0.970 | 0.997 |
| Nitrite Nitrogen | 0.0016 | <0.0010 | 0.0021 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 48.8 | 47.7 | 50.0 |
| Cadmium | 0.0000059 | <0.0000050 | 0.0000068 |
| Copper | 0.00164 | 0.00122 | 0.00207 |
| Iron | 0.010 | <0.010 | <0.010 |
| Selenium | 0.000338 | 0.000332 | 0.000345 |

Table 6-40: MW17-12-08 Water Quality Results Summary (2017)

| MW17-12-08 | 2017 Summary Statistics | | |
|--------------------------------|-------------------------|-----------|-----------|
| Parameters | Mean | Min | Max |
| pH | 8.13 | 8.05 | 8.27 |
| TDS (mg/L) | 328.7 | 321 | 337 |
| Sulfate-dissolved (mg/L) | 62.0 | 60.8 | 62.7 |
| Nutrients (mg/L) | | | |
| Ammonia Nitrogen | 0.0054 | <0.0050 | 0.0061 |
| Nitrate Nitrogen | 0.948 | 0.936 | 0.963 |
| Nitrite Nitrogen | 0.0040 | <0.0010 | 0.0058 |
| Dissolved Metals (mg/L) | | | |
| Calcium | 49.3 | 48.2 | 50.5 |
| Cadmium | 0.0000085 | 0.0000075 | 0.0000103 |
| Copper | 0.00145 | 0.00141 | 0.00151 |
| Iron | 0.042 | <0.010 | 0.060 |
| Selenium | 0.000343 | 0.000340 | 0.000347 |

6.4 Vibrating Wire Piezometers

There are currently 21 operating vibrating wire piezometers installed on site, listed in Table 6-41. SDP-2A became inoperative in October 2017, there were no other changes to the operational status of any piezometers in 2017. Summaries of data collected from each piezometer are provided in the following sections.

Table 6-41: Vibrating Wire Piezometer Summary

| Vibrating Wire Piezometer | Location | Operational Status |
|---------------------------|------------------------|-------------------------|
| DSP-1 | DSTSF | Destroyed (2011) |
| DSP-2 | DSTSF | Destroyed (2011) |
| DSP-3 | DSTSF | Destroyed (2012) |
| DSP-4 | DSTSF | Inoperative (2011) |
| DSP-5 | DSTSF | Operational |
| DSP-6 | DSTSF | Operational |
| DSP-7 | DSTSF | Operational |
| DSP-8 | DSTSF | Operational |
| DSP-9 | DSTSF | Inoperative (2016) |
| DSP-10 | DSTSF | Operational |
| SDP-2 | Southwest Dump | 2A - Inoperative (2017) |
| SDP-3 | Southwest Dump | Operational |
| SDP-4 | Southwest Dump | Operational |
| WDP-2 | Water Storage Pond Dam | Operational |
| WDP-3A | Water Storage Pond Dam | Operational |
| WDP-3 | Water Storage Pond Dam | Operational |
| WDP-4 | Water Storage Pond Dam | Operational |
| WDP-5 | Water Storage Pond Dam | Operational |
| WDP-6 | Water Storage Pond Dam | Operational |
| WDP-7 | Water Storage Pond Dam | Operational |
| WDP-8 | Water Storage Pond Dam | Operational |
| WDP-9 | Water Storage Pond Dam | Operational |
| WDP-10 | Water Storage Pond Dam | Operational |
| WDP-11 | Water Storage Pond Dam | Operational |
| WDP-12 | Water Storage Pond Dam | Operational |
| WDP-13 | Water Storage Pond Dam | Operational |

6.4.1 DSTSF Piezometers

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

Pore water pressures in DSP-5A and DSP-5B have been gradually increasing since installation in 2013. Analysis carried out by SRK Consulting in 2015 to consider the increasing pressures indicated high FOS values ($FOS > 2$) even without consideration of the constructed MVFE2. DSP-7 and DSP-8 water pressures have been gradually increasing since installation in late 2015. Review of the data by SRK consulting in 2016 identified no stability concern. DSP-10 water pressures increased significantly upon installation, and the trend has gradually been increasing since March 2016. Review of DSP-10 data by SRK consulting in 2016 identified no stability concern.

DSP-05 and DSP-06 data are collected monthly, DSP-07 and DSP-08 data are collected bi-monthly, and DSP-10 data are collected weekly.

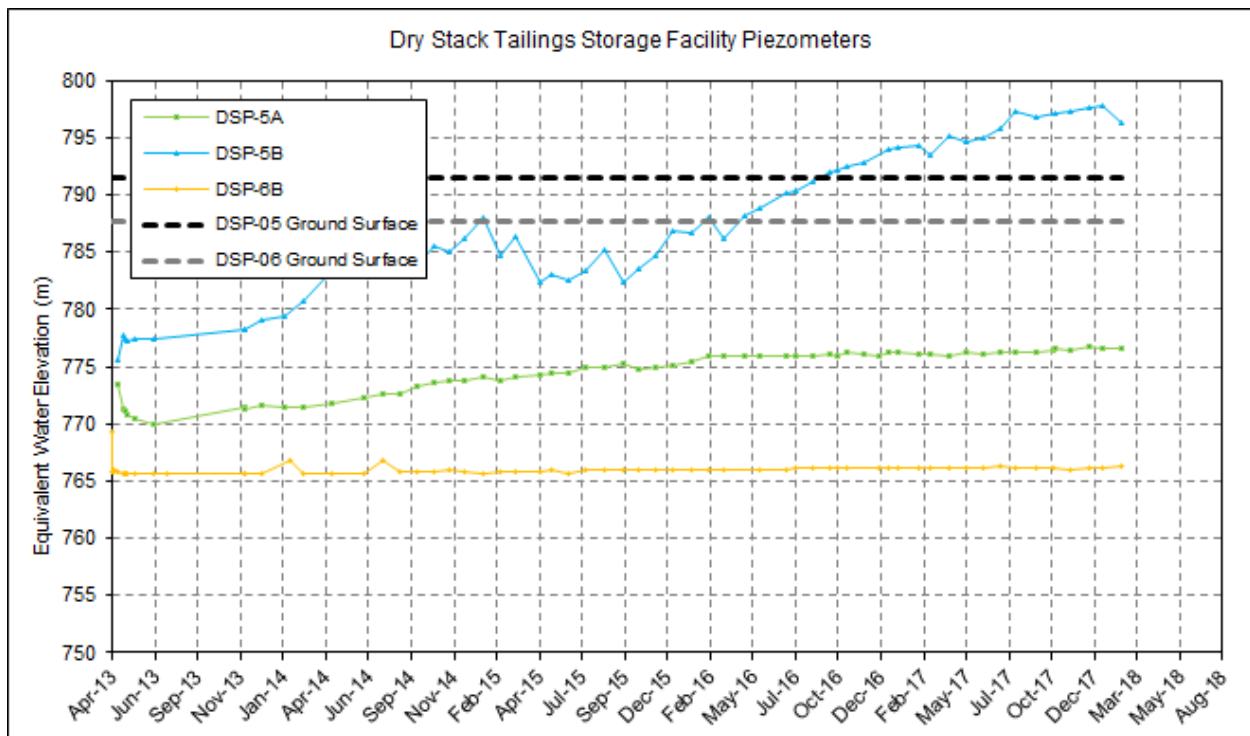


Figure 6-2: DSTSF Piezometer Data – DSP-05 and DSP-06 (2013-2017)

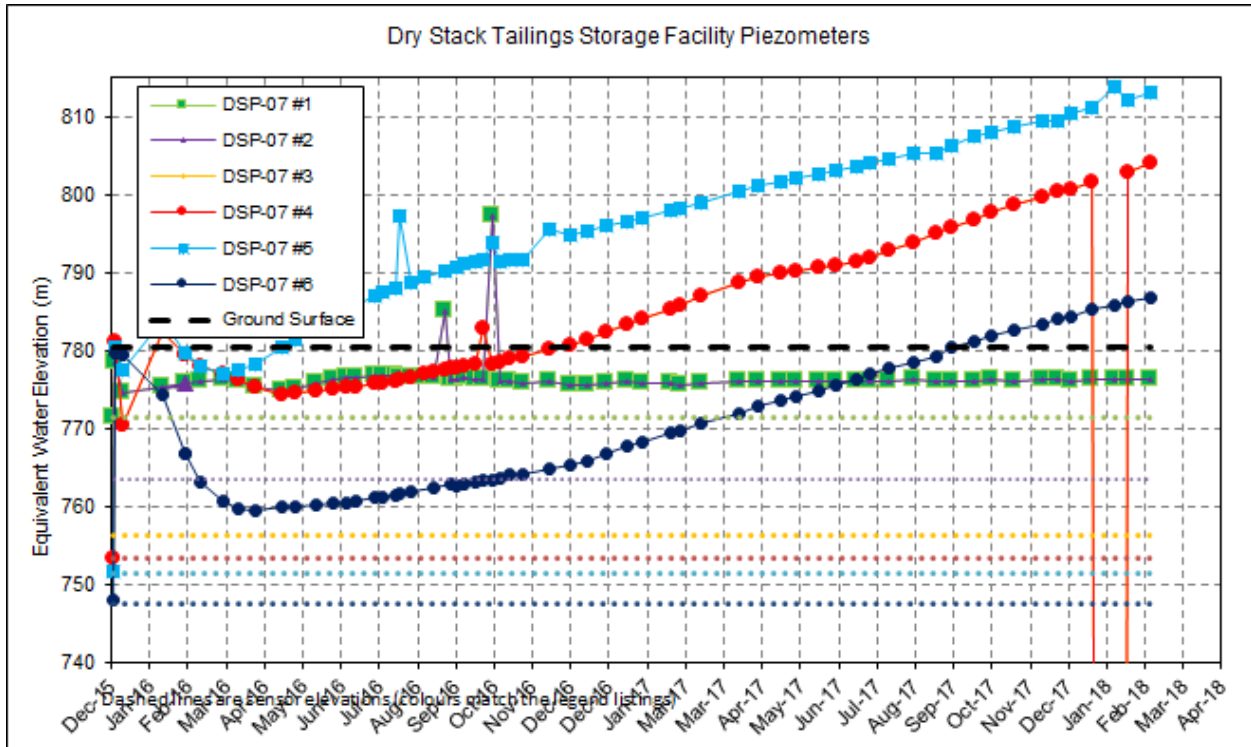


Figure 6-3: DSTSF Piezometer Data – DSP-07 (2015-2017)

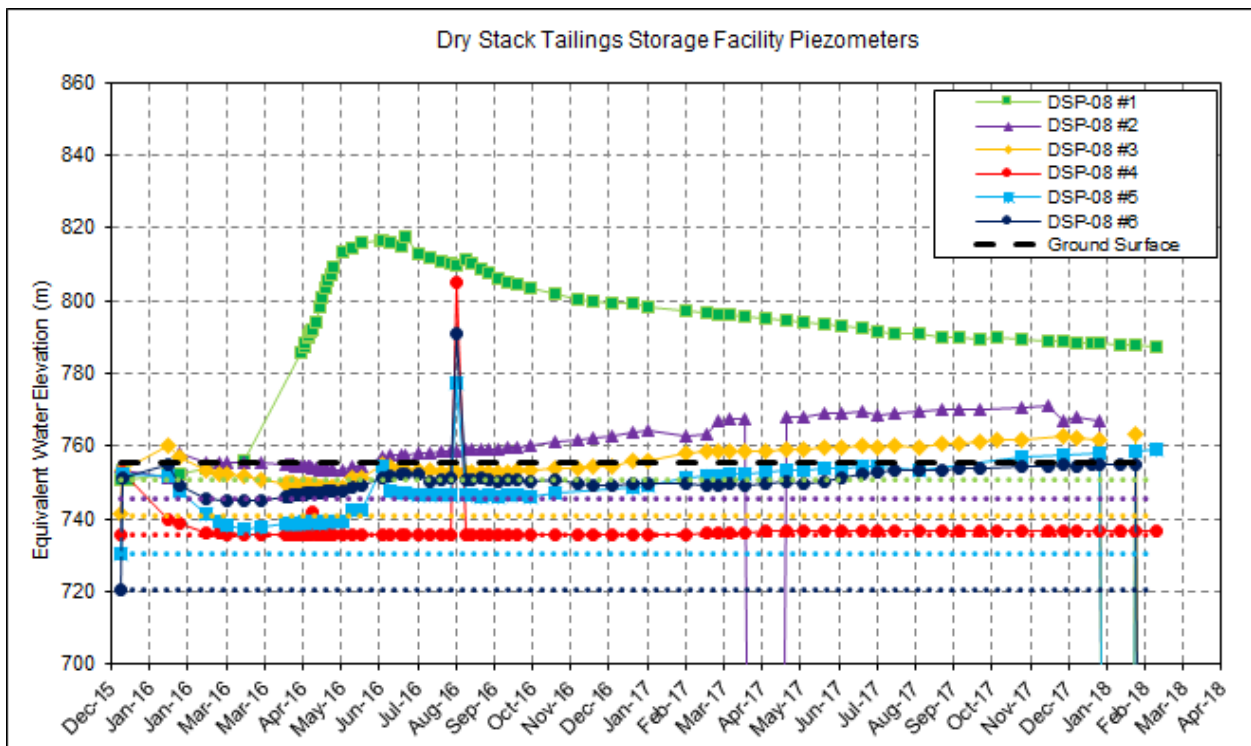


Figure 6-4: DSTSF Piezometer Data – DSP-08 (2015-2017)

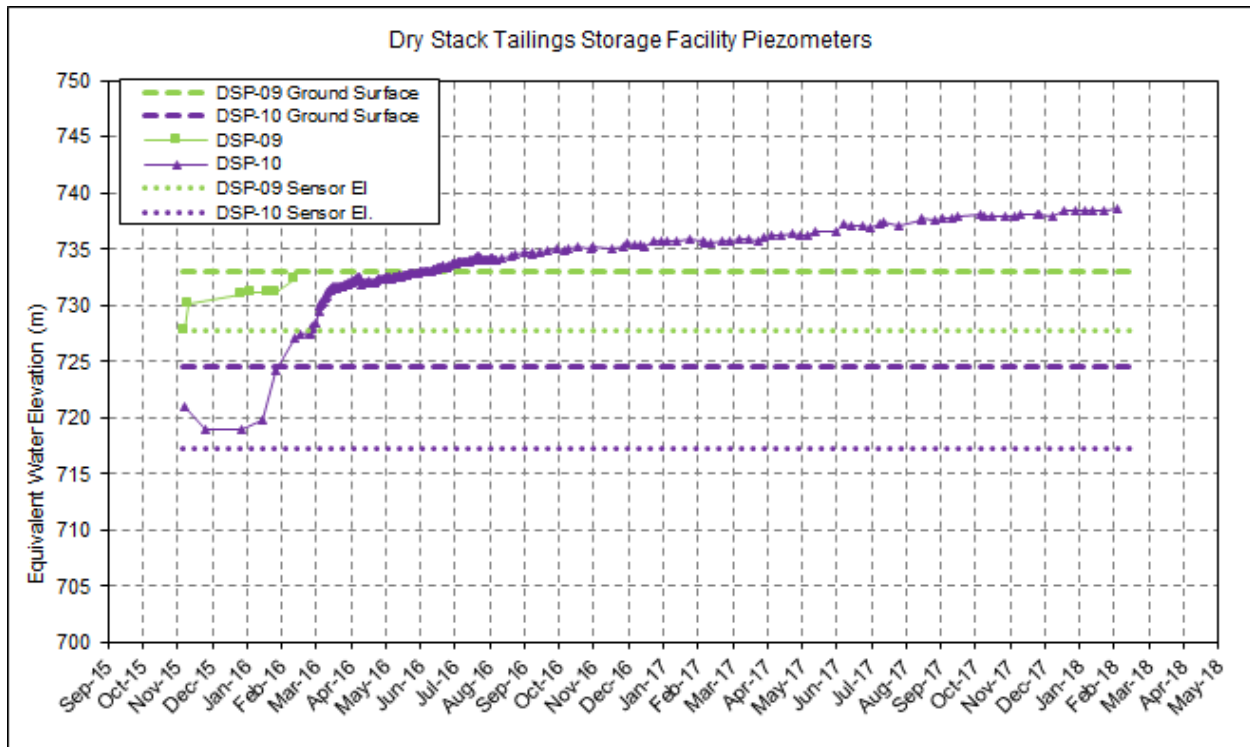


Figure 6-5: DSTSF Piezometer Data – DSP-09 and DSP-10 (2015-2017)

6.4.2 Southwest Dump Piezometers

Data collected from Southwest Dump vibrating wire piezometers are presented in Figure 6-6. Sensors SDP-3A and SDP-3B are reading negative pressures and have not been included in the figure. Data are collected monthly. Data indicate relatively consistent and indicate seasonal changes in pore pressure in 2017. Work on the dump in 2017 consisted primarily of re-sloping for closure.

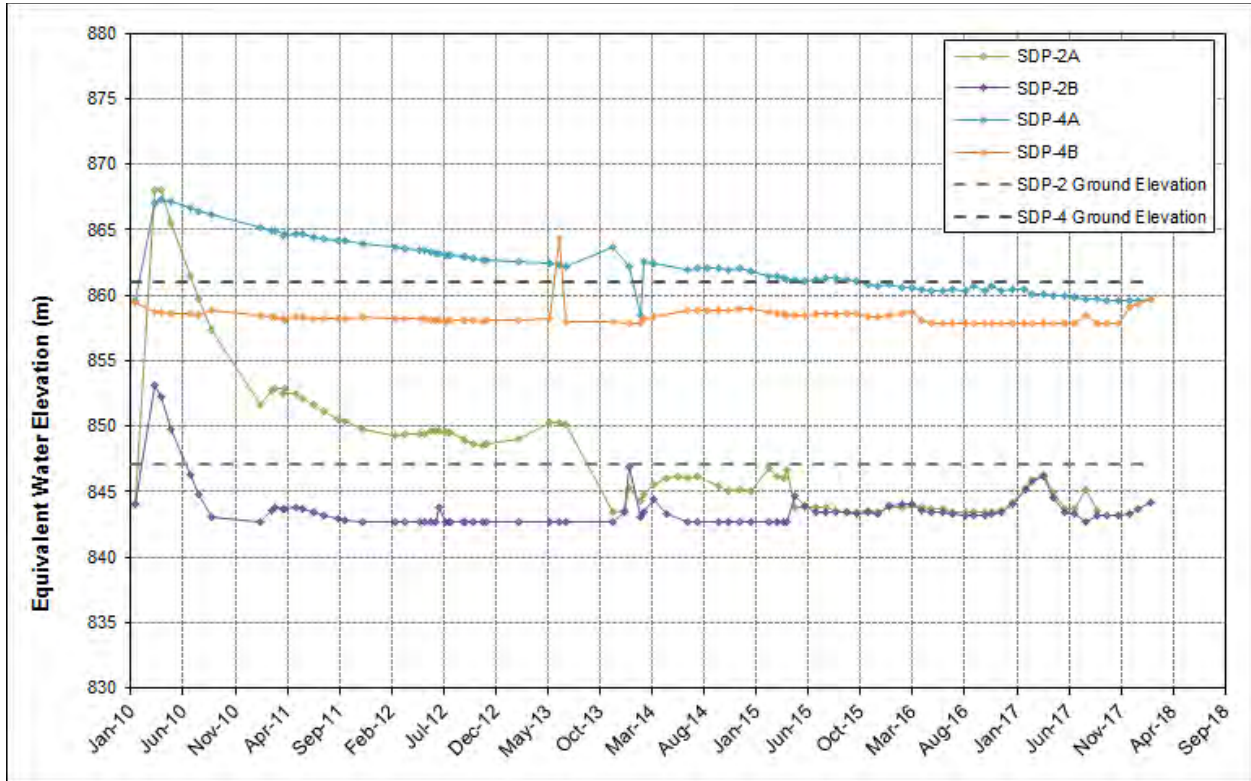


Figure 6-6: Southwest Dump Piezometer Data (2010-2017)

6.4.3 Water Storage Pond Dam Piezometers

Data collected from WSP Dam vibrating wire piezometers are presented in Figure 6-7. WDP-2, WDP-3, WDP-5, and WDP-11 are reading negative pressures and have not been included in the figure. Data are collected monthly. Pressures in 2017 generally followed the trend of the water level in the water storage pond as in previous years.

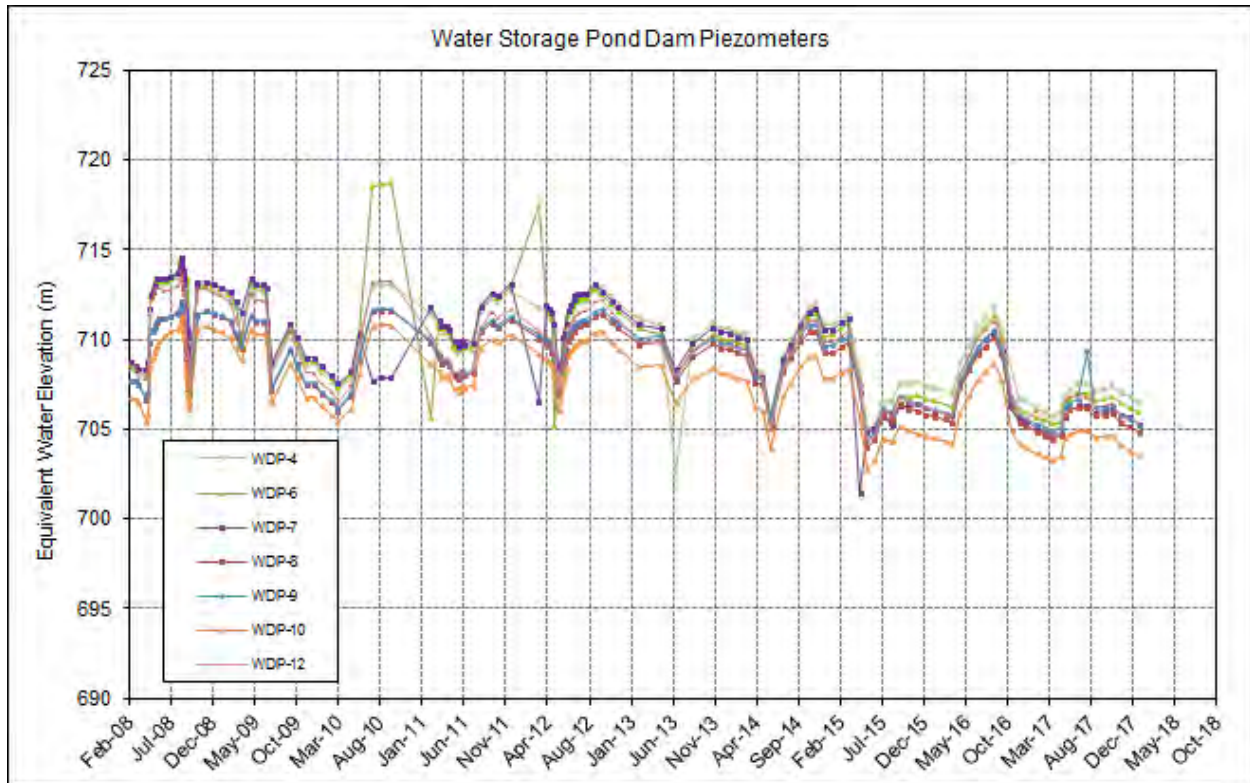


Figure 6-7: WSP Dam Piezometer Data (2008-2017)

6.5 Ground Temperature Cables

There are currently 22 operating thermistors (ground temperature cables) installed on site, listed in Table 6-42. There were no changes to the operational status of any of the existing thermistors in 2017. Summaries of data collected from each thermistor are contained in the following sections.

Table 6-42: Thermistor Summary (2017)

| Thermistor | Location | Operational Status |
|------------|-----------------|--------------------|
| A2T-1 | DSTSF | Operational |
| DST-1 | DSTSF | Destroyed (2011) |
| DST-2 | DSTSF | Destroyed (2011) |
| DST-3 | DSTSF | Destroyed (2012) |
| DST-4 | DSTSF | Inoperative (2012) |
| DST-5 | DSTSF | Destroyed (2011) |
| DST-6 | DSTSF | Destroyed (2011) |
| DST-7 | DSTSF | Destroyed (2010) |
| DST-8 | DSTSF | Destroyed (2011) |
| DST-9 | DSTSF | Destroyed (2011) |
| DST-10 | DSTSF | Operational |
| DST-11 | DSTSF | Operational |
| DST-12 | DSTSF | Inoperative (2012) |
| DST-13 | DSTSF | Operational |
| DST-14 | DSTSF | Operational |
| DST-15 | DSTSF | Operational |
| MWPT1 | Mill Water Pond | Destroyed (2016) |
| MWPT2 | Mill Water Pond | Destroyed (2016) |
| MW11-01A | Mill Water Pond | Destroyed (2016) |
| MPDT-1 | Main Pit Dam | Destroyed (2016) |
| MPDT-2 | Main Pit Dam | Destroyed (2016) |
| MW-11-02 | Ridgetop | Operational |
| MW-11-03 | Ridgetop | Operational |
| SDT-1 | Southwest Dump | Operational |
| SDT-2 | Southwest Dump | Operational |
| SDT-3 | Southwest Dump | Operational |
| SDT-4 | Southwest Dump | Operational |
| 08SWC271 | Southwest Dump | Destroyed (2010) |
| 08SWC274 | Southwest Dump | Destroyed (2011) |
| 08SWC275 | Southwest Dump | Destroyed (2008) |
| 08SWC277 | Southwest Dump | Destroyed (2008) |
| 08SWC278 | Southwest Dump | Destroyed (2008) |
| 08SWC280 | Southwest Dump | Destroyed (2008) |

| Thermistor | Location | Operational Status |
|-------------------|------------------------|---------------------------|
| WDT – 1 | Water Storage Pond Dam | Operational |
| WDT – 2 | Water Storage Pond Dam | Operational |
| WDT – 3 | Water Storage Pond Dam | Operational |
| WDT – 4 | Water Storage Pond Dam | Operational |
| WDT – 5 | Water Storage Pond Dam | Operational |
| WDT – 6 | Water Storage Pond Dam | Operational |
| WDT – 7 | Water Storage Pond Dam | Operational |
| WDT – 8 | Water Storage Pond Dam | Operational |

6.5.1 DSTSF Thermistors

Data collected from DSTSF thermistors are presented in Figure 6-8 through Figure 6-13. Data are collected quarterly. No major changes to ground temperatures at the DSTSF were observed in 2017.

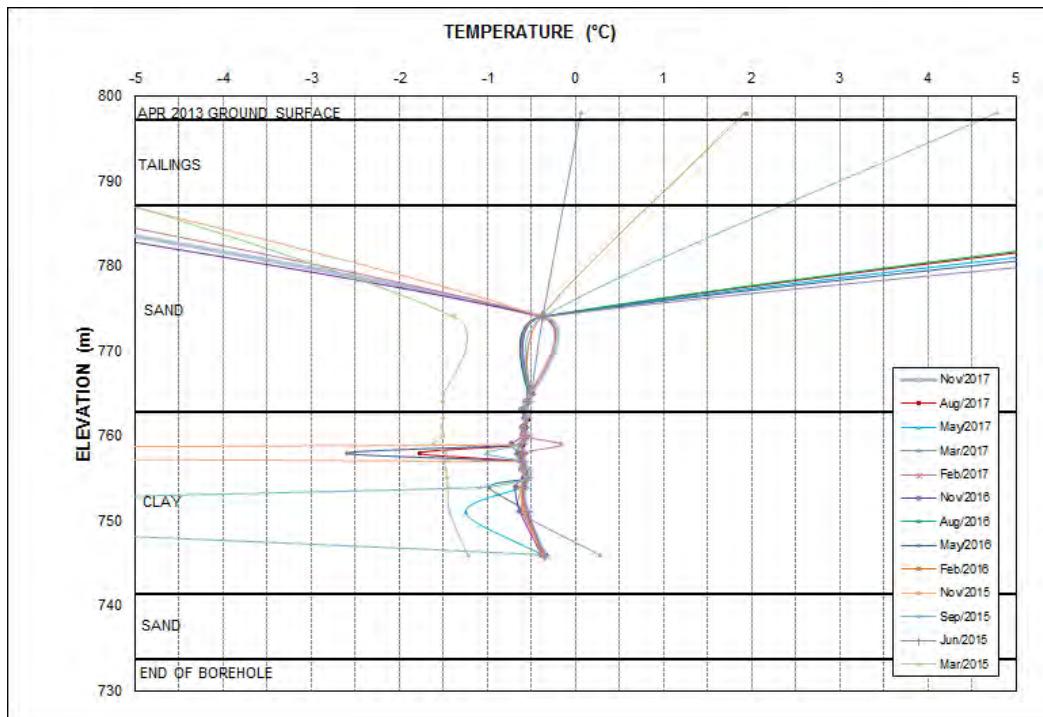


Figure 6-8: Thermistor DST-10 (2015-2017)

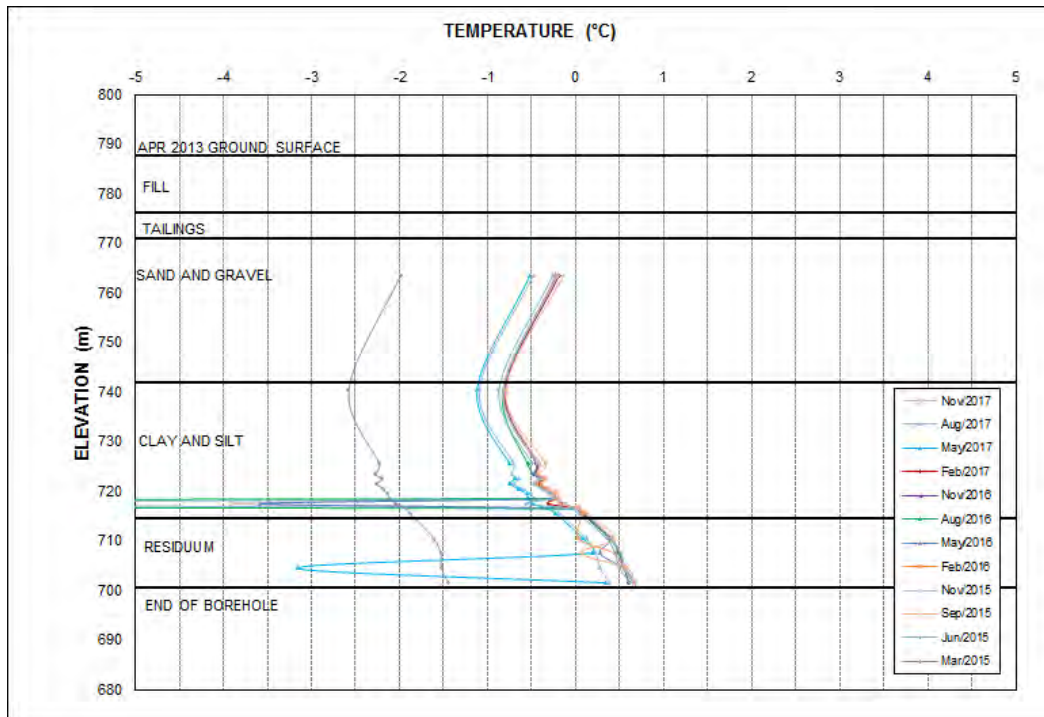


Figure 6-9: Thermistor DST-11 (2015-2017)

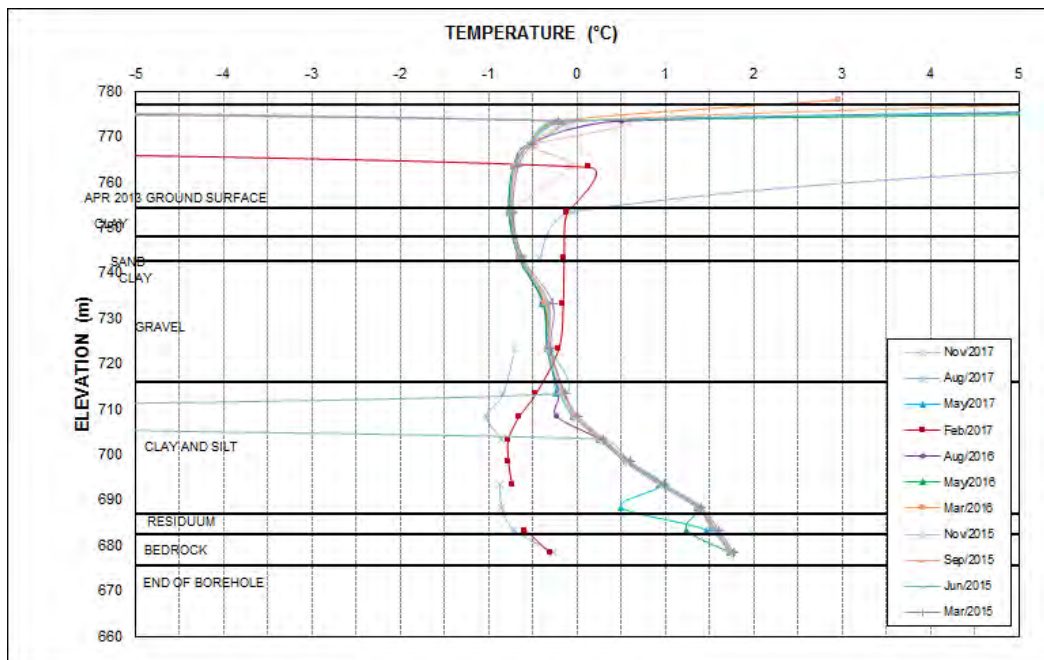


Figure 6-10: Thermistor DST-13 (2015-2017)

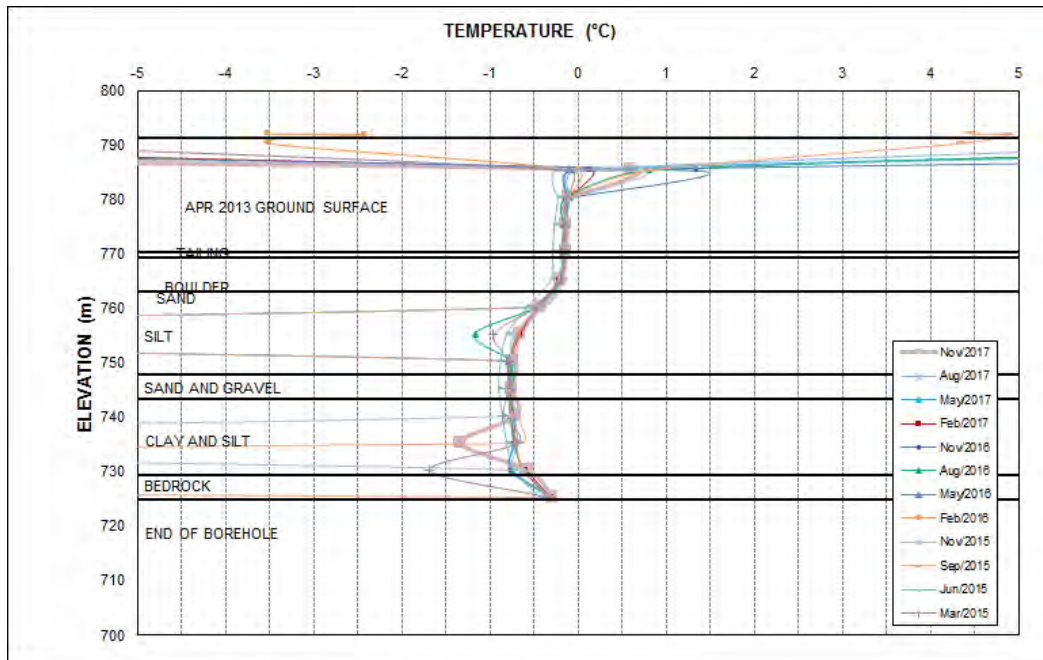


Figure 6-11: Thermistor DST-14 (2015-2017)

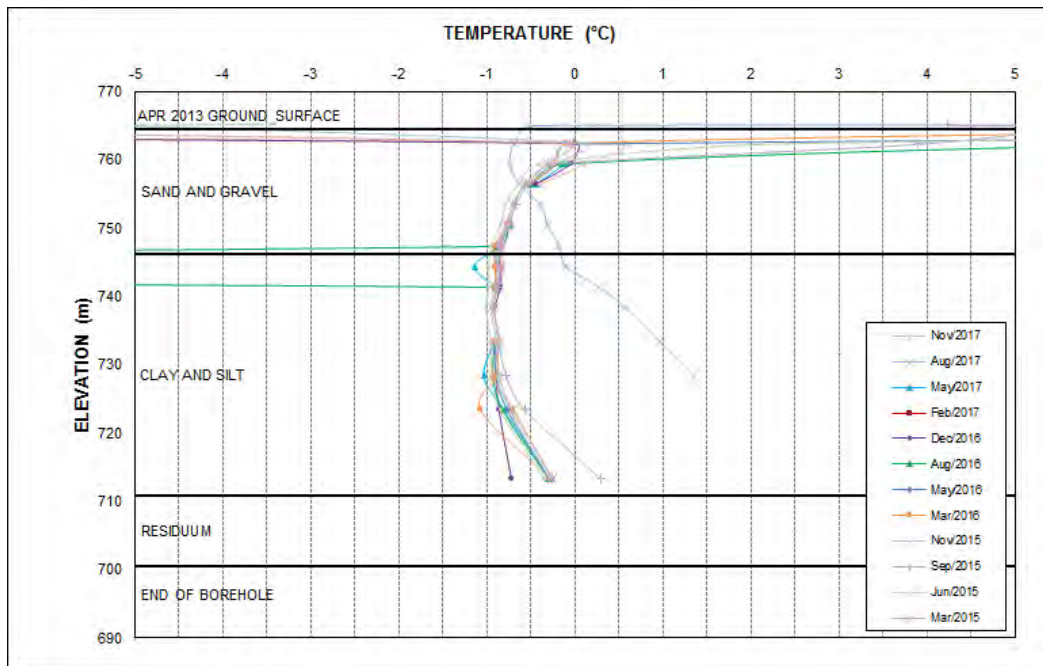


Figure 6-12: Thermistor DST-15 (2015-2017)

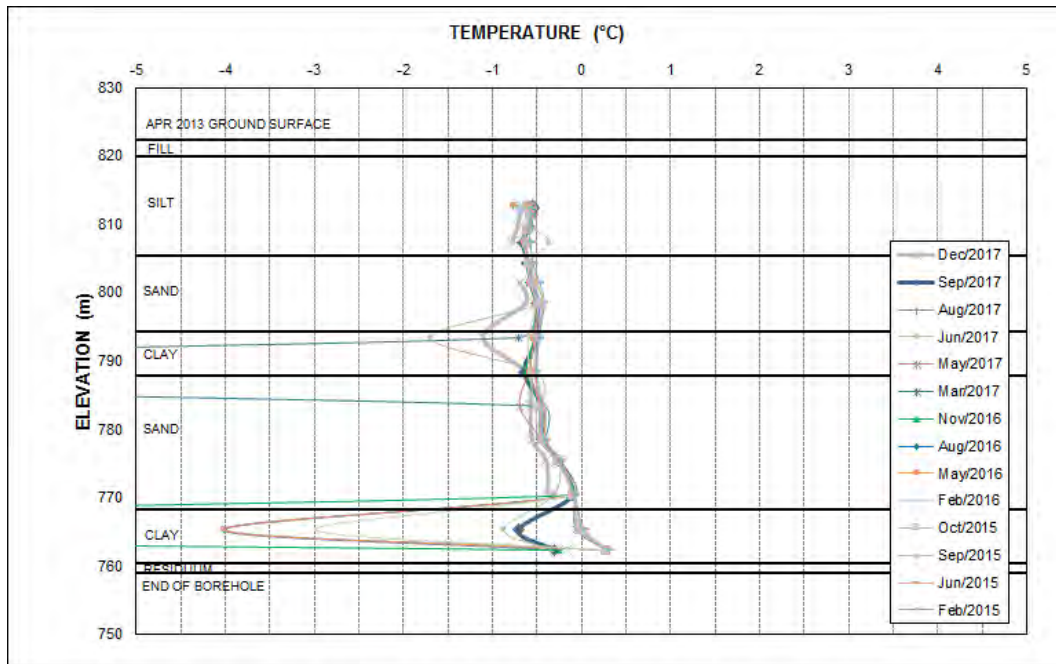


Figure 6-13: Thermistor AT2-1 (2015-2017)

6.5.2 Ridgetop Thermistors

Data collection has reduced to annually for both Ridgetop thermistors. No major changes to ground temperatures at the Ridgetop were observed in 2017.

6.5.3 Southwest Dump Thermistors

Data collected from SWD thermistors are presented in Figure 6-14 through 6-17. Data are collected quarterly. No major changes to ground temperatures at the SWD were observed in 2017.

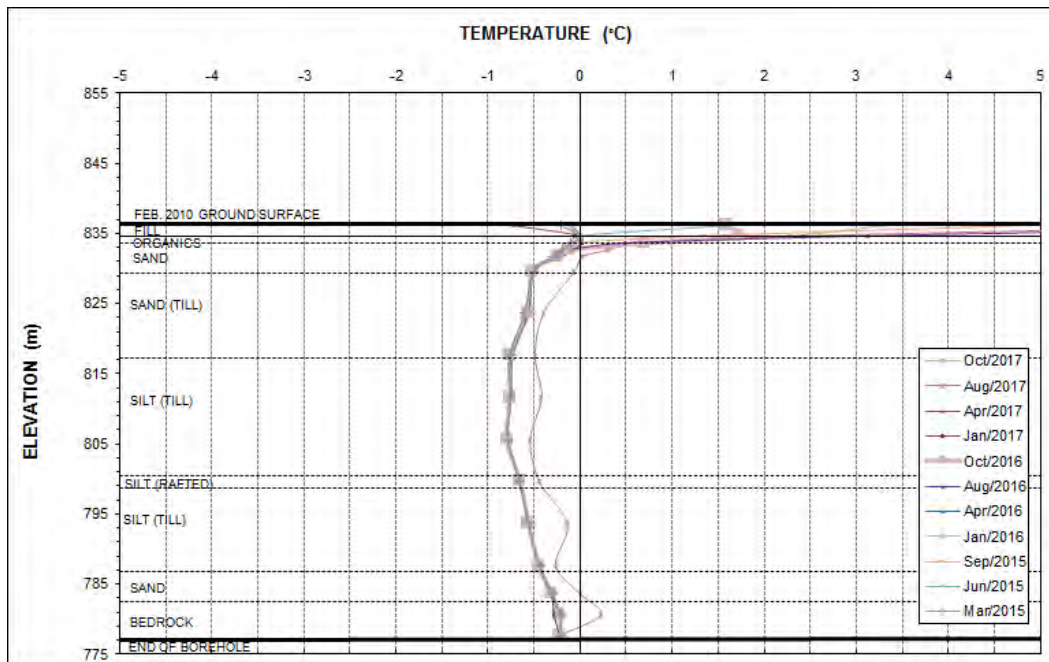


Figure 6-14: Thermistor SDT-1 (2015-2017)

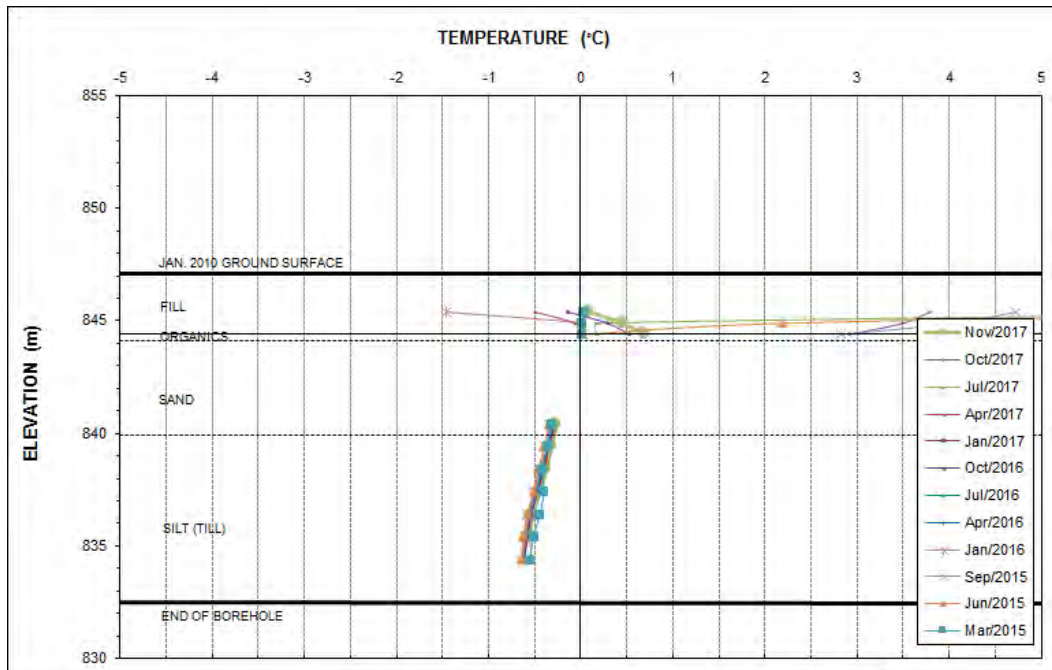


Figure 6-15: Thermistor SDT-2 (2015-2017)

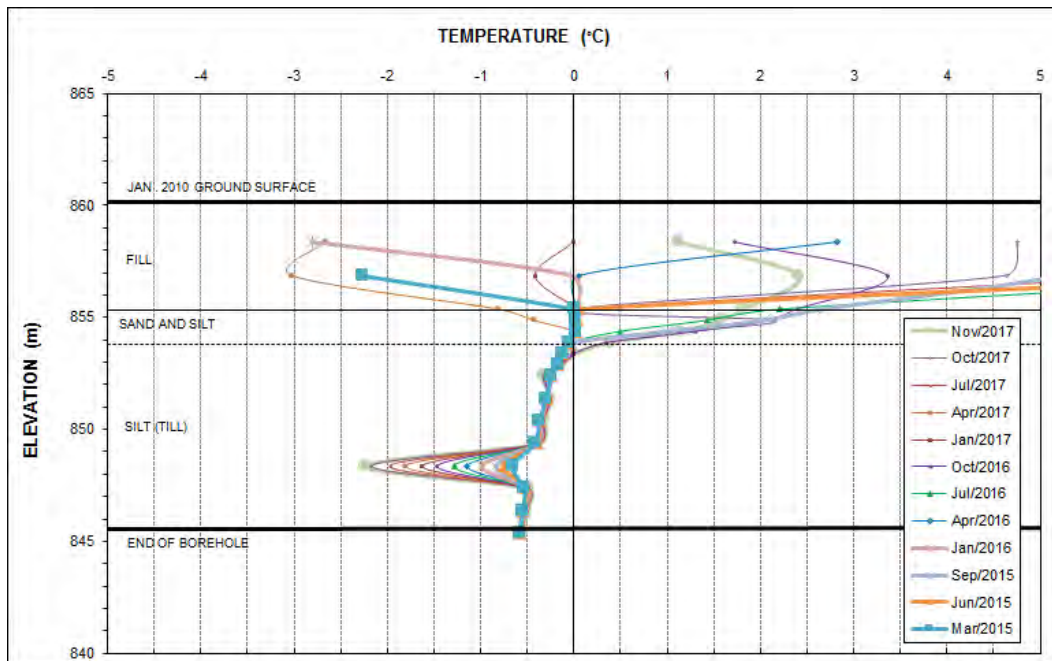


Figure 6-16: Thermistor SDT-3 (2015-2017)

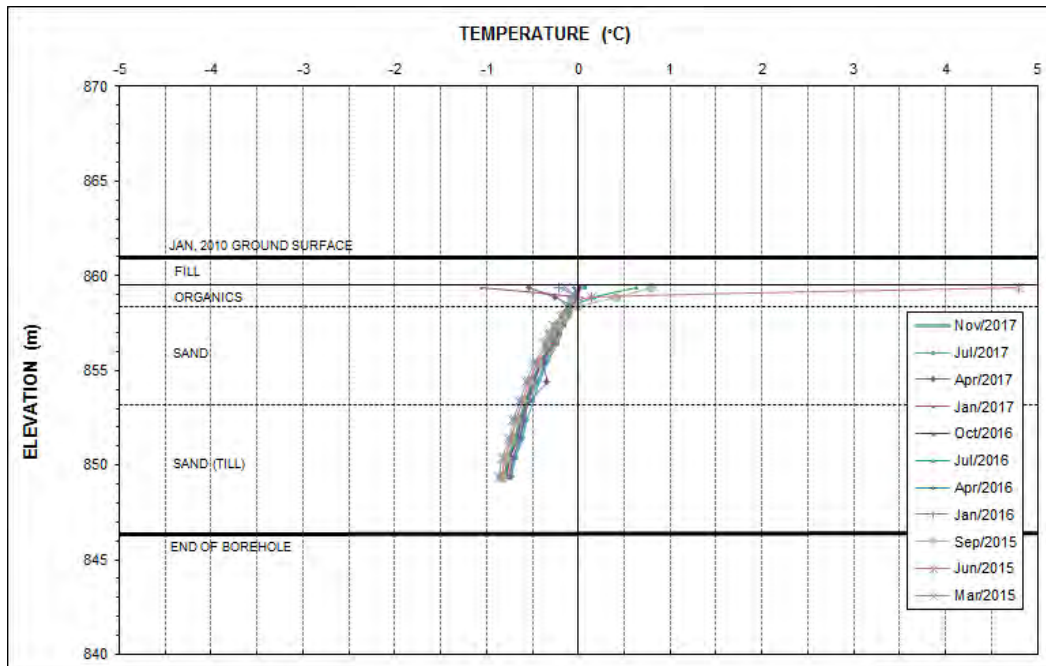


Figure 6-17: Thermistor SDT-4 (2014-2017)

6.5.4 Water Storage Pond Dam Thermistors

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

7 Seepage Water Quality Monitoring Program

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

Seepage monitoring conducted in 2017 was carried out in accordance with the EMSRP. The EMSRP states that seepage surveys will be conducted twice a year, during spring runoff and in early fall, by walking the toe of each waste dump, stockpile or other areas of interest. The survey route for each seepage monitoring event are recorded using the tracking function of a GPS. A map showing the 2017 survey routes and monitoring locations can be found in Figure 7-1.

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

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

Observations from the 2017 Seepage Monitoring Program indicate that many seepage sites identified are seasonally variable. It has also been observed that weather patterns have an impact, where snow melt or rain contribute to observable flows that are absent during warm, dry weather. Analysis of seepage results and water quality analysis assists in improving understanding of water chemistry, load, and water balance issuing from waste dumps, overburden dumps, ore stockpiles, and tailings facilities.

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

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



MINTO MINE



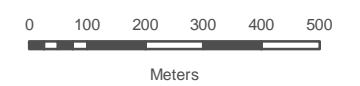
**SEEPAGE MONITORING PROGRAM
ANNUAL REPORT**

**FIGURE 7-1
2017 SEEPAGE
MONITORING PROGRAM**

OCTOBER 2017

- Fall 2017 Seepage Survey Monitoring Stations
- Spring 2017 Seepage Survey Monitoring Stations
- Spring 2017 Seep Survey Lines
- Fall 2017 Seep Survey Lines

1:13,000
when printed on 11 x 17 inch paper



Aerial imagery obtained from Challenger Geomatics. Imagery acquired August 9th 2017.

Datum: NAD 83 Projection: UTM Zone 8N

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7.1 Mill Valley Fill

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

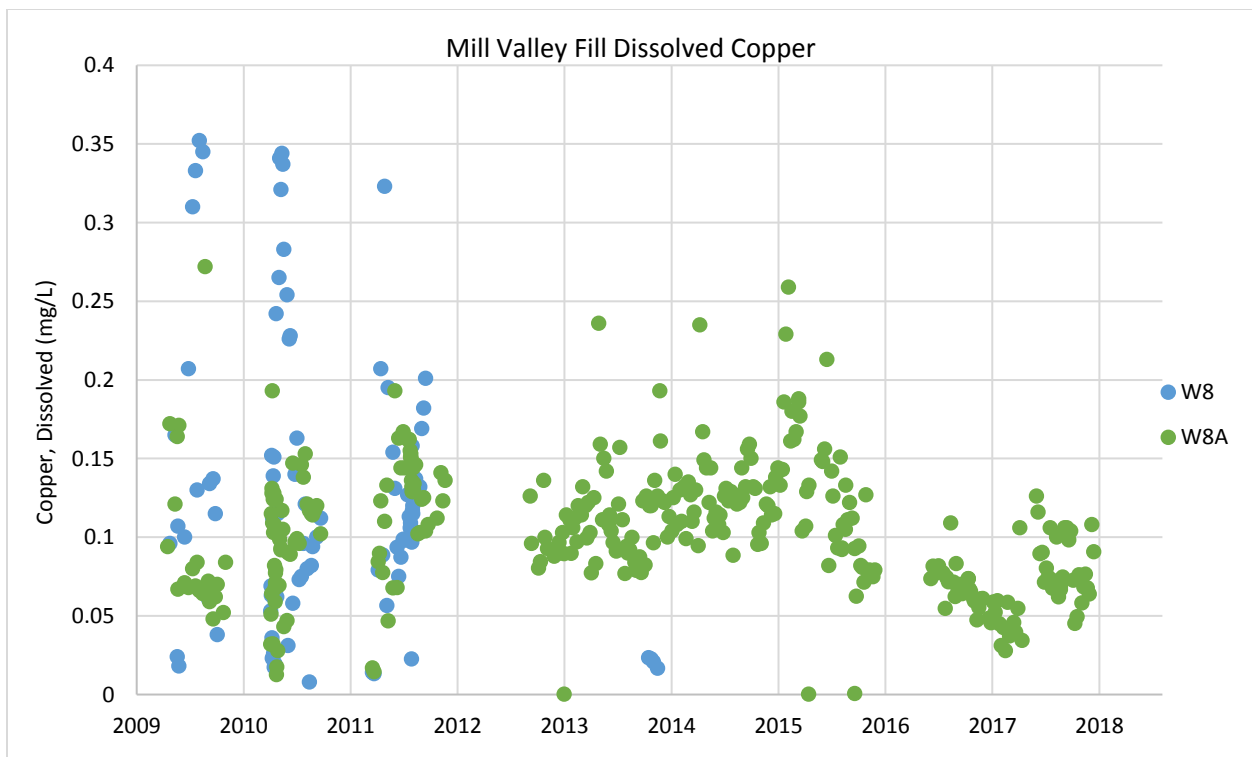


Figure 7-2: Mill Valley Fill Dissolved Copper

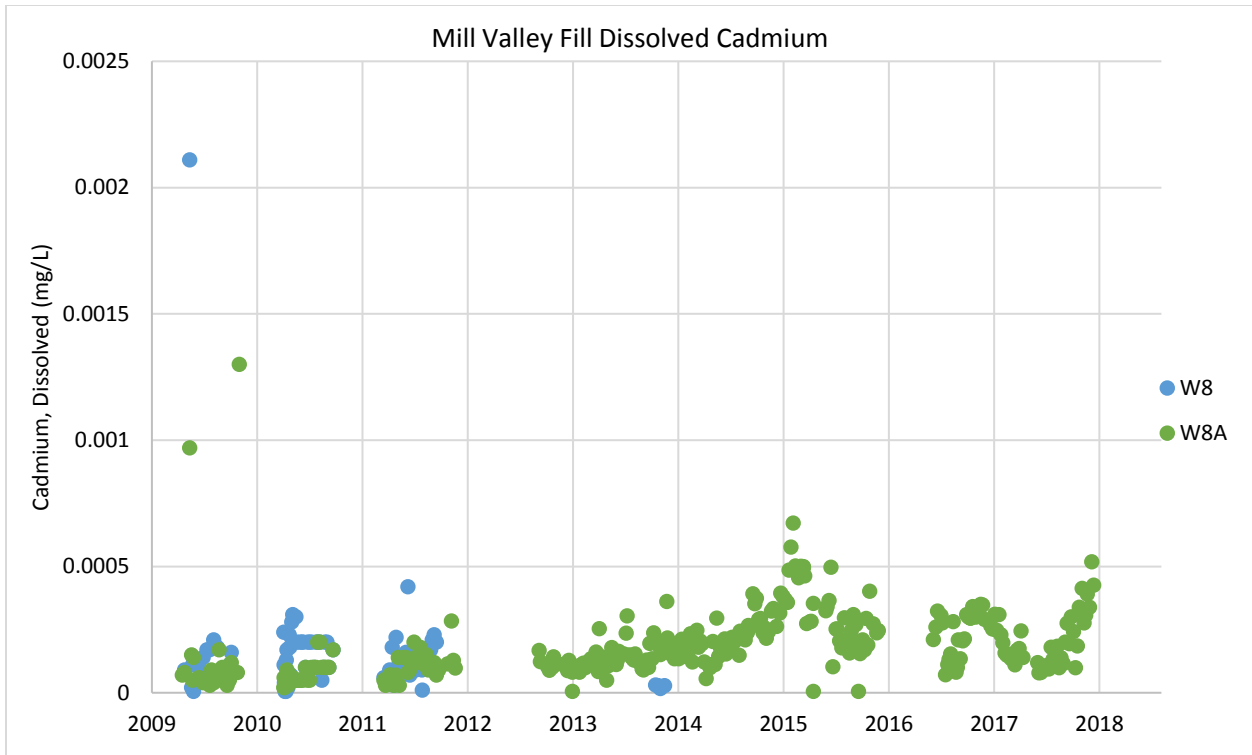


Figure 7-3: Mill Valley Fill Dissolved Cadmium

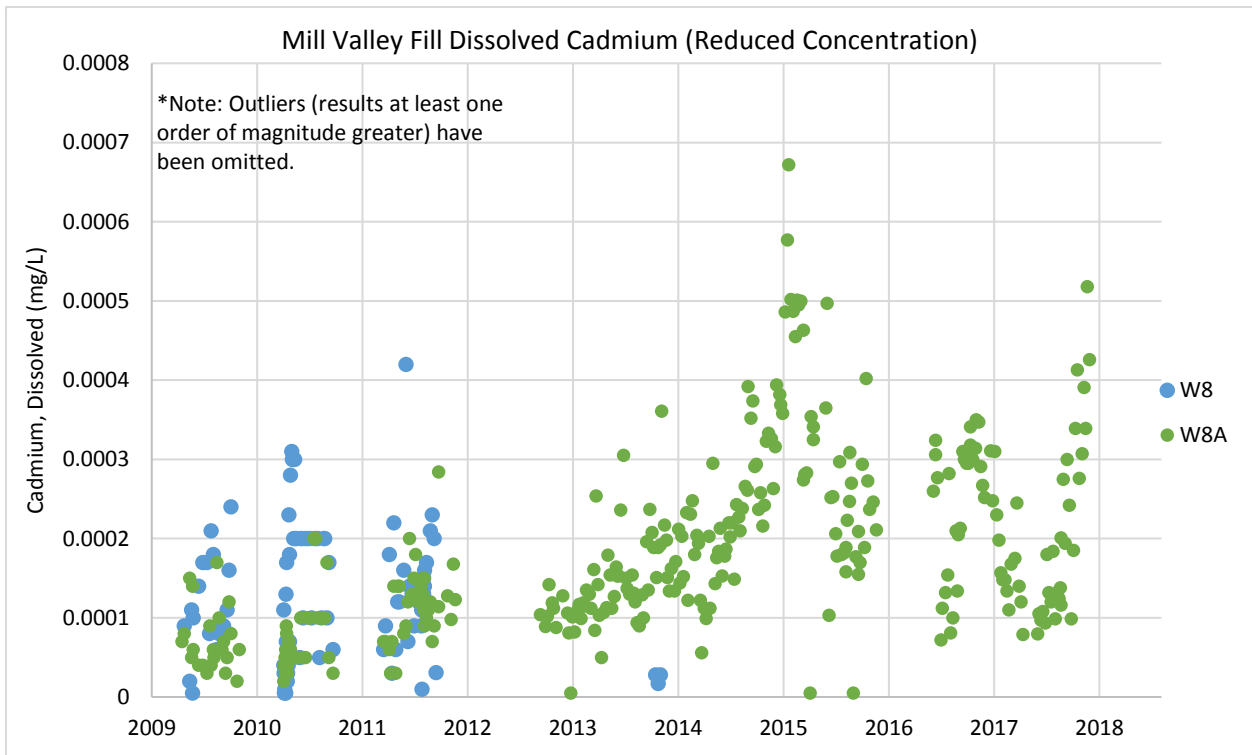


Figure 7-4: Mill Valley Fill Dissolved Cadmium (Reduced Concentration)

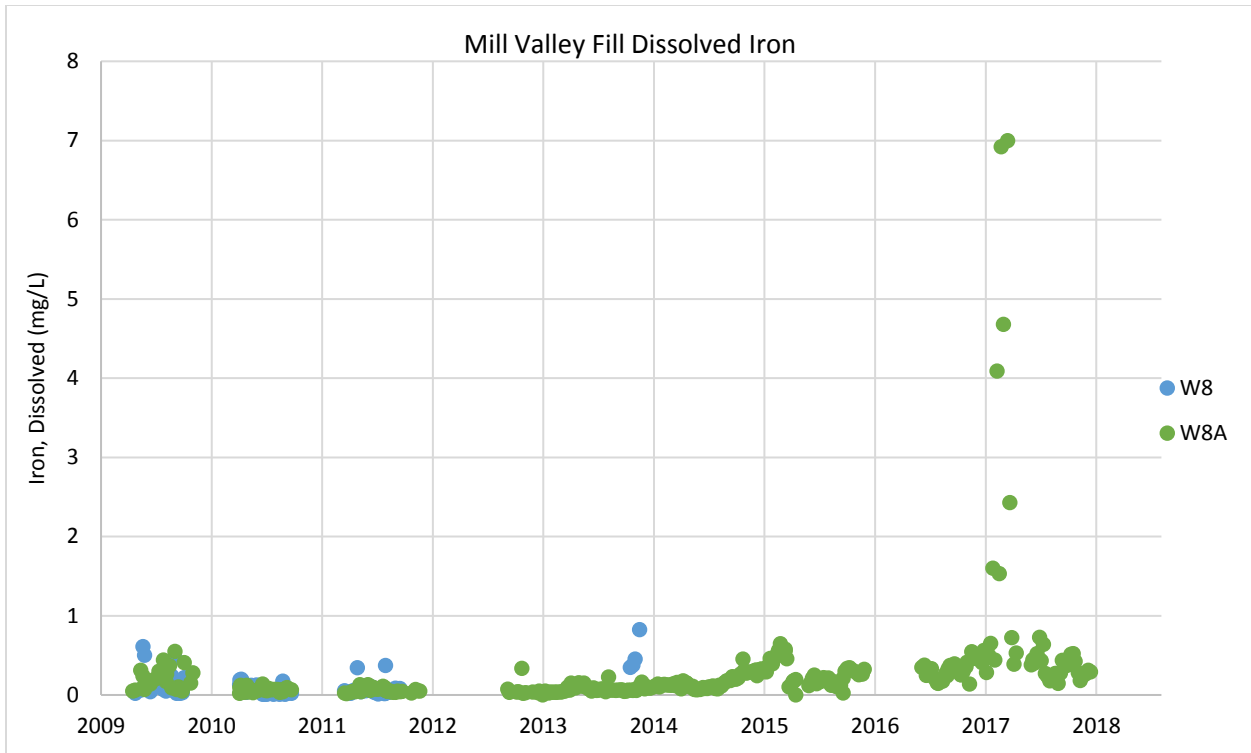


Figure 7-5: Mill Valley Fill Dissolved Iron

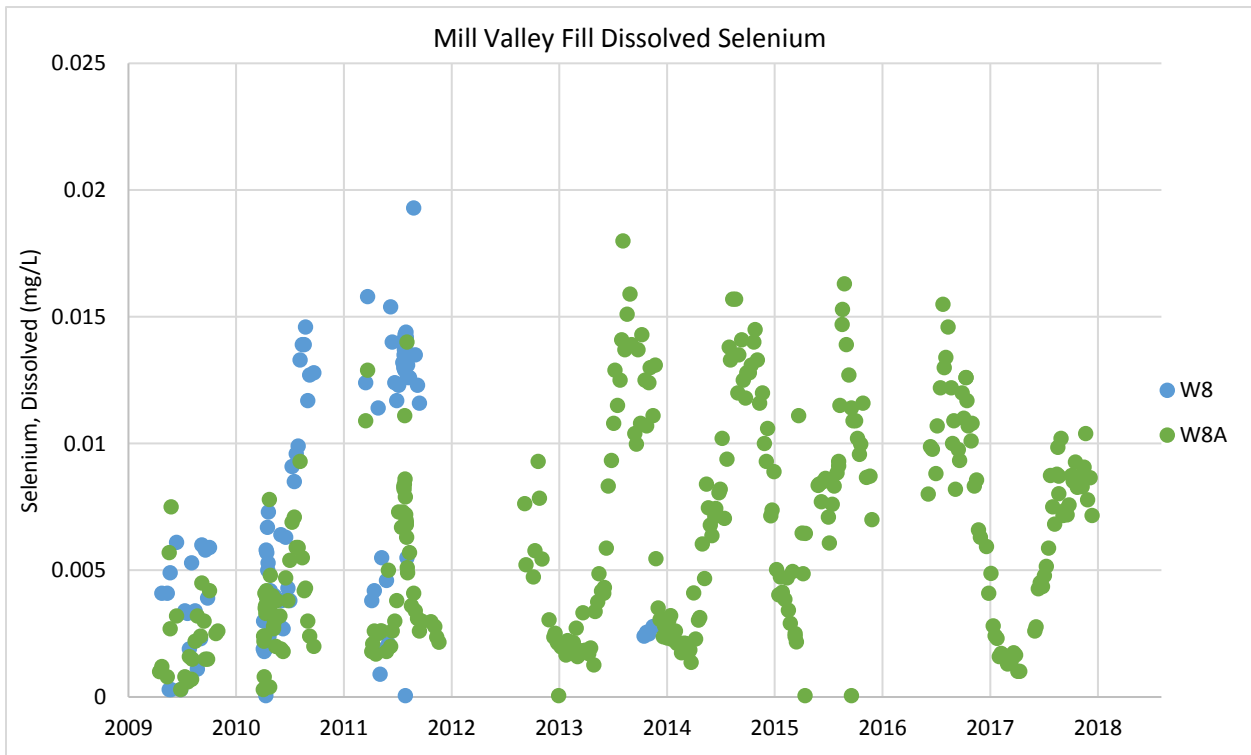


Figure 7-6: Mill Valley Fill Dissolved Selenium

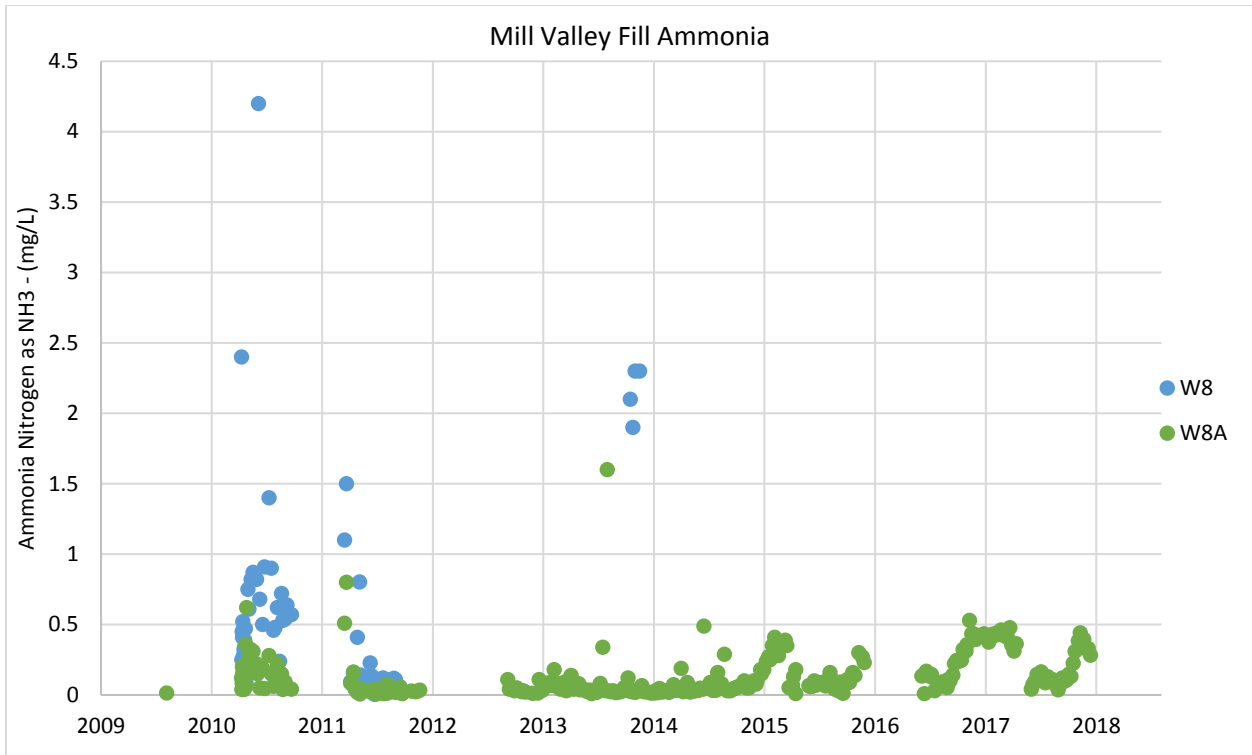


Figure 7-7: Mill Valley Fill Ammonia

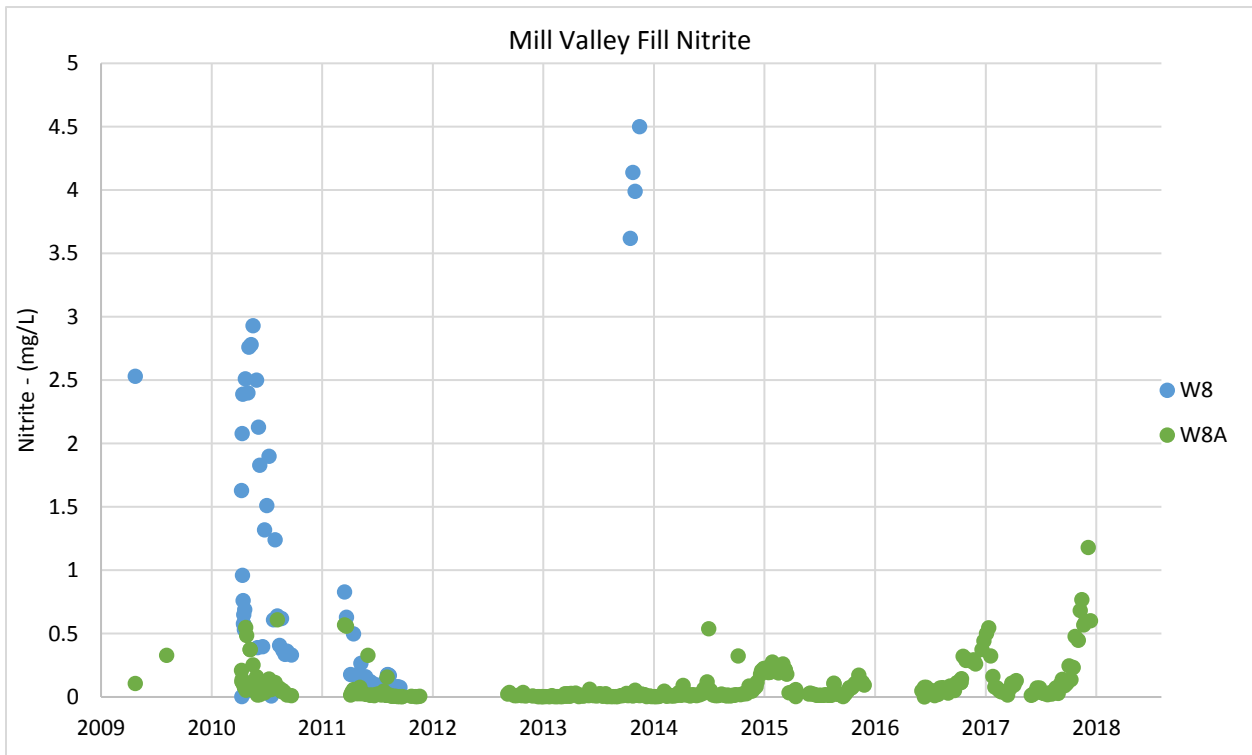


Figure 7-8: Mill Valley Fill Nitrite

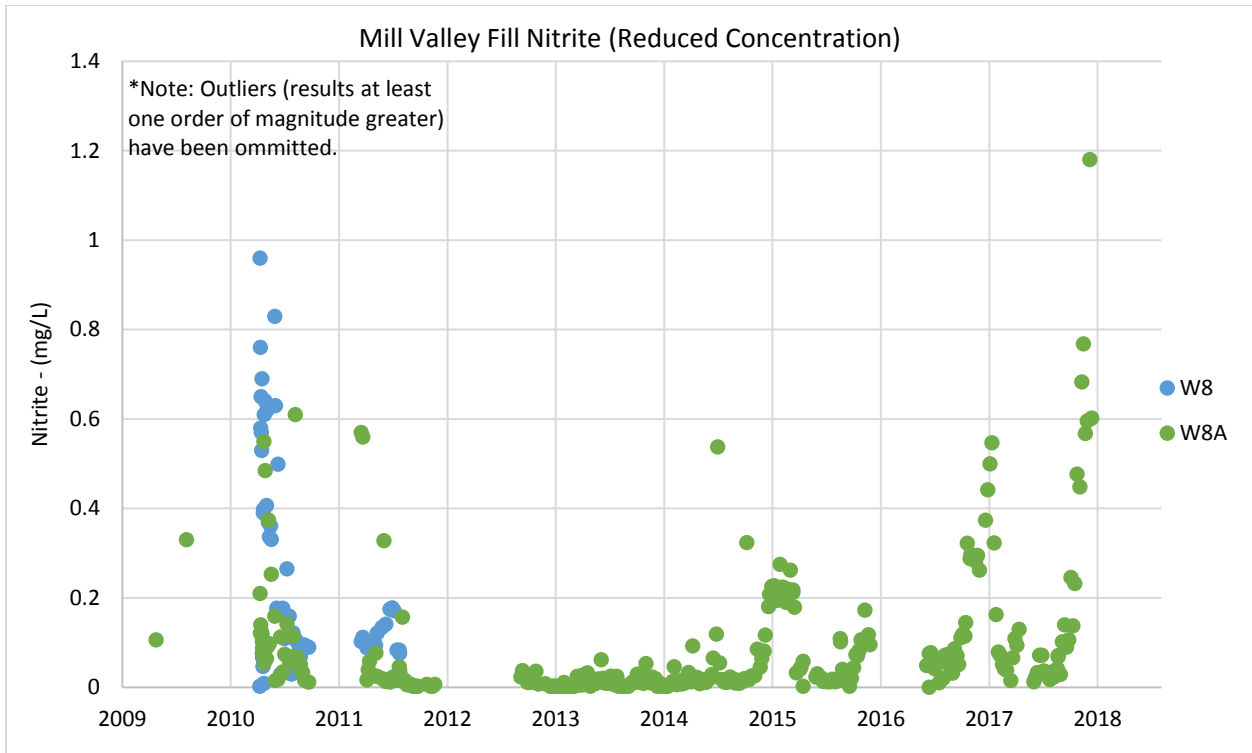


Figure 7-9: Mill Valley Fill Nitrite (Reduced Concentration)

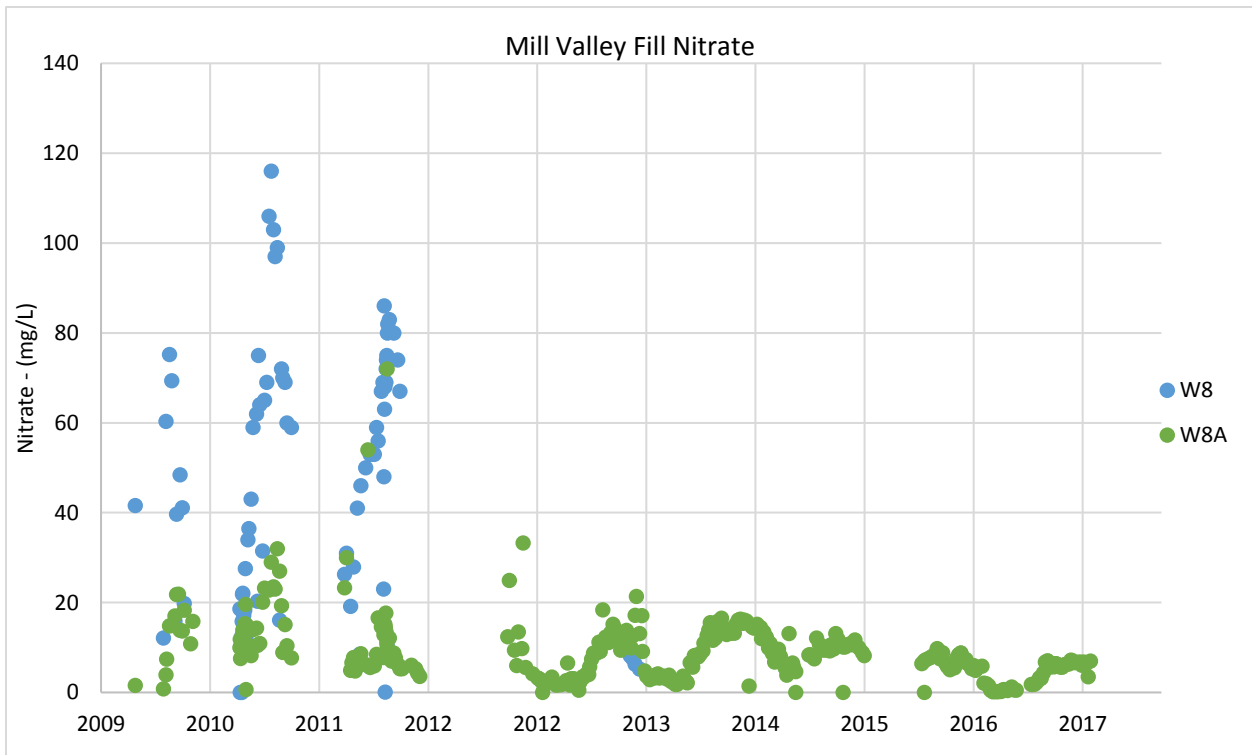


Figure 7-10: Mill Valley Fill Nitrate

7.2 Southwest Dump

Seepage was collected at stations SS1, SS28, SS29, SS30, SS31, SS43, SS44, SS48, SS49, SS51, and SS52, SS54, SS56, SS57 and SS63. Additionally, W32, W38, W39 and W40 were monitored during the summer season. Samples are taken within $\pm 5\text{m}$ of the original GPS point. If there is no seepage within the 5m buffer, the site is considered dry during that sampling session. SS54, SS56 and SS57 were seepage sites newly discovered in spring of 2017 and SS63 was discovered in fall 2017. Water quality results from the 2017 survey program for W38 and W39, as well as W32 and W40 historical data, are presented in Figure 7-11 to 7-18. Historical data and 2017 seepage water quality results for SS1, SS13, SS21, SS22, SS28, SS29, SS30, SS31, SS39, SS43, SS44, SS48, SS49, SS50, SS51, SS52, SS54, SS556 and SS57 are summarized in Figure 7-19 to Figure 7-39. Data was separated between the north (SS1, SS21, SS28, SS29, SS54 and SS56), the south end of the southwest dump (SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52, and SS57) and the ice rich overburden dump seep (SS48, SS49 and SS63). The figures include water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

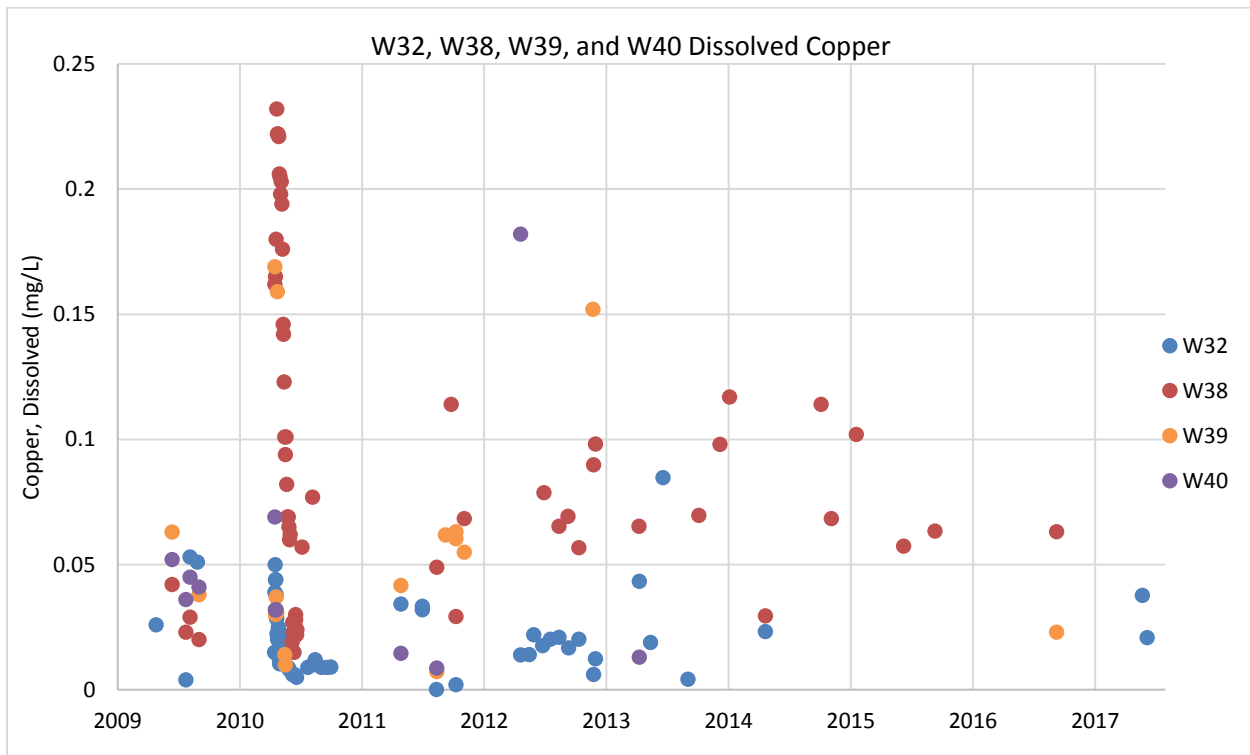


Figure 7-11: W32, W38, W39, and W40 Dissolved Copper

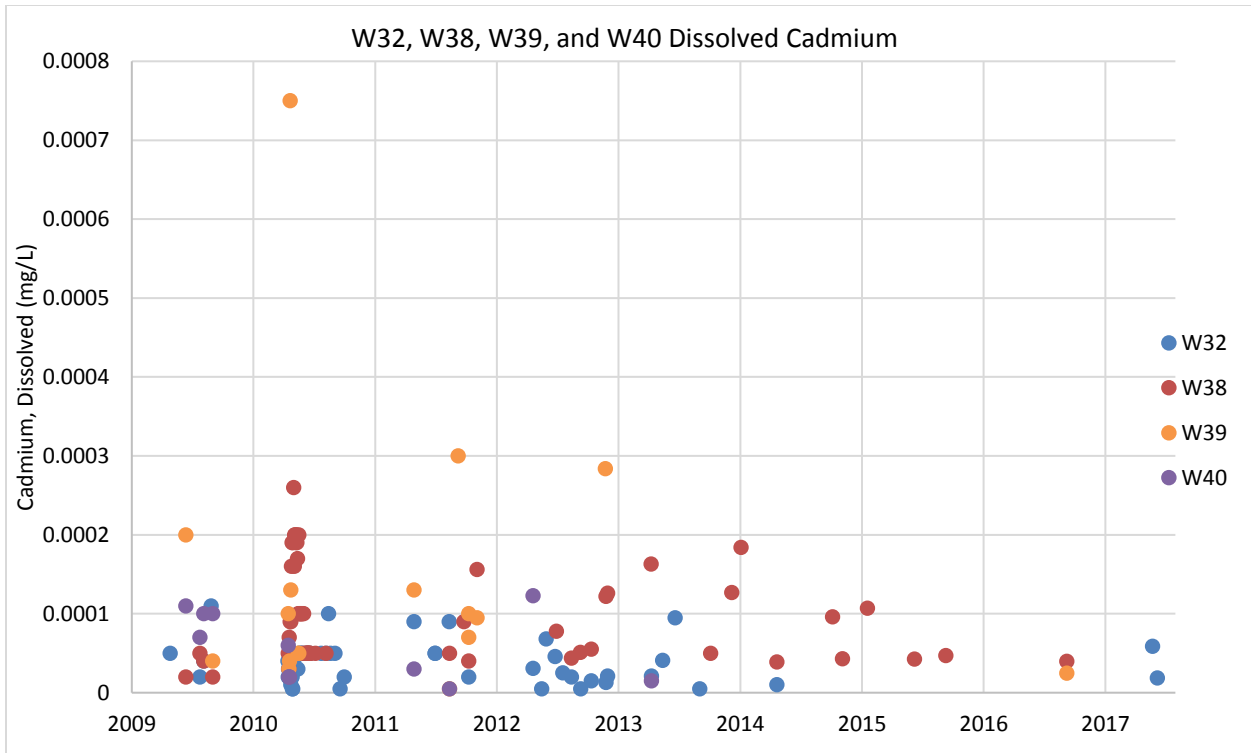


Figure 7-12: W32, W38, W39, and W40 Dissolved Cadmium

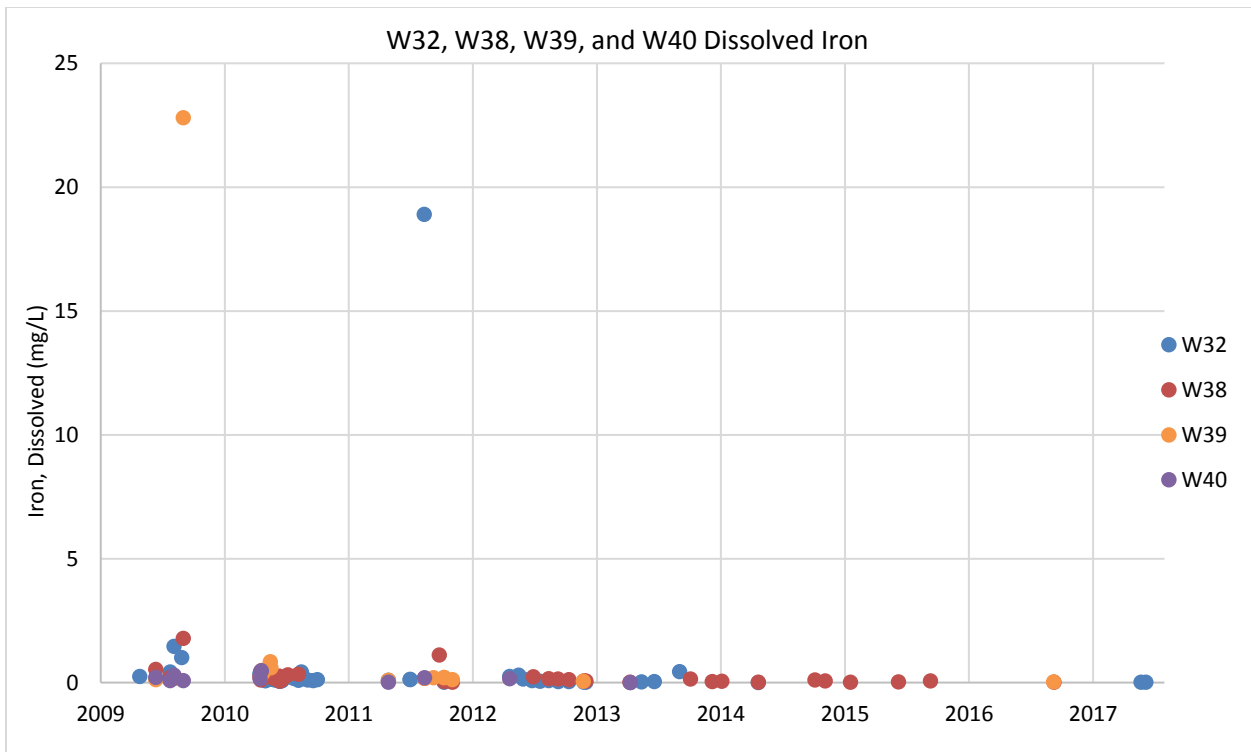


Figure 7-13: W32, W38, W39, and W40 Dissolved Iron

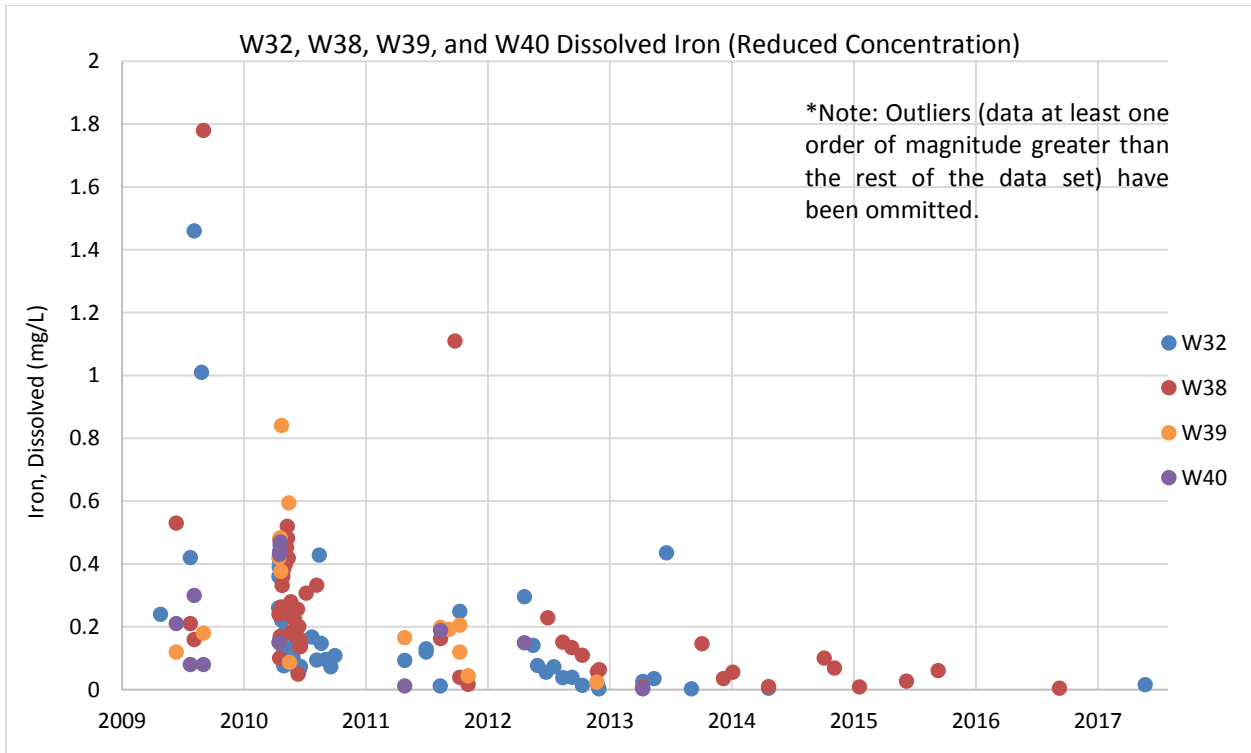


Figure 7-14: W32, W38, W39, and W40 Dissolved Iron (Reduced Concentration)

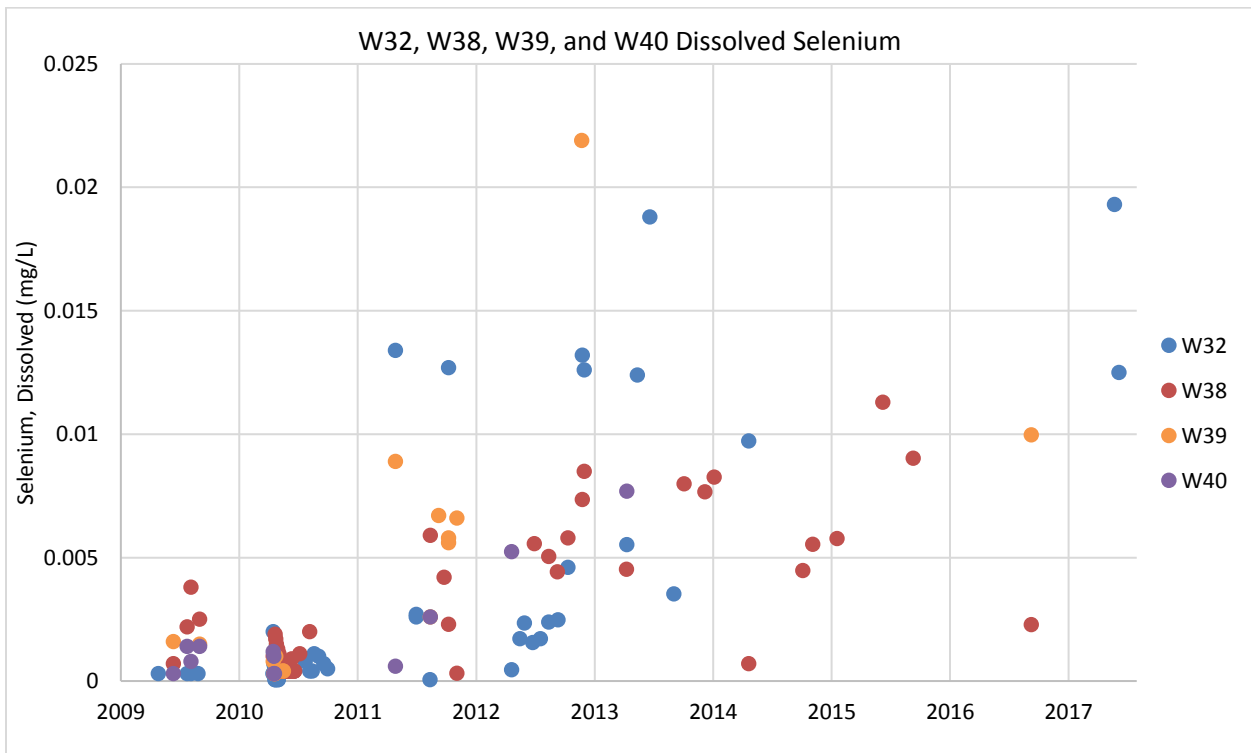


Figure 7-15: W32, W38, W39, and W40 Dissolved Selenium

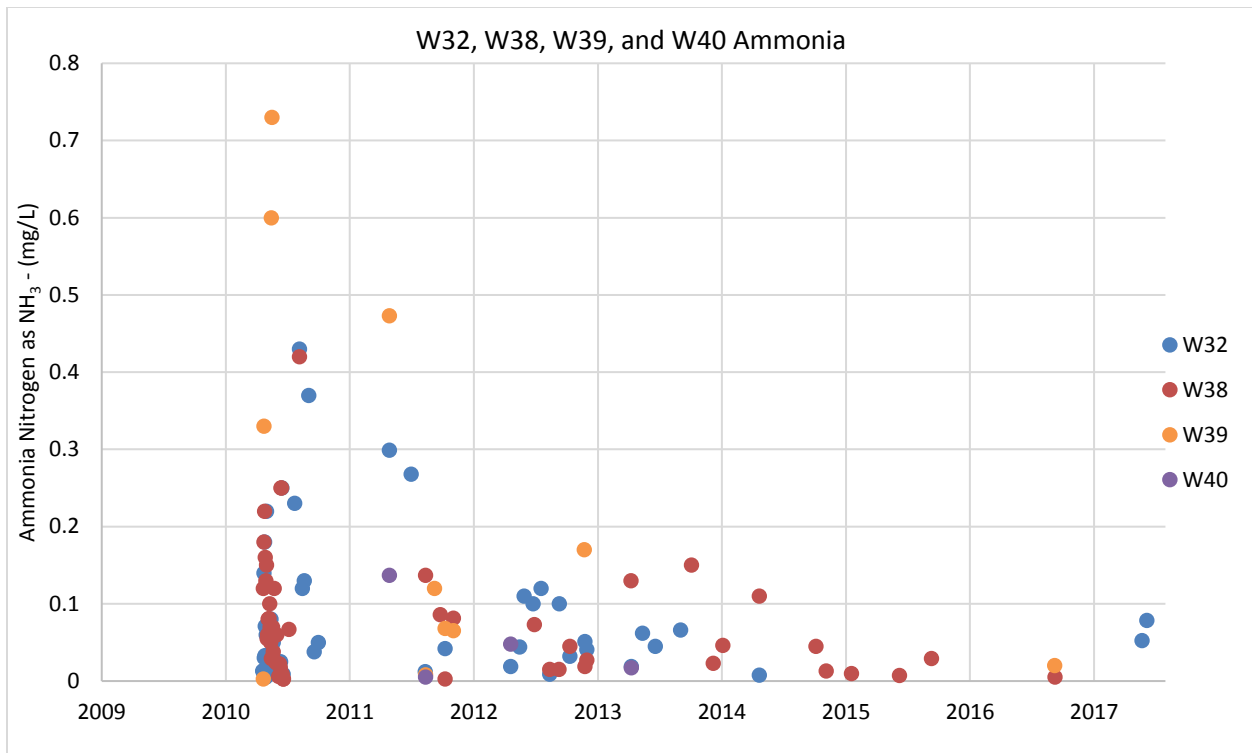


Figure 7-16: W32, W38, W39, and W40 Ammonia

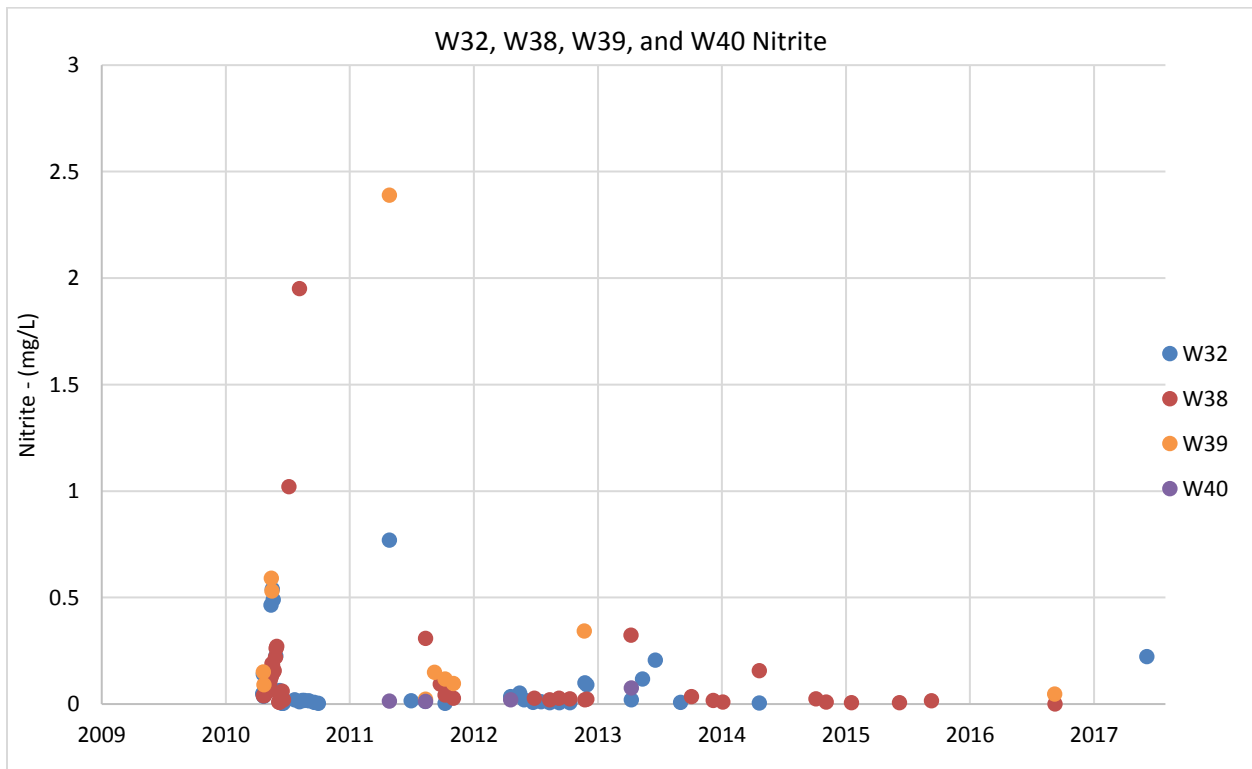


Figure 7-17: W32, W38, W39, and W40 Nitrite

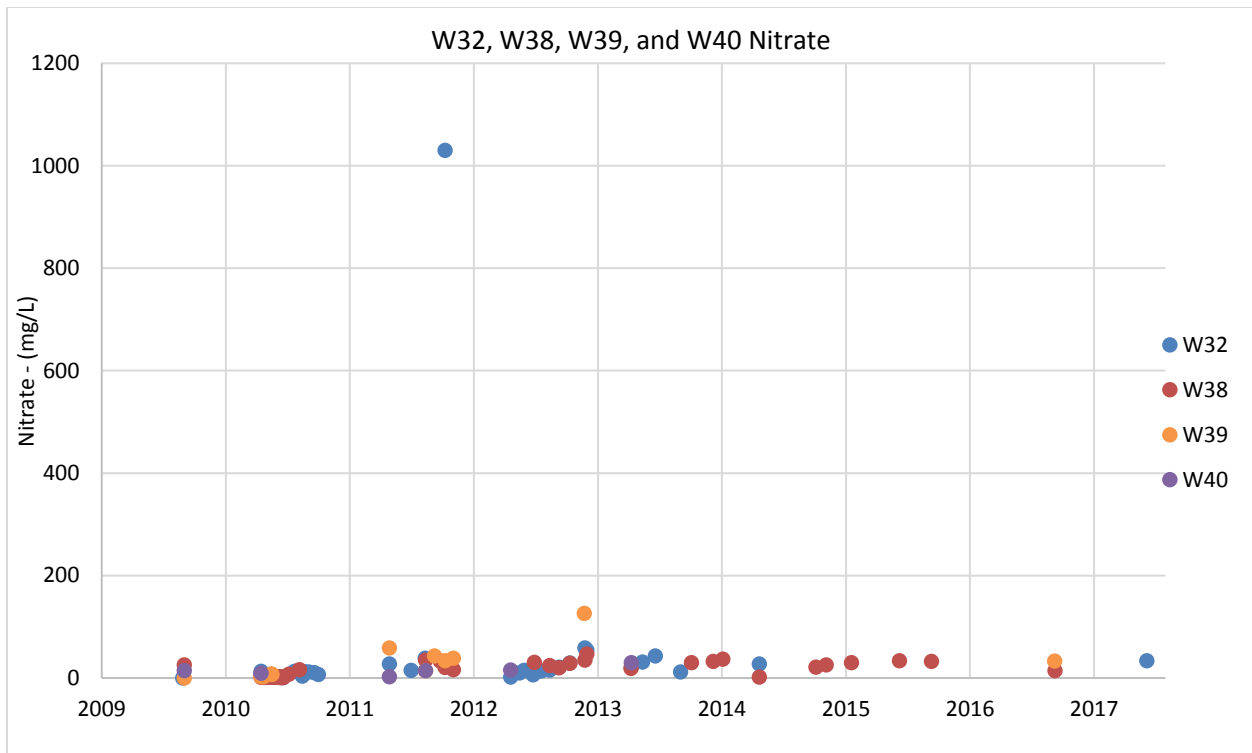


Figure 7-18: W32, W38, W39, and W40 Nitrate

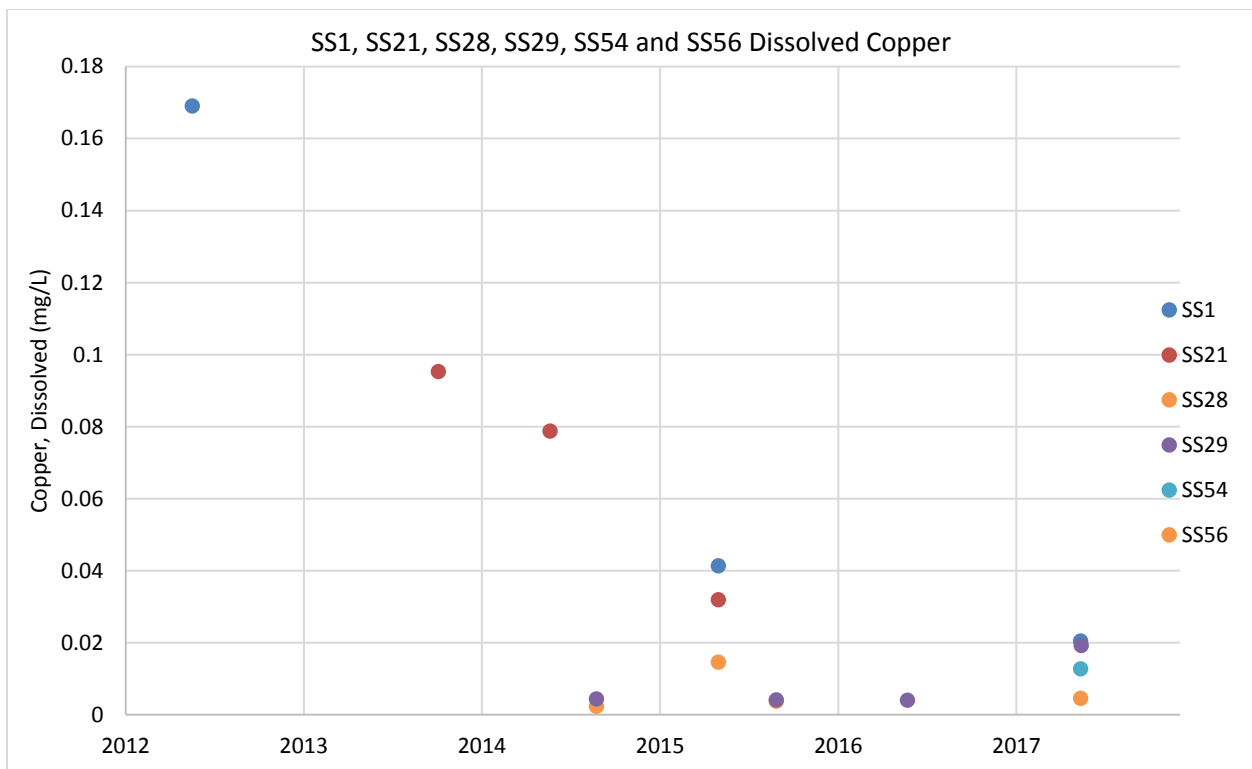


Figure 7-19: SS1, SS21, SS28, SS29, SS54 and SS56 Dissolved Copper

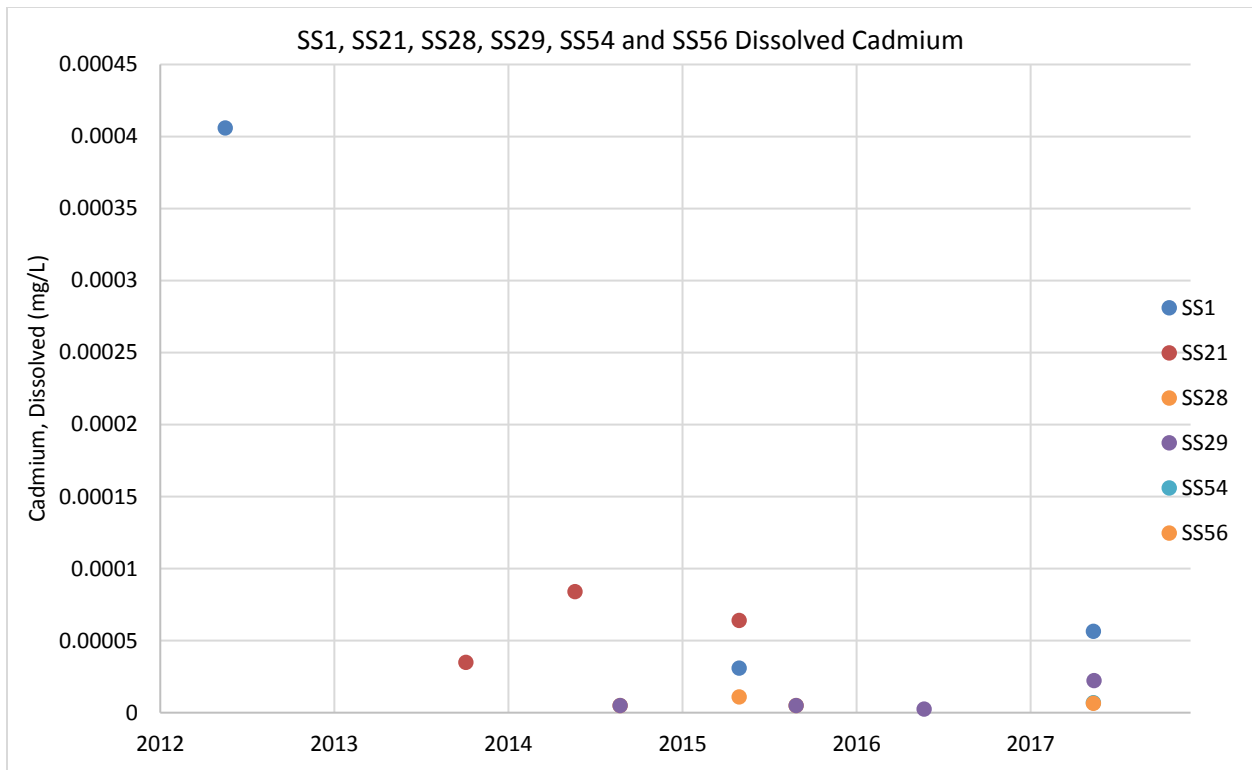


Figure 7-20: SS1, SS21, SS28, SS29, SS54 and SS56 Dissolved Cadmium

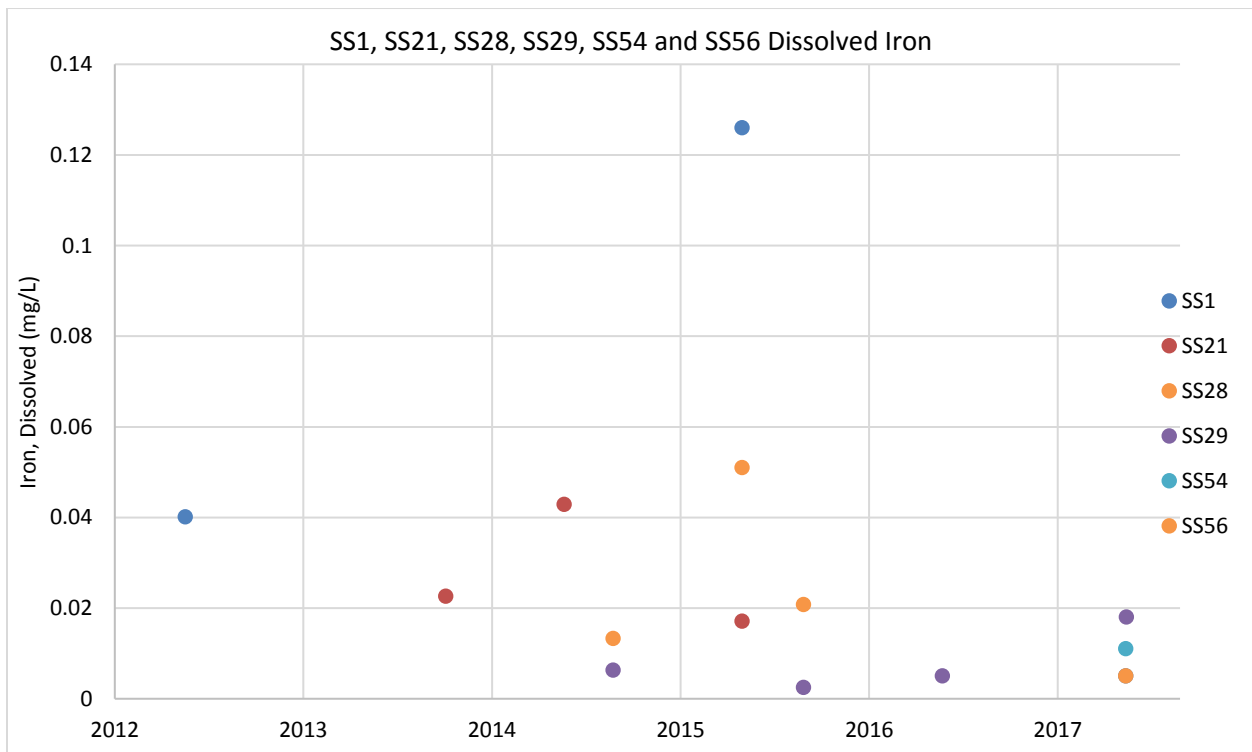


Figure 7-21: SS1, SS21, SS28, SS29, SS54 and SS56 Dissolved Iron

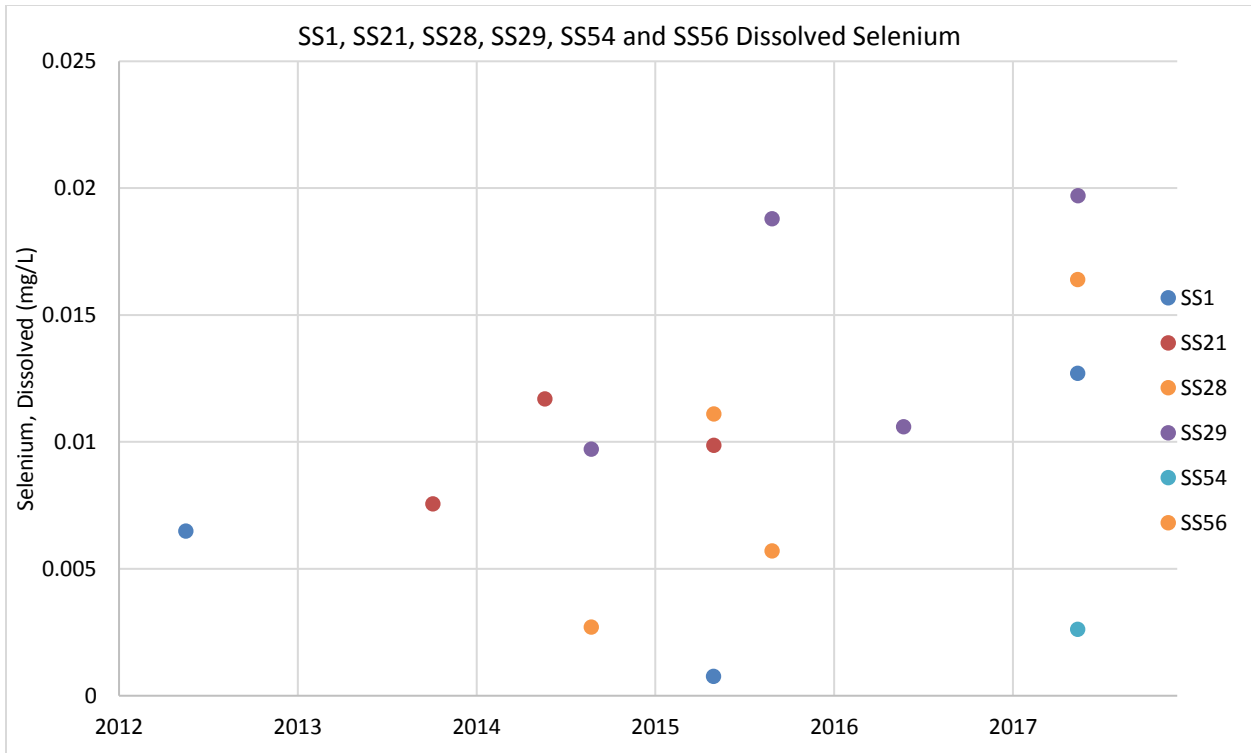


Figure 7-22: SS1, SS21, SS28, SS29, SS54 and SS56 Dissolved Selenium

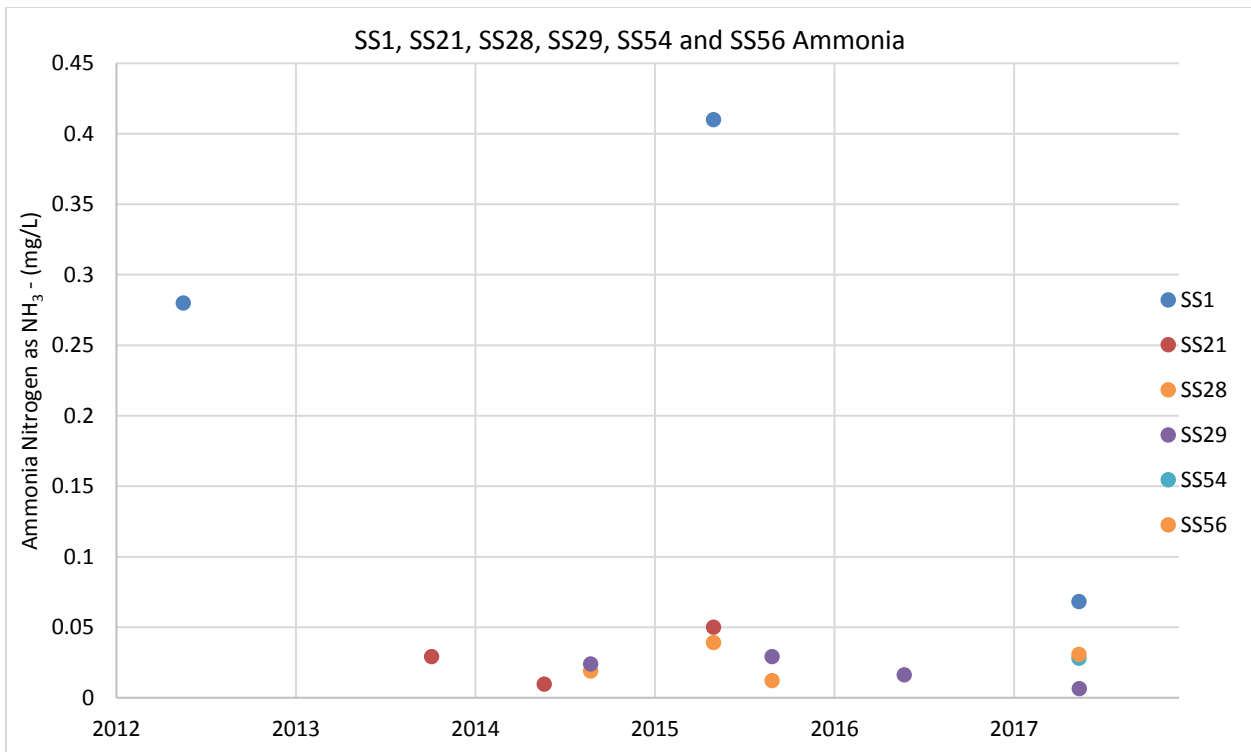


Figure 7-23: SS1, SS21, SS28, SS29, SS54 and SS56 Ammonia

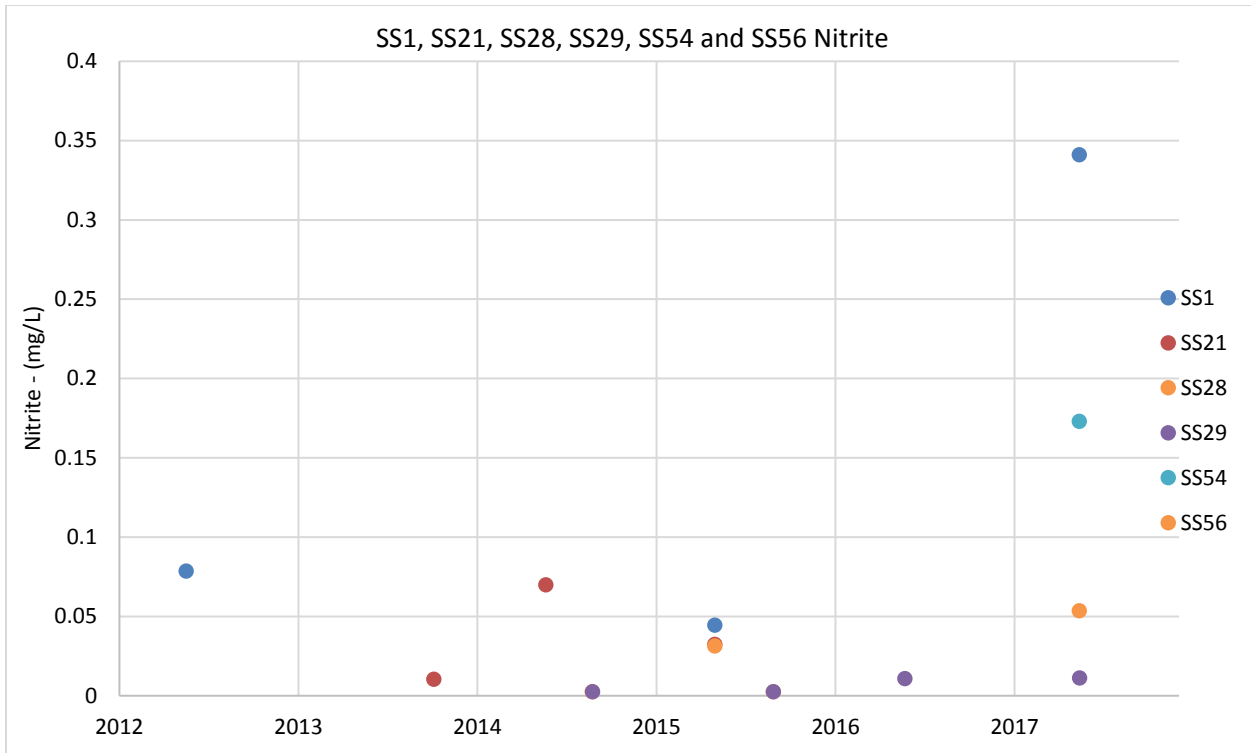


Figure 7-24: SS1, SS21, SS28, SS29, SS54 and SS56 Nitrite

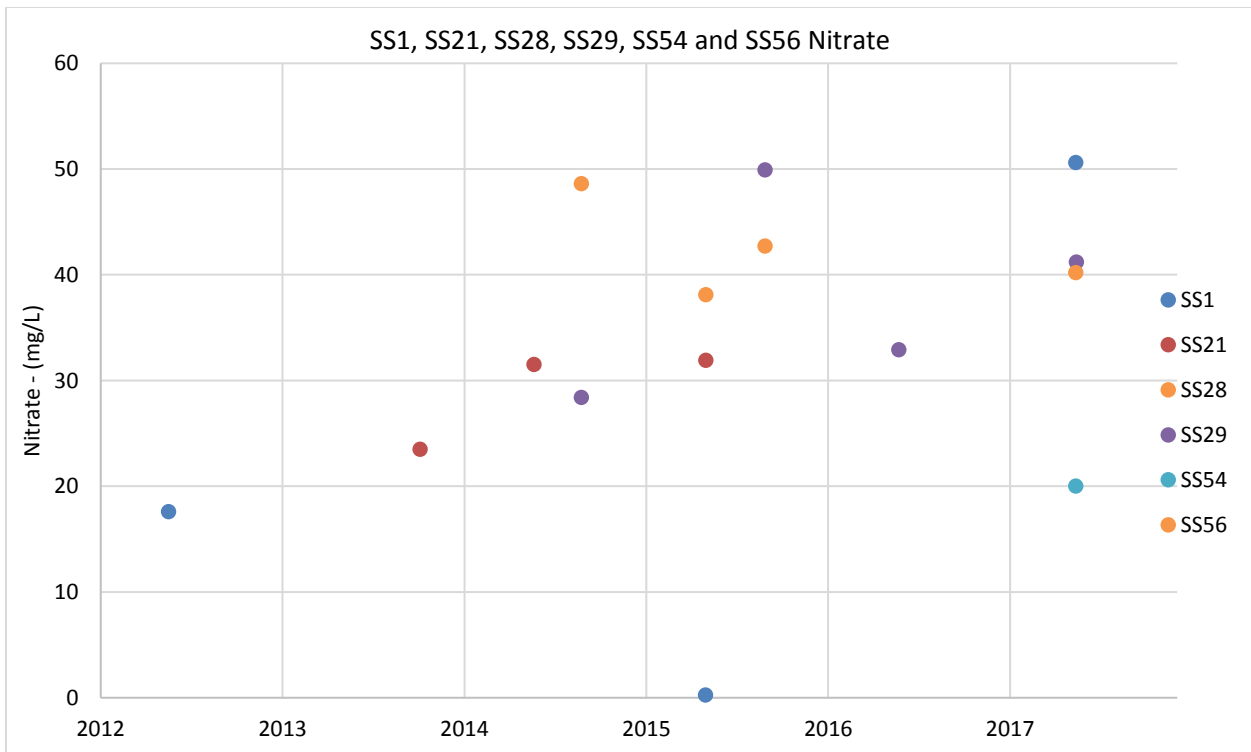


Figure 7-25: SS1, SS21, SS28, SS29, SS54 and SS56 Nitrate

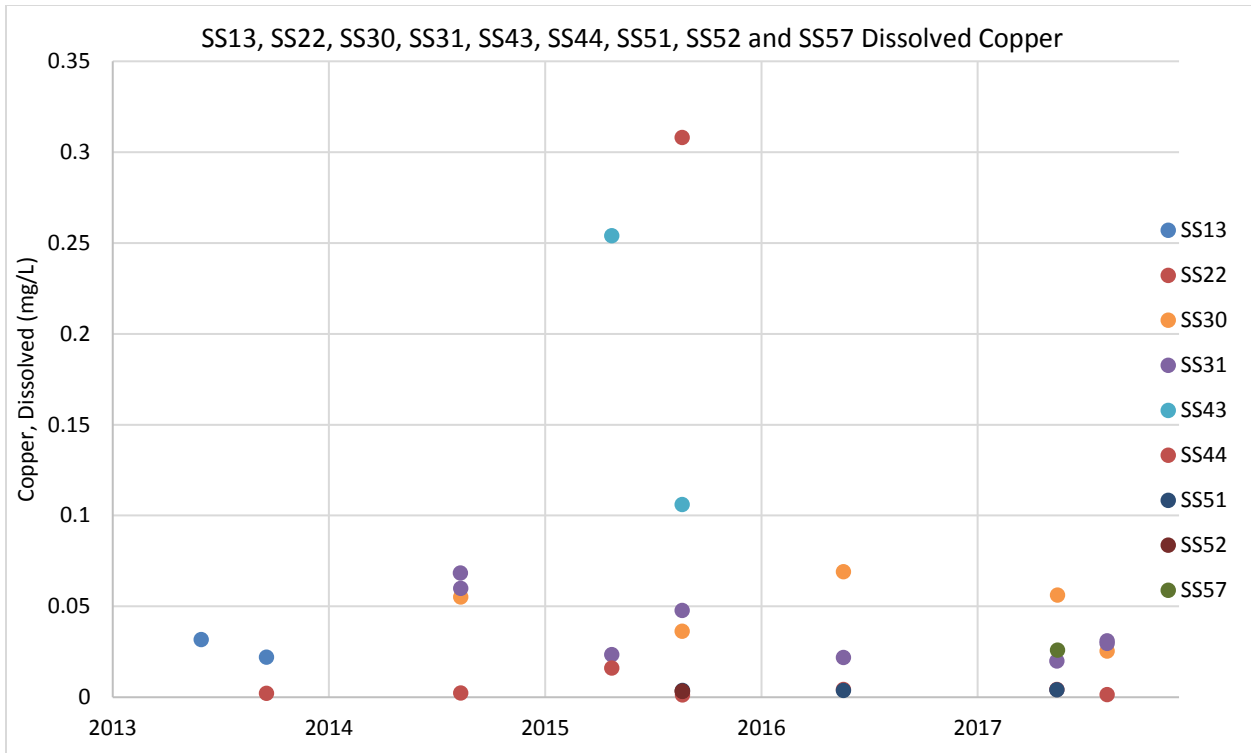


Figure 7-26: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Dissolved Copper

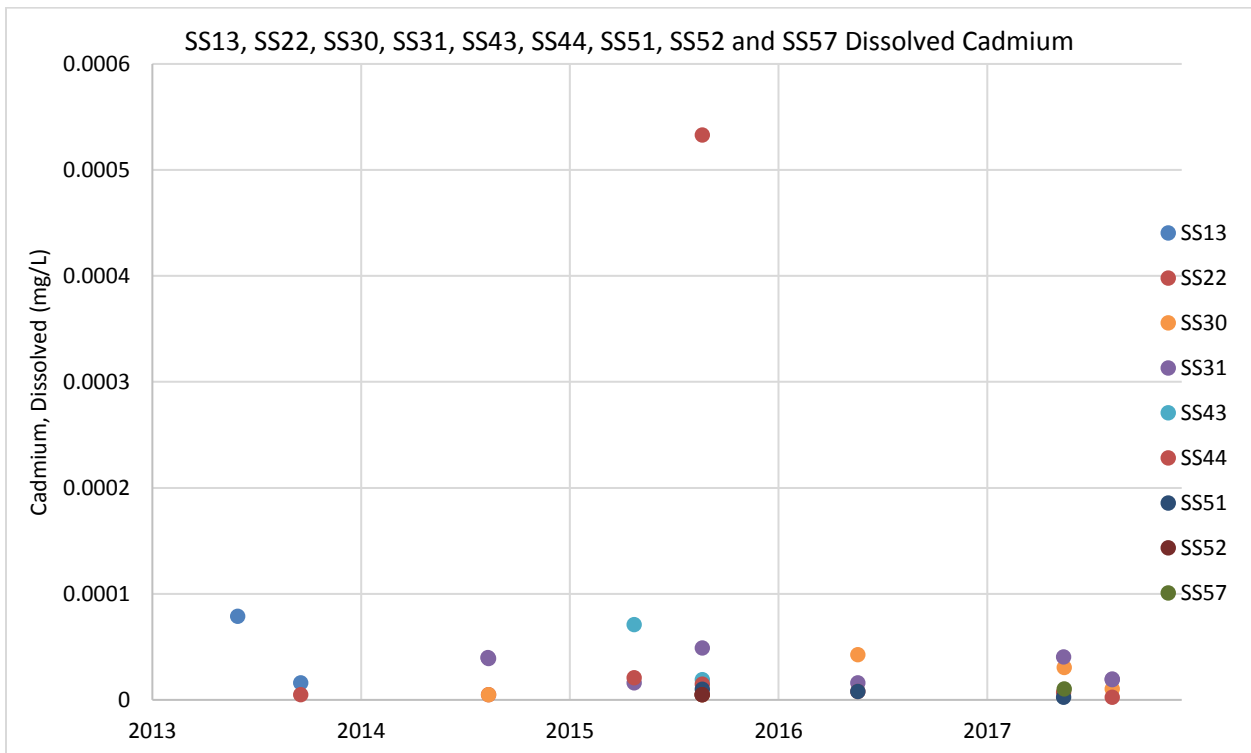


Figure 7-27: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Dissolved Cadmium

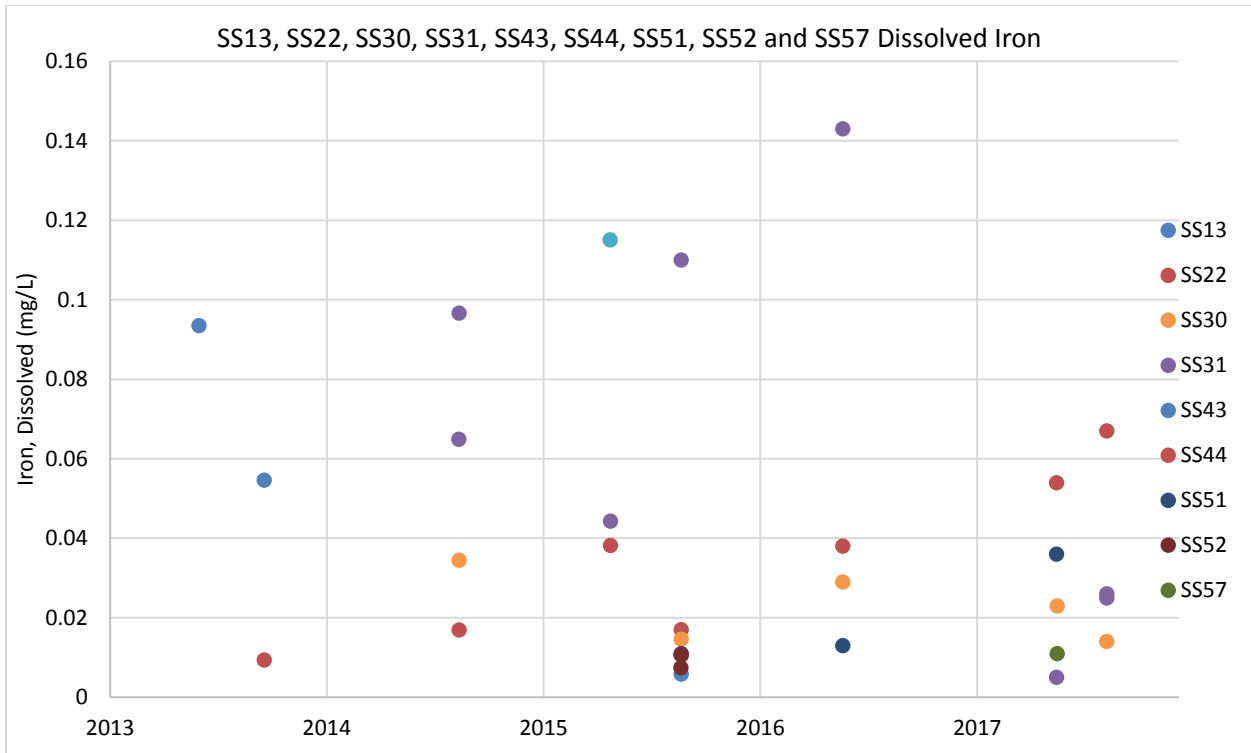


Figure 7-28: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Dissolved Iron

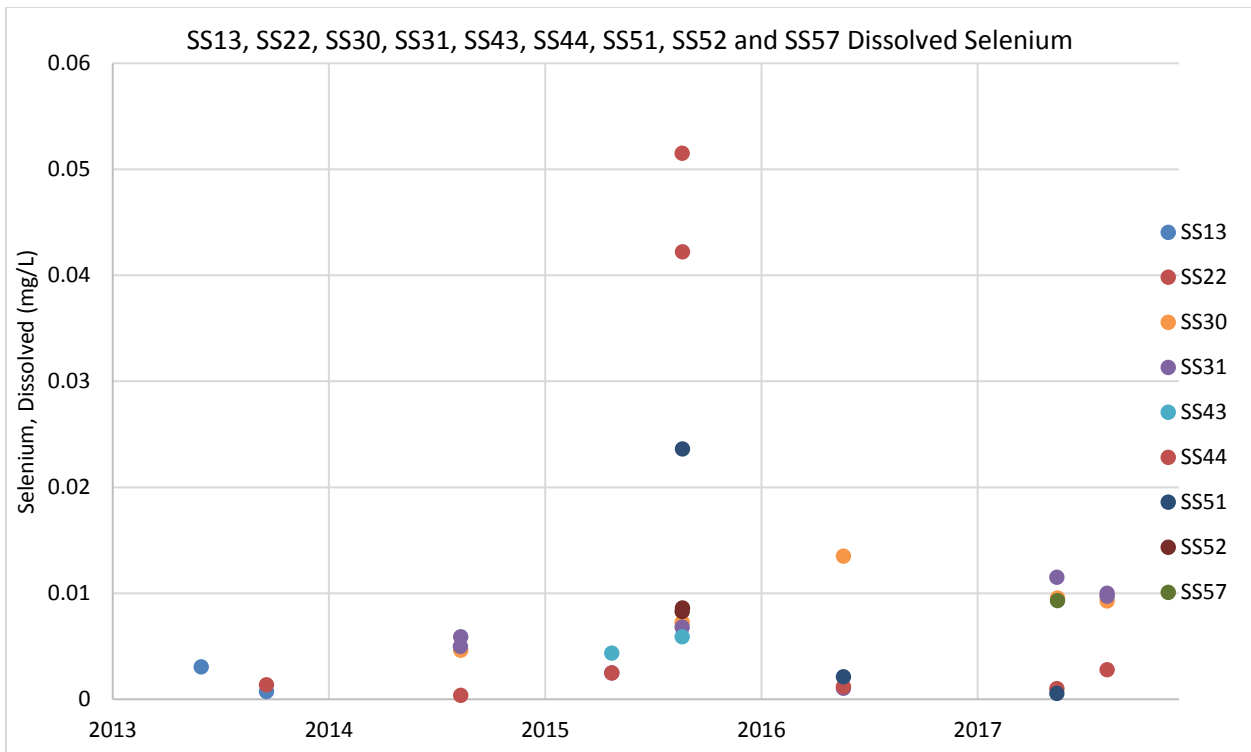


Figure 7-29: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Dissolved Selenium

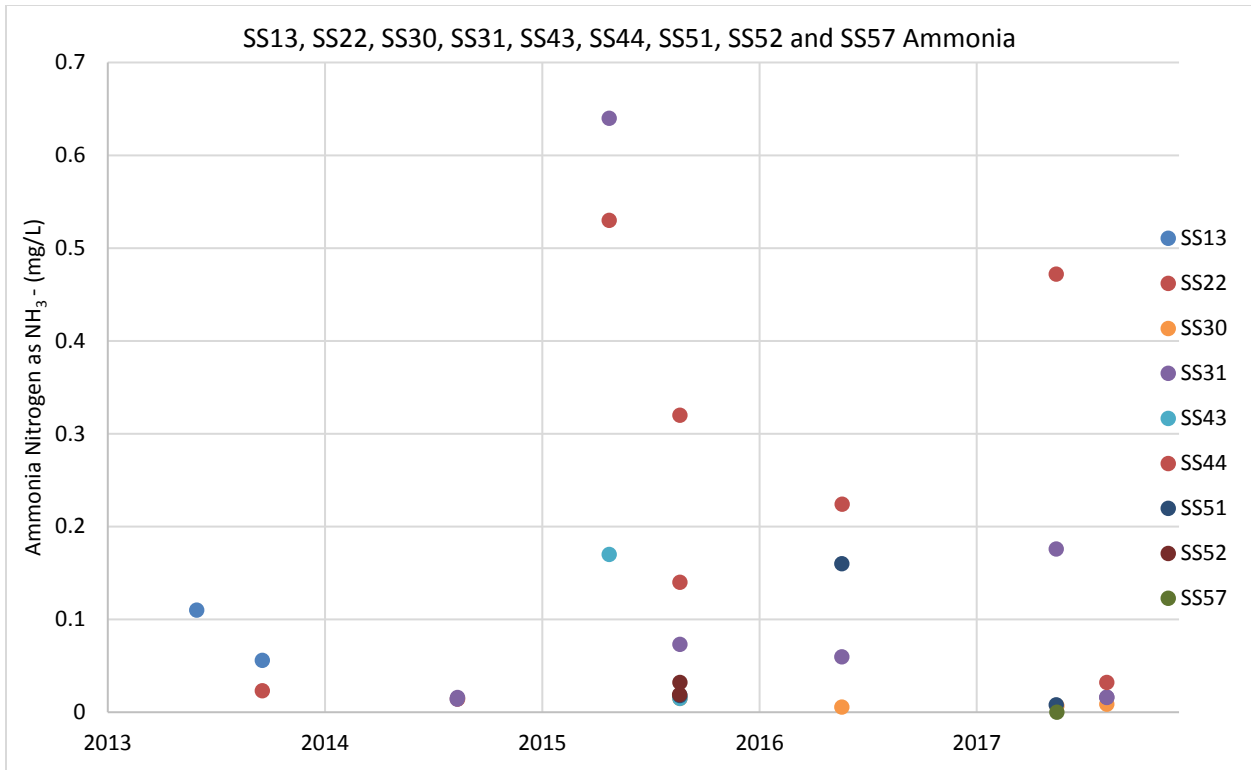


Figure 7-30: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Ammonia

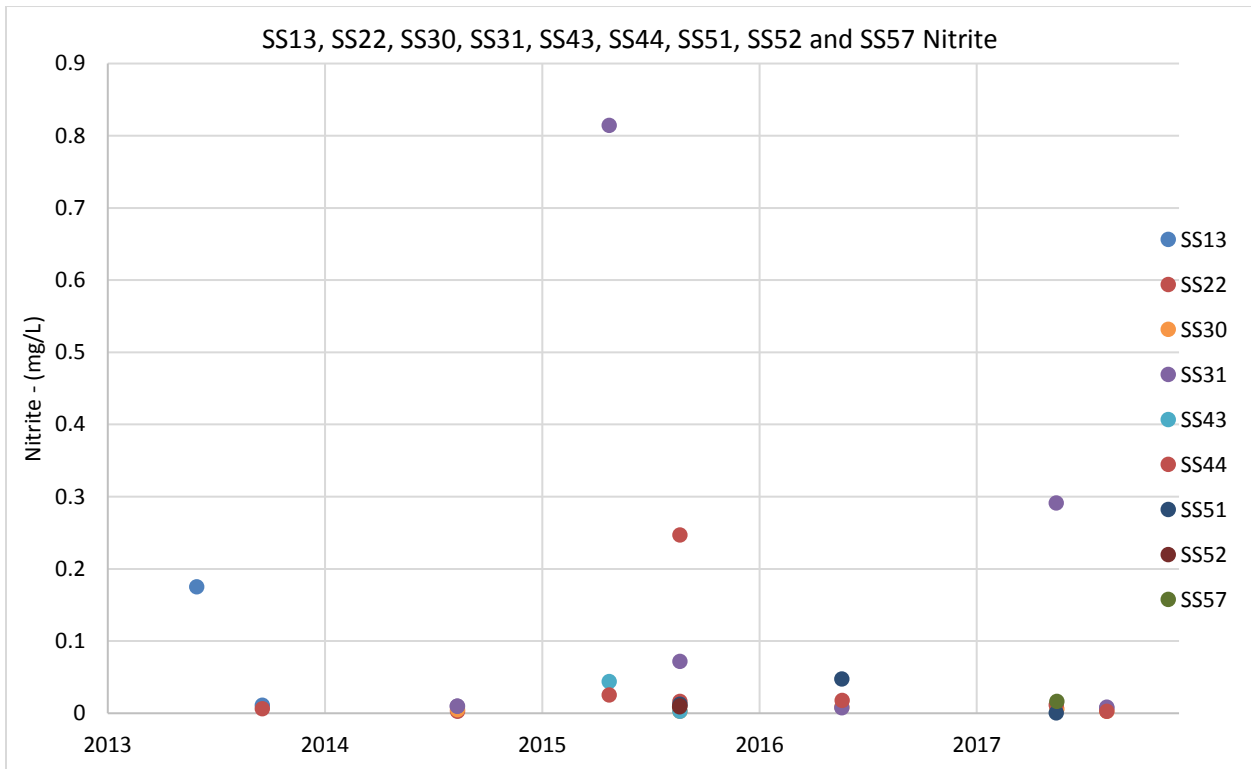


Figure 7-31: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Nitrite

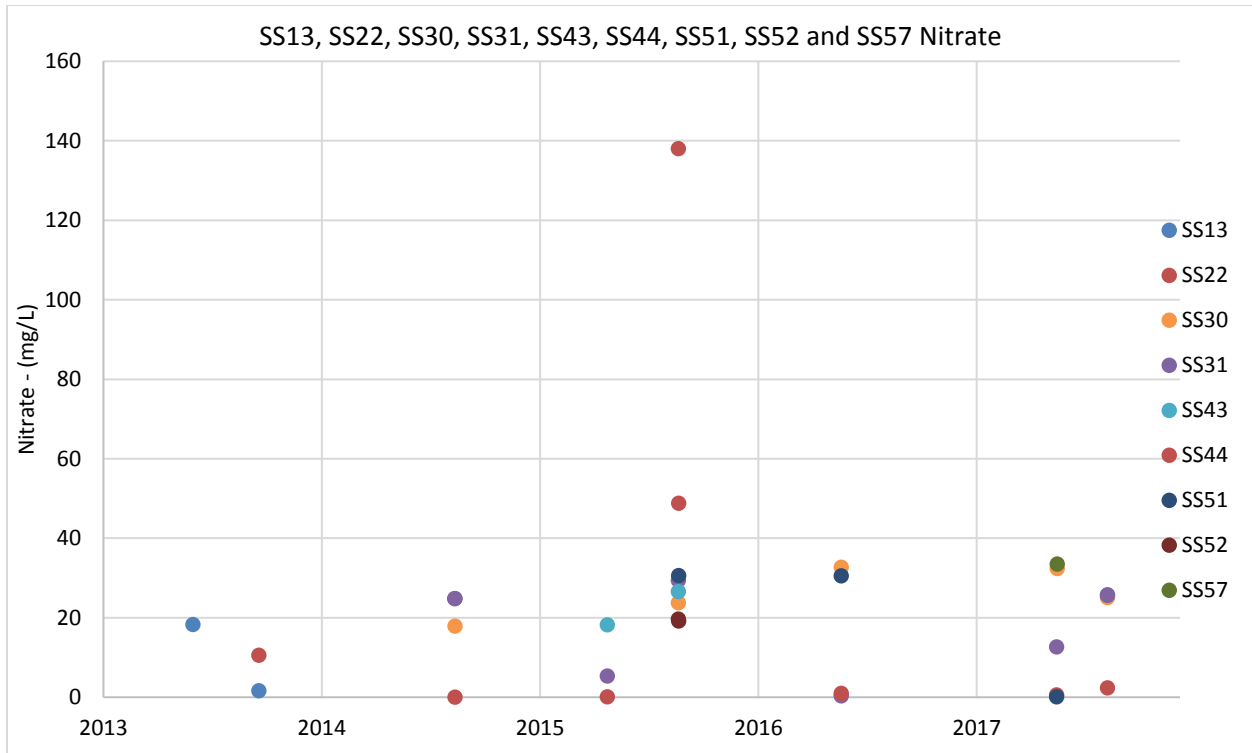


Figure 7-32: SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52 and SS57 Nitrate

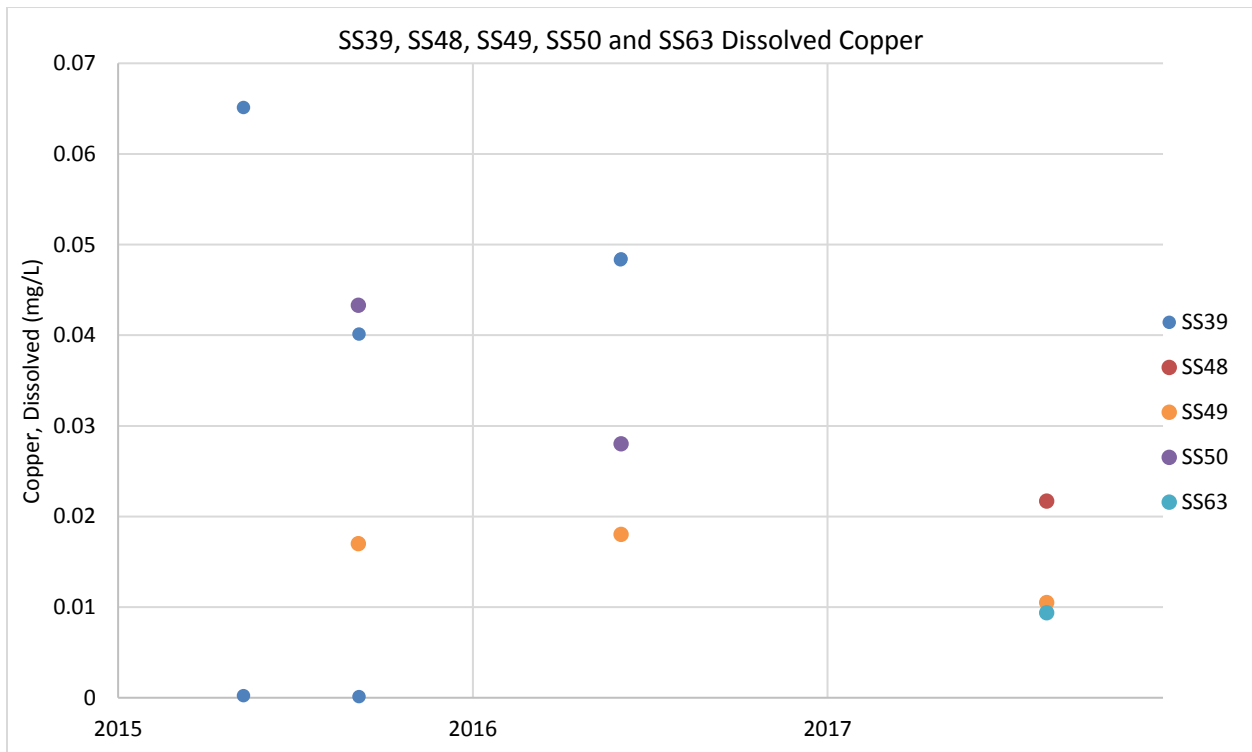


Figure 7-33: SS39, SS48, SS49, SS50 and SS63 Dissolved Copper

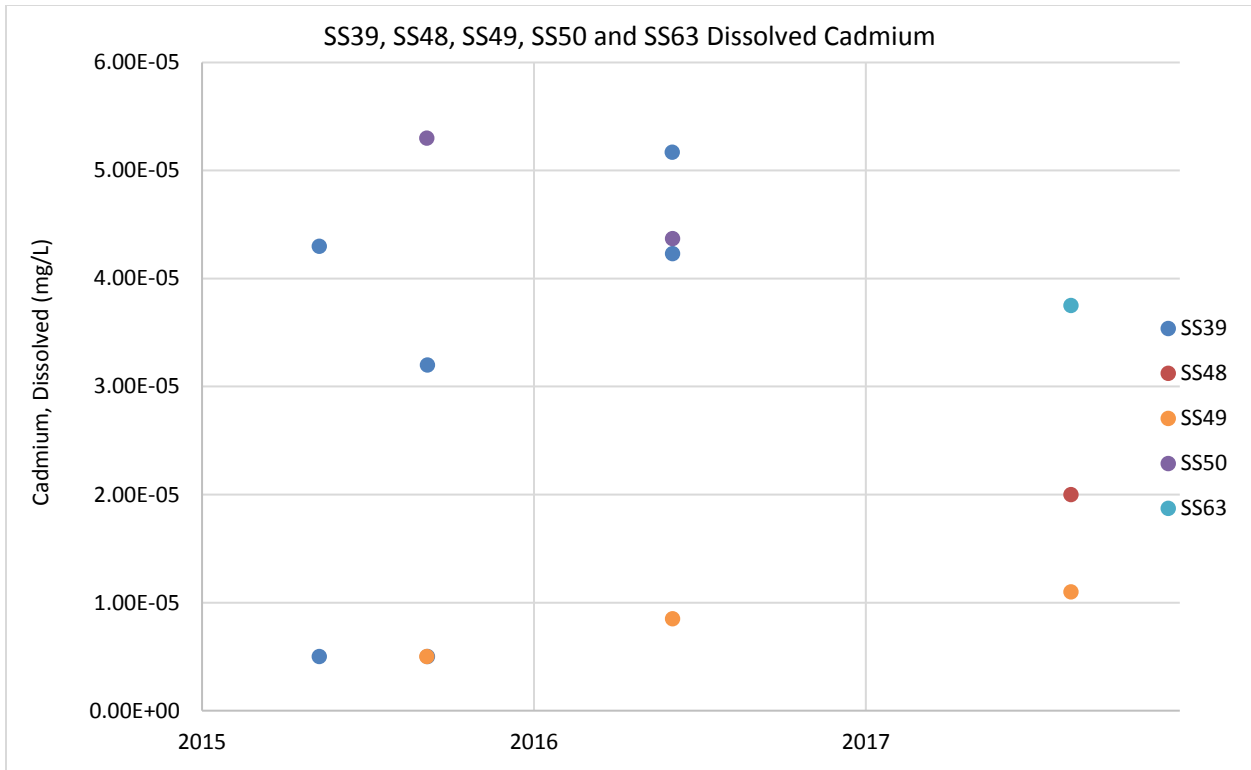


Figure 7-34: SS39, SS48, SS49, SS50 and SS63 Dissolved Cadmium

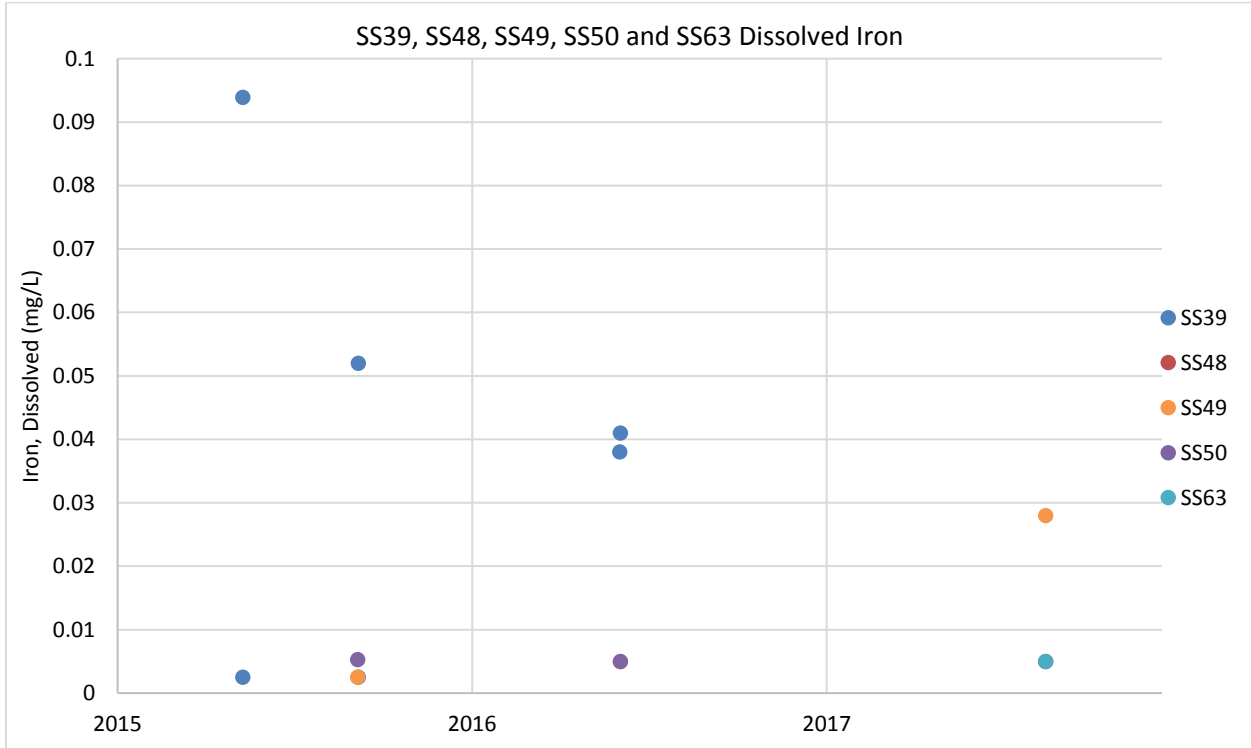


Figure 7-35: SS39, SS48, SS49, SS50 and SS63 Dissolved Iron

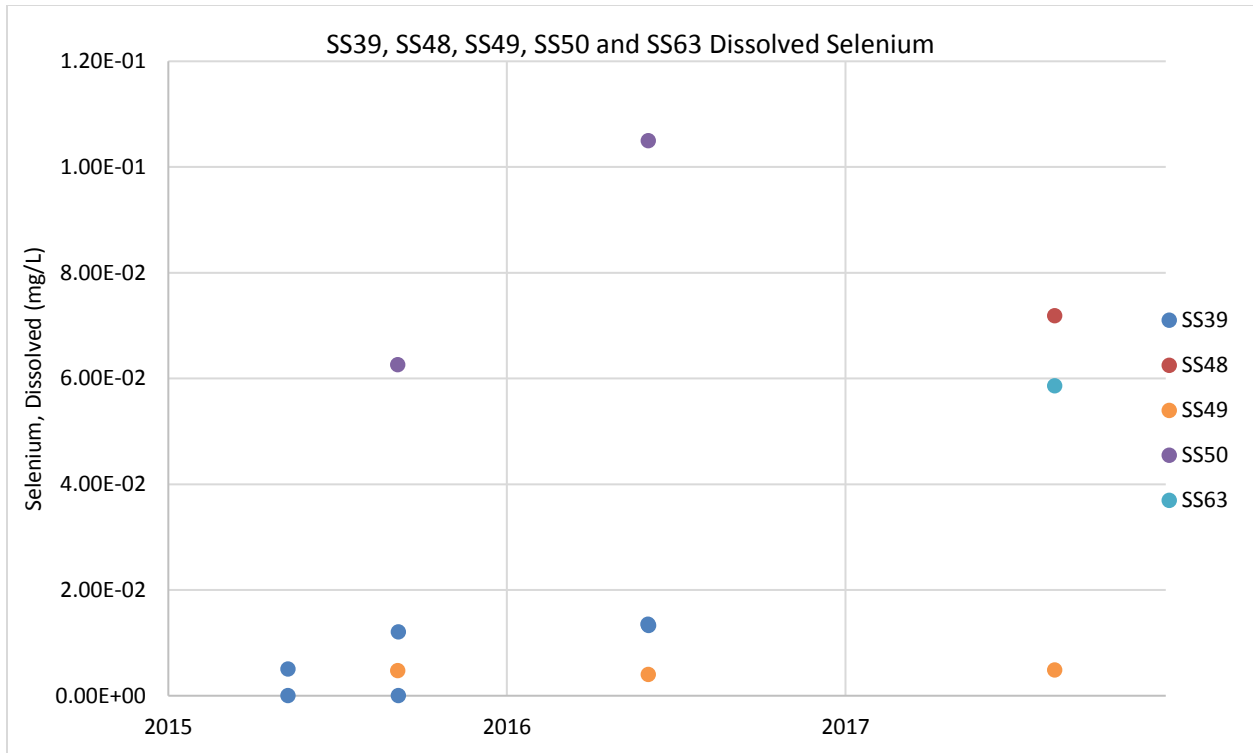


Figure 7-36: SS39, SS48, SS49, SS50 and SS63 Dissolved Selenium

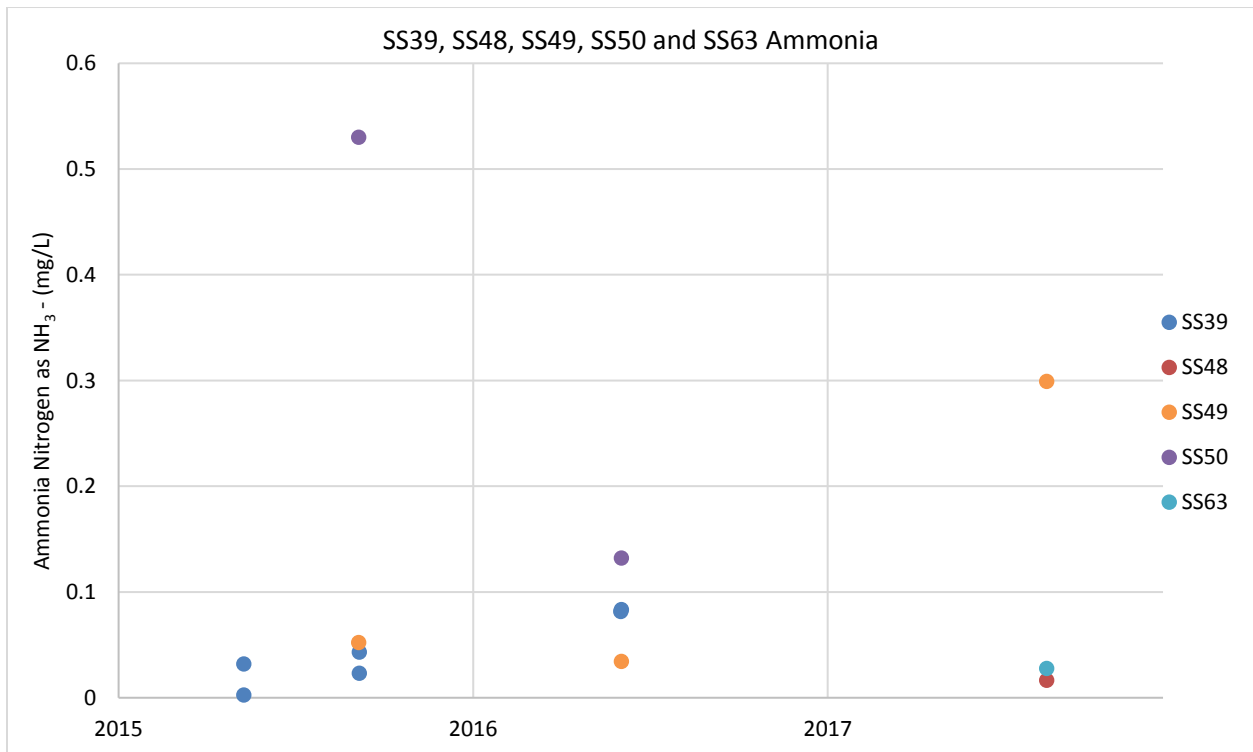


Figure 7-37: SS39, SS48, SS49, SS50 and SS63 Dissolved Ammonia

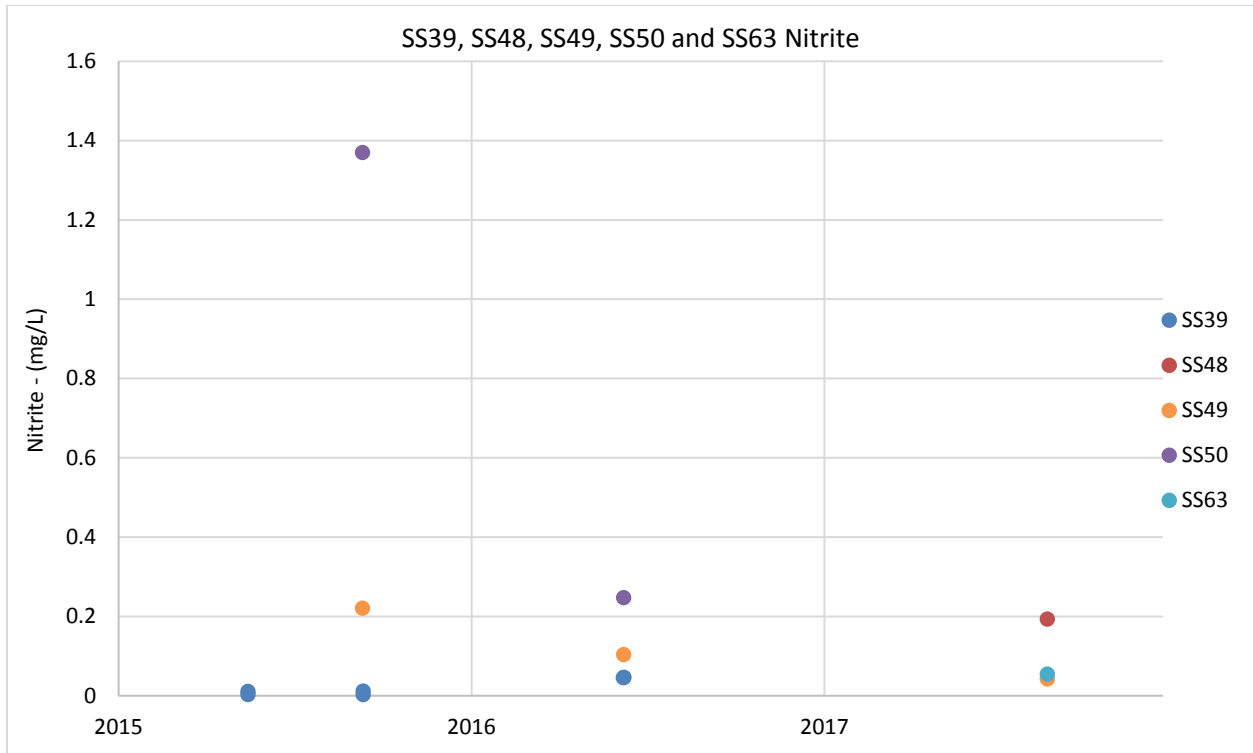


Figure 7-38: SS39, SS48, SS49, SS50 and SS63 Dissolved Nitrite

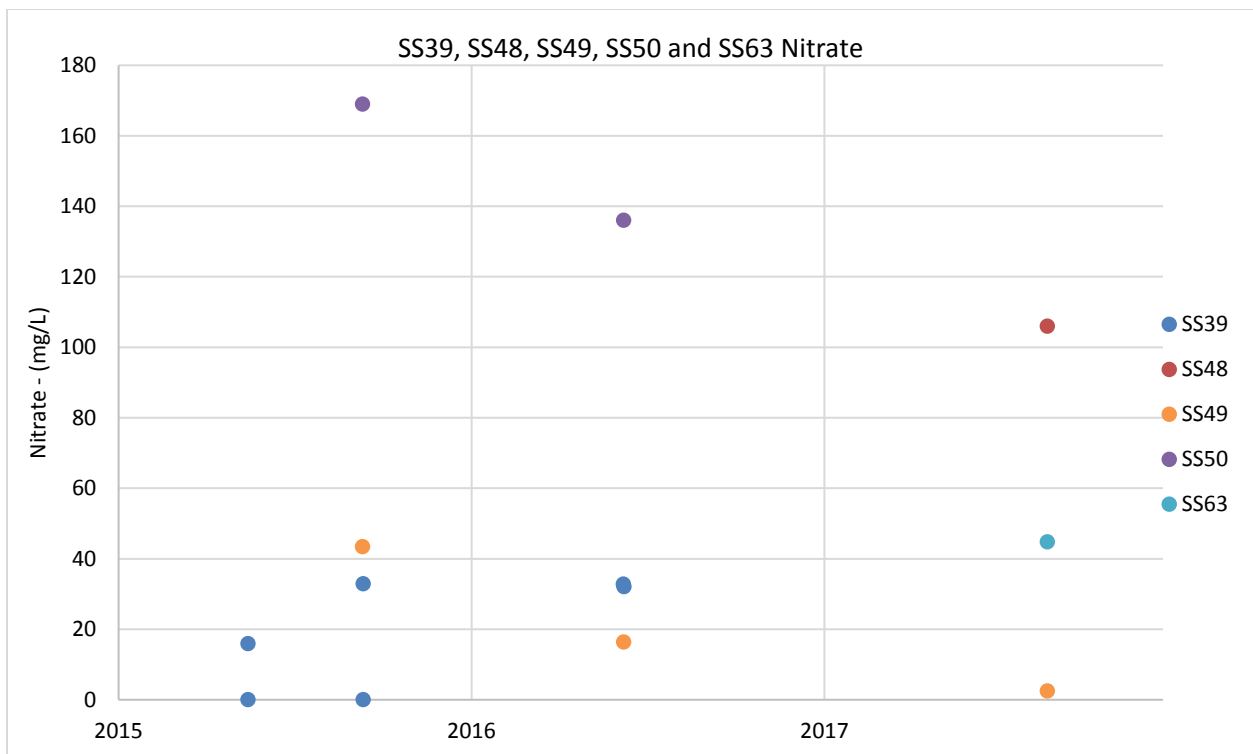


Figure 7-39: SS39, SS48, SS49, SS50 and SS63 Dissolved Nitrate

7.3 Minto Creek Detention Structure (MCDS) and Water Storage Pond

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

Water collected at W62 is pumped to the Main Pit. Water quality results for W37 (historical) and W62 are outlined in Figure 7-40 through Figure 7-46 and include results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

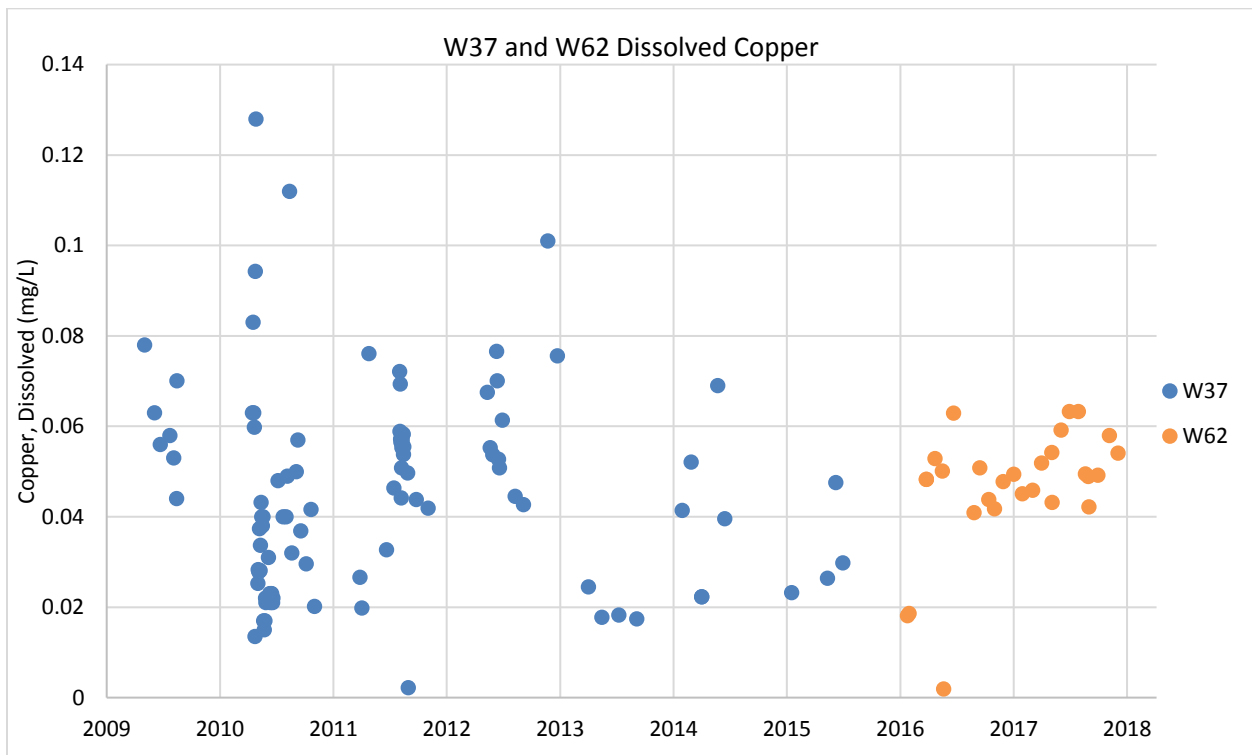


Figure 7-40: W37 and W62 Dissolved Copper

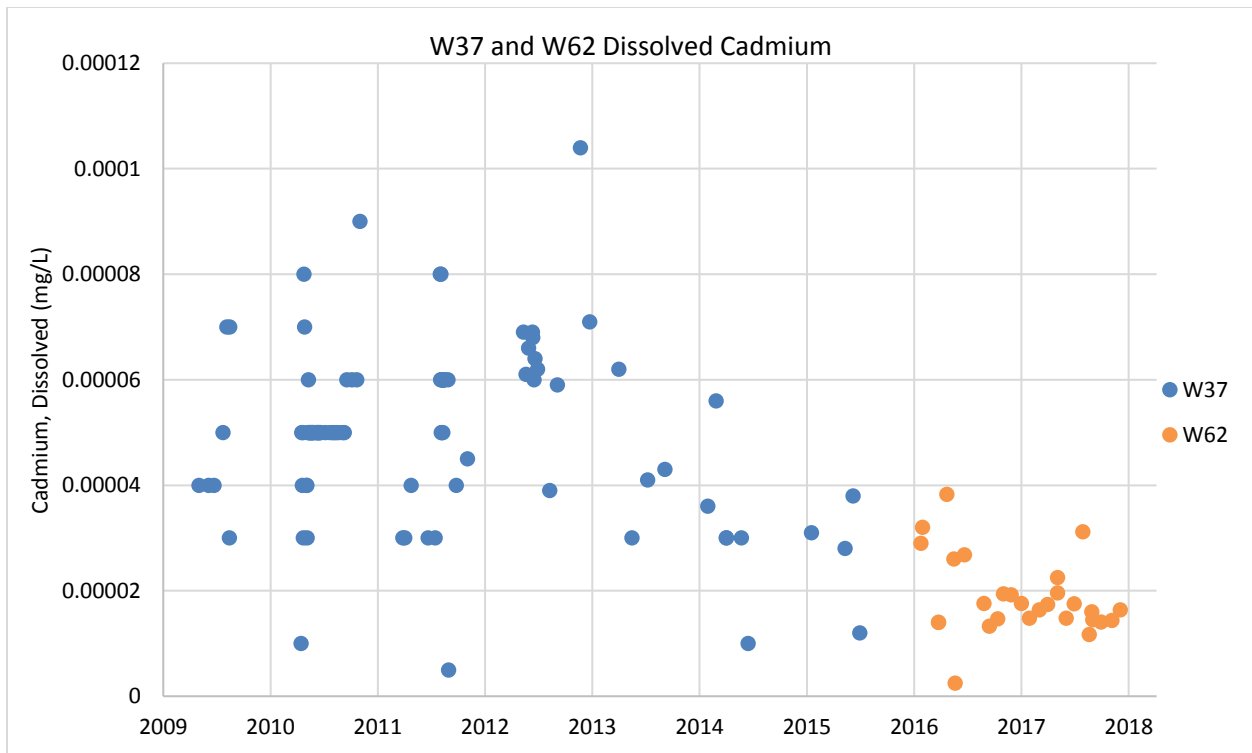


Figure 7-41: W37 and W62 Dissolved Cadmium

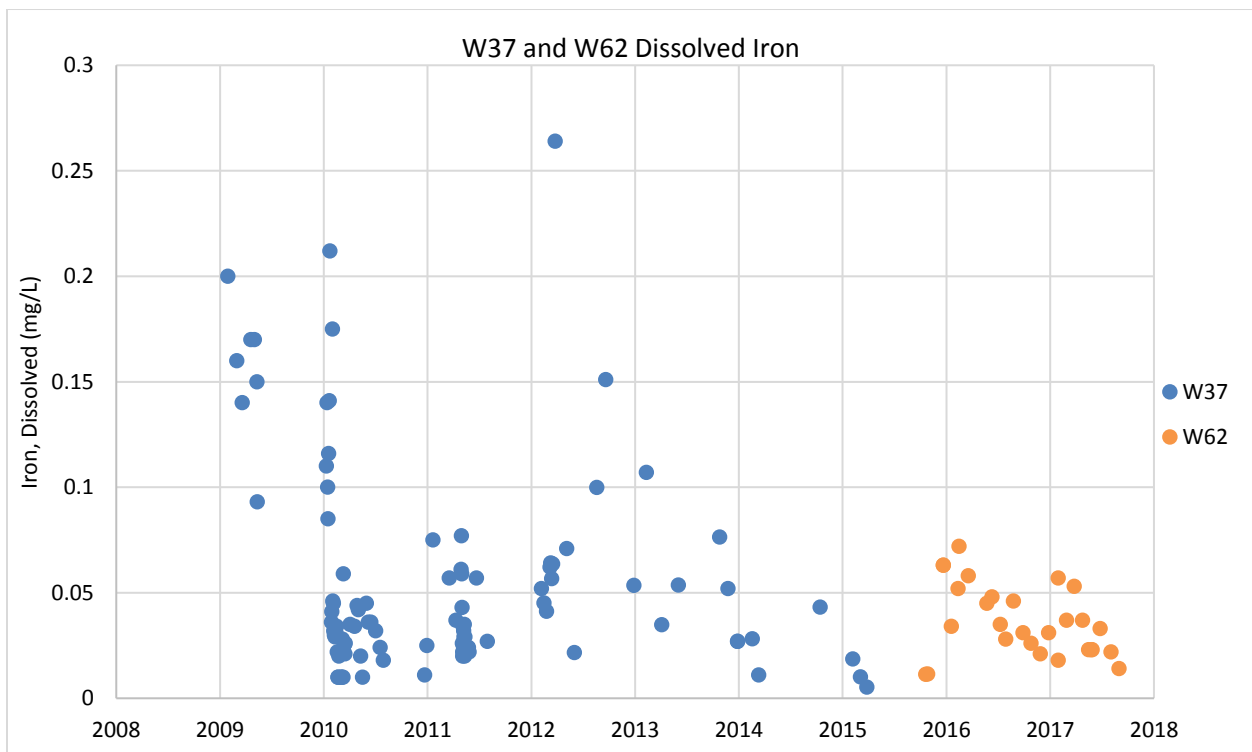


Figure 7-42: W37 and W62 Dissolved Iron

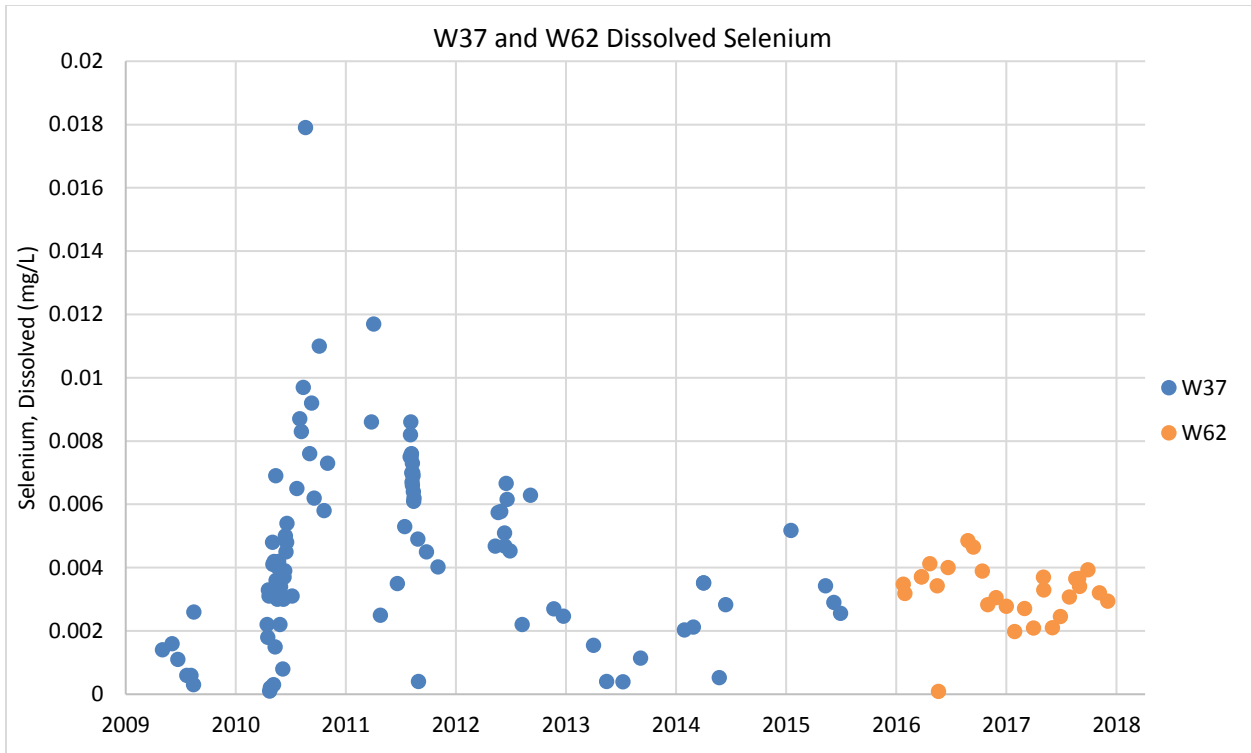


Figure 7-43: W37 and W62 Dissolved Selenium

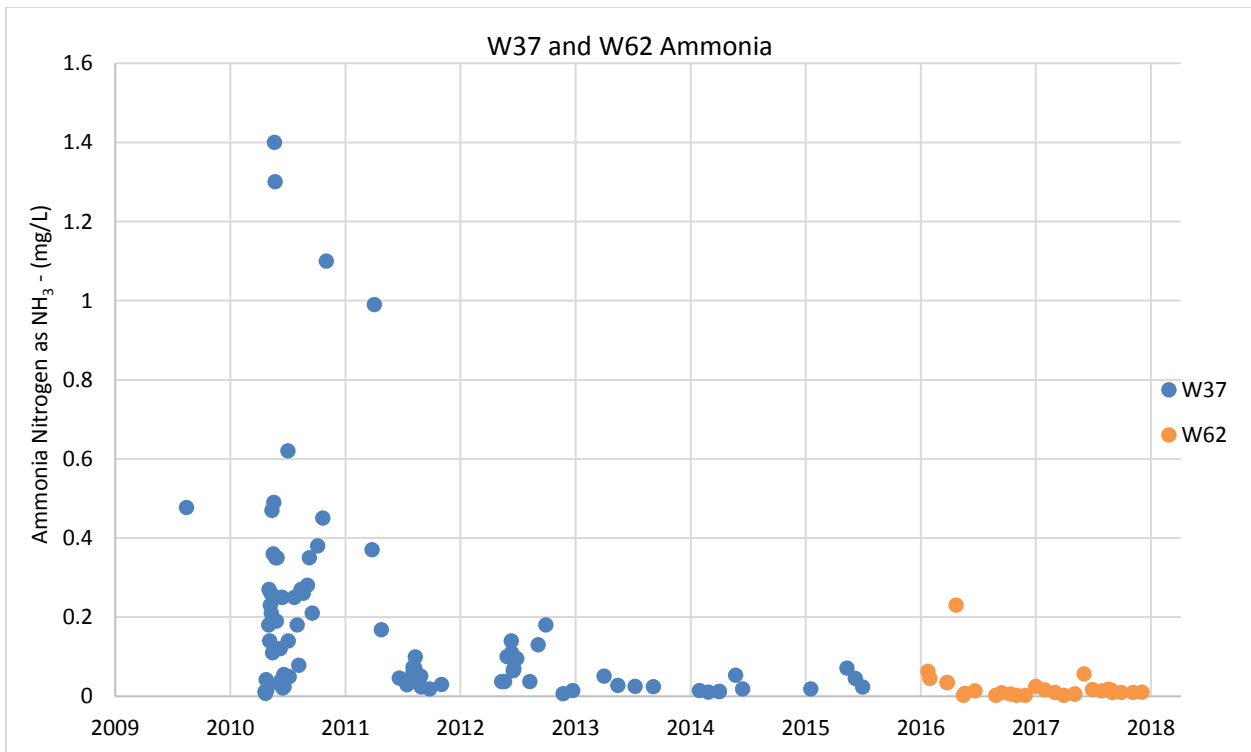


Figure 7-44: W37 and W62 Ammonia

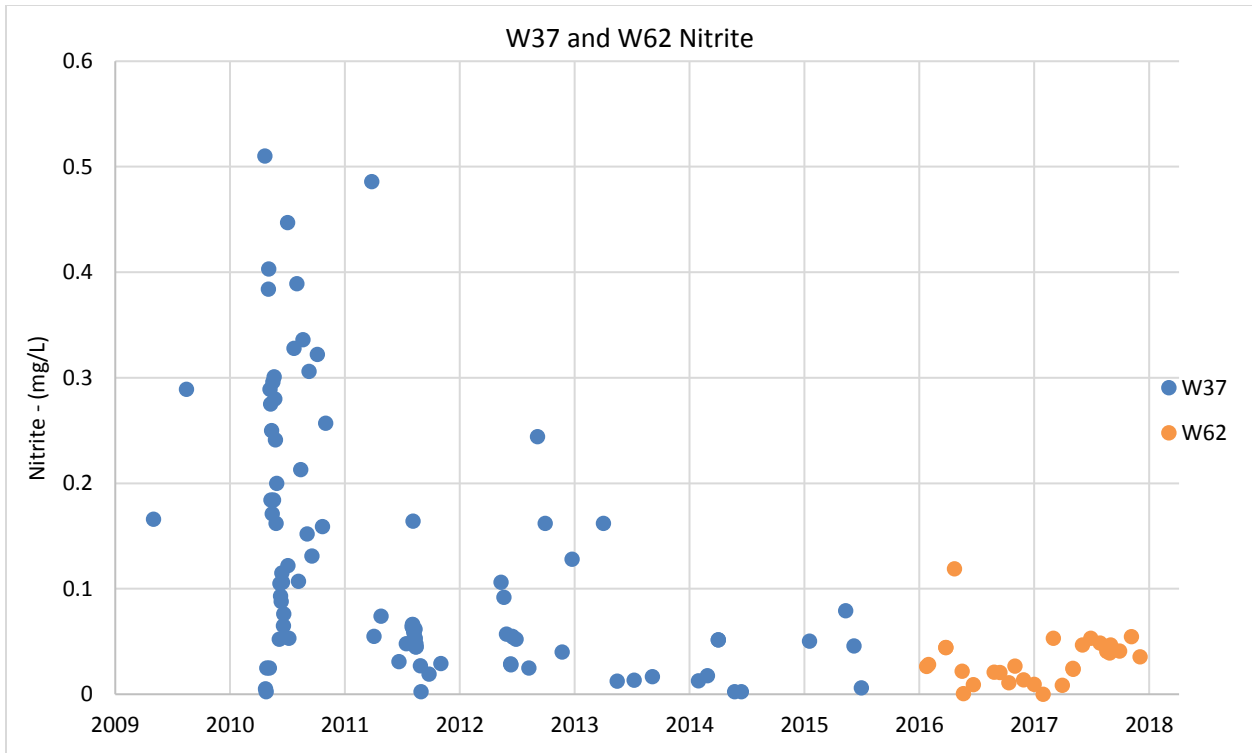


Figure 7-45: W37 and W62 Nitrite

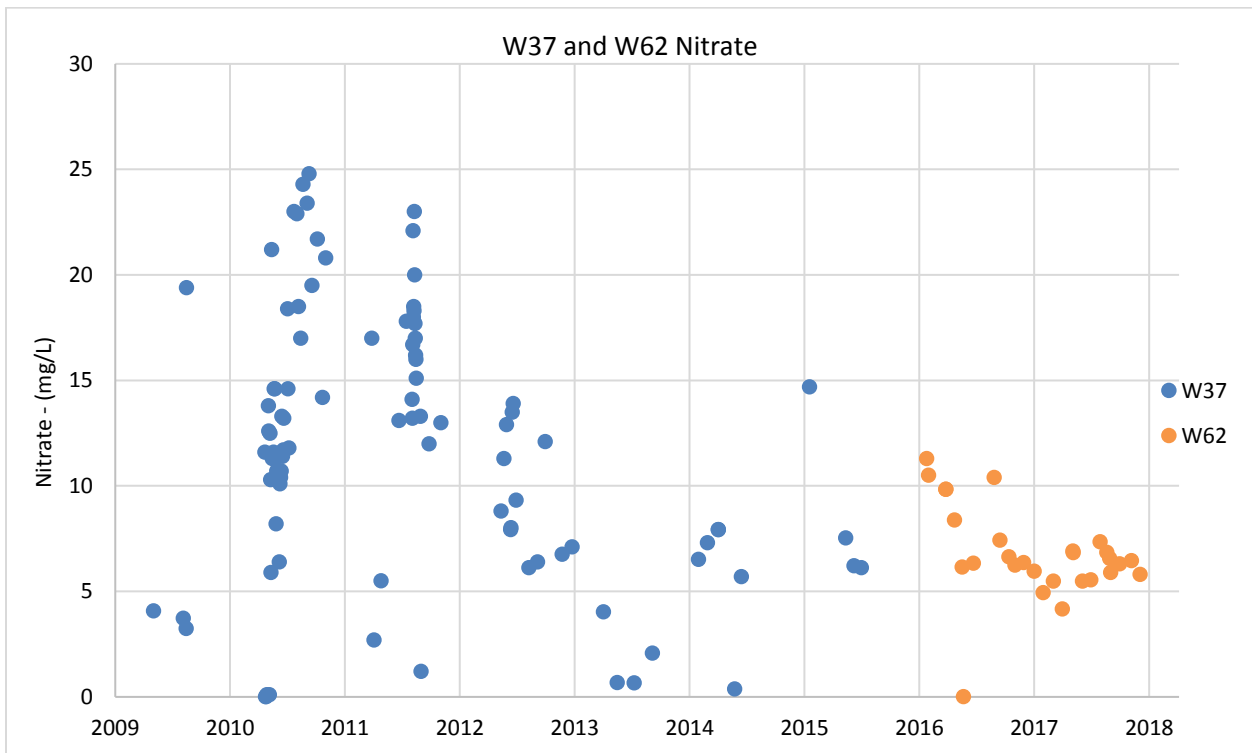


Figure 7-46: W37 and W62 Nitrate

7.4 Water Storage Pond Dam Seep

Seepage water quality at the Water Storage Pond Dam is represented by station W17. Water quality at station W17 is relatively consistent due to its being fed by a large stable body of water (Water Storage Pond). All dam seepage is collected in a vertical culvert and pumped back to the WSP via a 4" insulated heat traced pipe. Water quality statistics for station W17 from 2007 to 2017 are summarized below in Table 7-1. A total of 62 samples were collected in the 2017 monitoring period. Water quality results for W17 are further outlined in Figure 7-47 through Figure 7-55 and include historic water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

Table 7-1: W17 Water Quality Results Summary (2007-2017)

| W17 Parameters | Effluent Quality Standards (WUL Clause 9) | 2007 - 2016 Summary Statistics | | | 2017 Summary Statistics | | |
|------------------------------------|---|--------------------------------|-----------|--------------|-------------------------|-----------|-----------|
| | | Mean | Min | Max | Mean | Min | Max |
| pH | 6.0-9.0 | 8.13 | 5.43 | 8.5 | 8.25 | 8.04 | 8.47 |
| TSS (mg/L) | 15 | 2.02 | 0.5 | 267 | 1.98 | 1.5 | 14.8 |
| Nutrients (mg/L) | | | | | | | |
| Ammonia | 0.75 | 0.030 | -0.01 | 0.85 | 0.0041 | 0.0025 | 0.059 |
| Nitrite Nitrogen | 0.18 | 0.042 | 0.0005 | 7.85 | 0.00066 | 0.0005 | 0.0107 |
| Nitrate Nitrogen | 27.3 | 4.09 | 0.0025 | 12.4 | 0.344 | 0.0903 | 1.9 |
| Dissolved Metals (mg/L) | | | | | | | |
| Aluminum | 0.3 | 0.0060 | 0.0005 | 0.26 | 0.0023 | 0.0005 | 0.0111 |
| Arsenic | 0.015 | 0.00037 | 0.00005 | 0.0037 | 0.000346 | 0.00025 | 0.00043 |
| Cadmium | 0.004104* | 0.000030 | 0.0000025 | 0.0028 | 0.0000042 | 0.0000025 | 0.0000148 |
| Chromium | 0.003 | 0.00062 | 0.00005 | 0.008 | 0.000068 | 0.00005 | 0.0002 |
| Copper | 0.039 | 0.0063 | 0.0001 | 0.031 | 0.00690 | 0.00508 | 0.022 |
| Iron | 3.3 | 0.011 | 0.0025 | 0.45 | 0.00686 | 0.005 | 0.056 |
| Lead | 0.012 | 0.00011 | 0.000009 | 0.0008 | 0.000025 | 0.000025 | 0.000025 |
| Molybdenum | 0.219 | 0.0065 | 0.000025 | 0.022 | 0.00545 | 0.00289 | 0.00629 |
| Nickel | 0.33 | 0.00095 | 0.00025 | 0.011 | 0.000627 | 0.00025 | 0.00087 |
| Selenium | 0.006 | 0.0011 | 0.000025 | 0.005 | 0.000404 | 0.0002 | 0.000722 |
| Zinc | 0.09 | 0.0036 | 0.0005 | 0.043 | 0.000819 | 0.0005 | 0.0047 |

Bold values indicate exceedances of the WUL standards

*Based on measured hardness

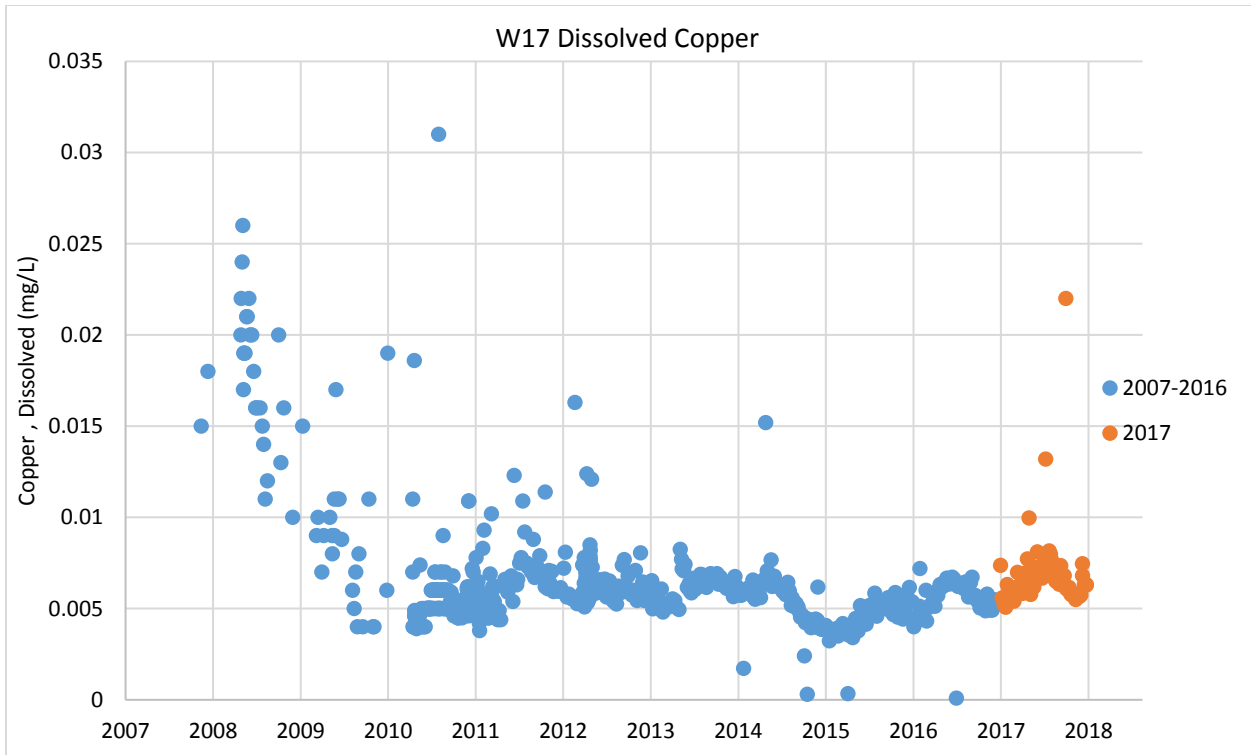


Figure 7-47: W17 Dissolved Copper

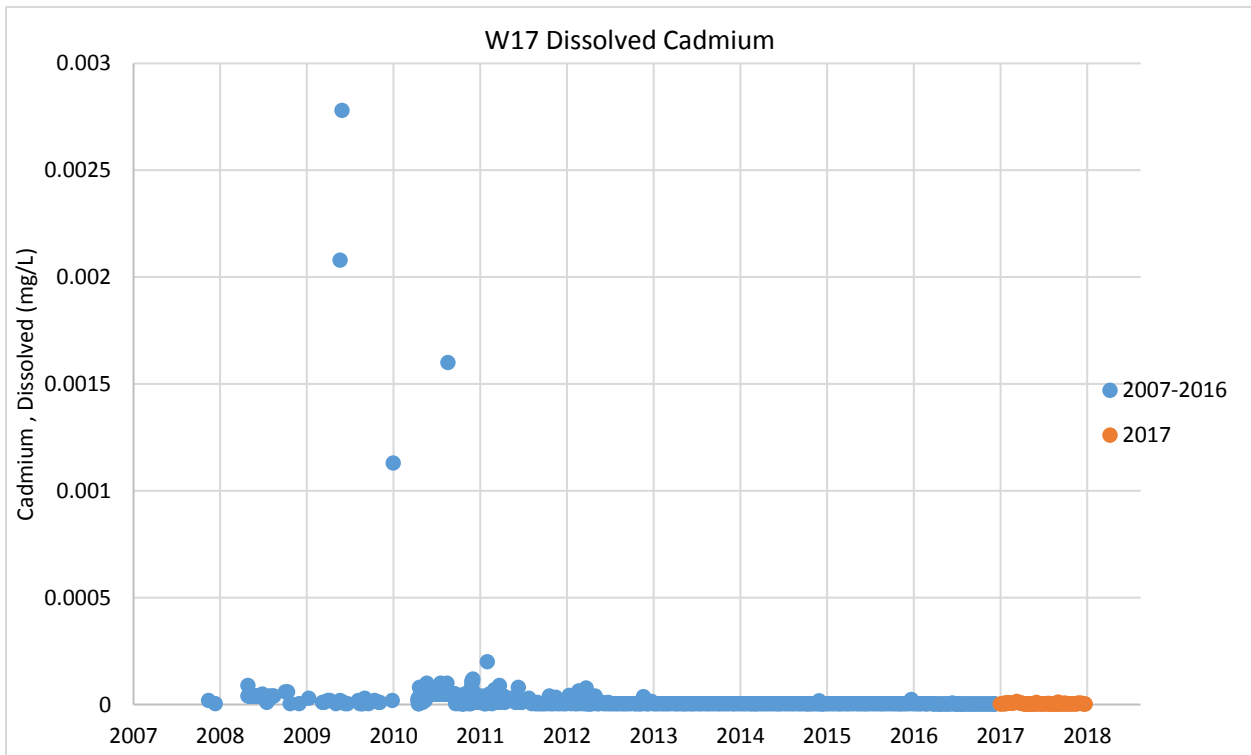


Figure 7-48: W17 Dissolved Cadmium

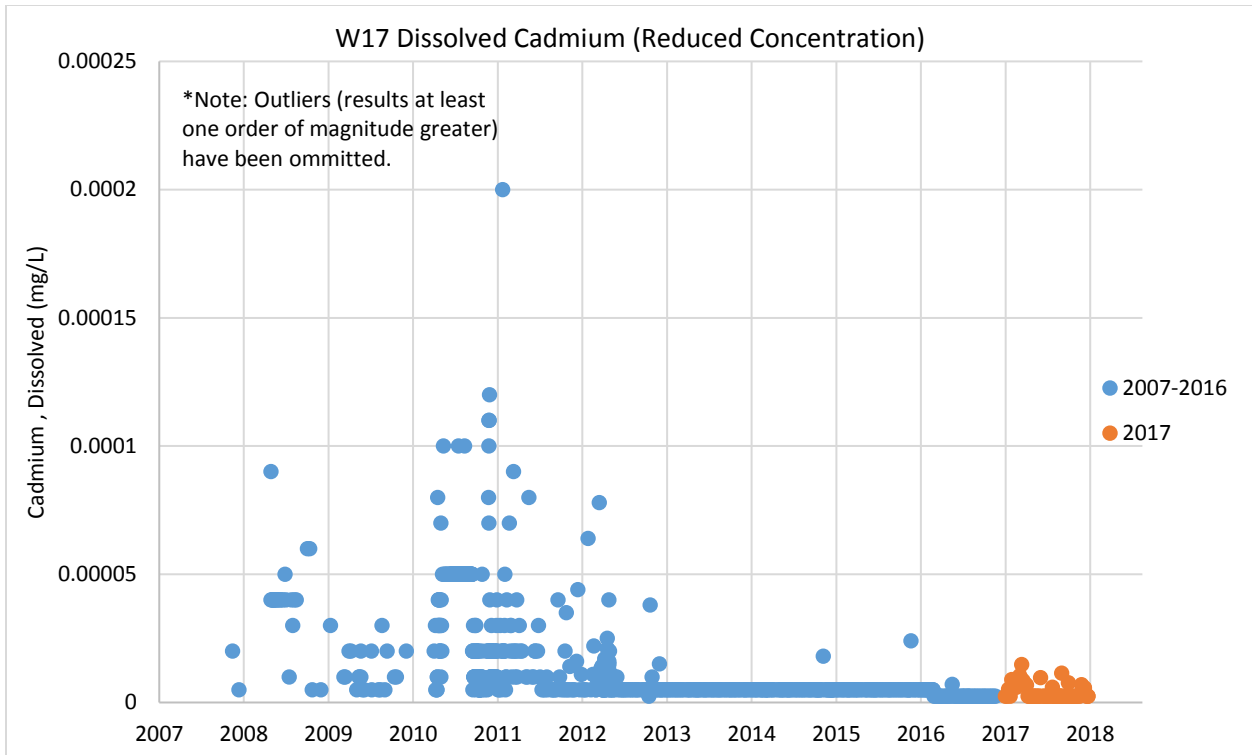


Figure 7-49: W17 Dissolved Cadmium (Reduced Concentration)

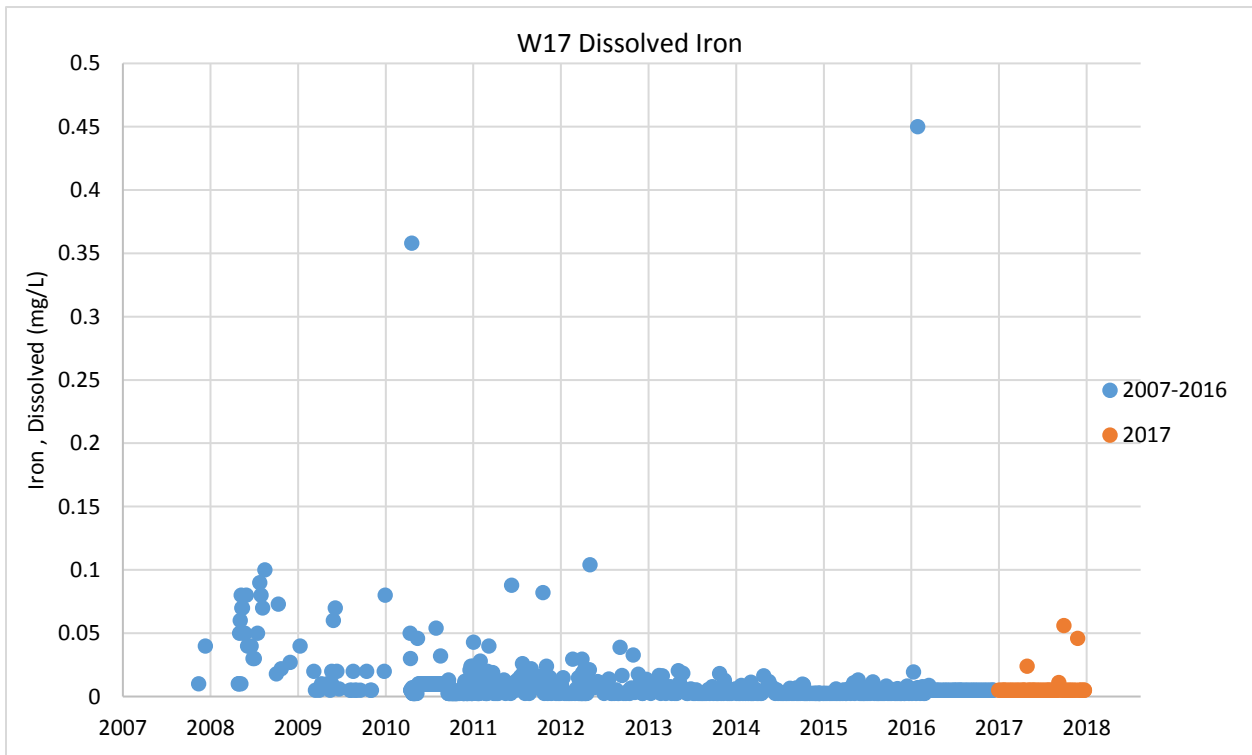


Figure 7-50: W17 Dissolved Iron

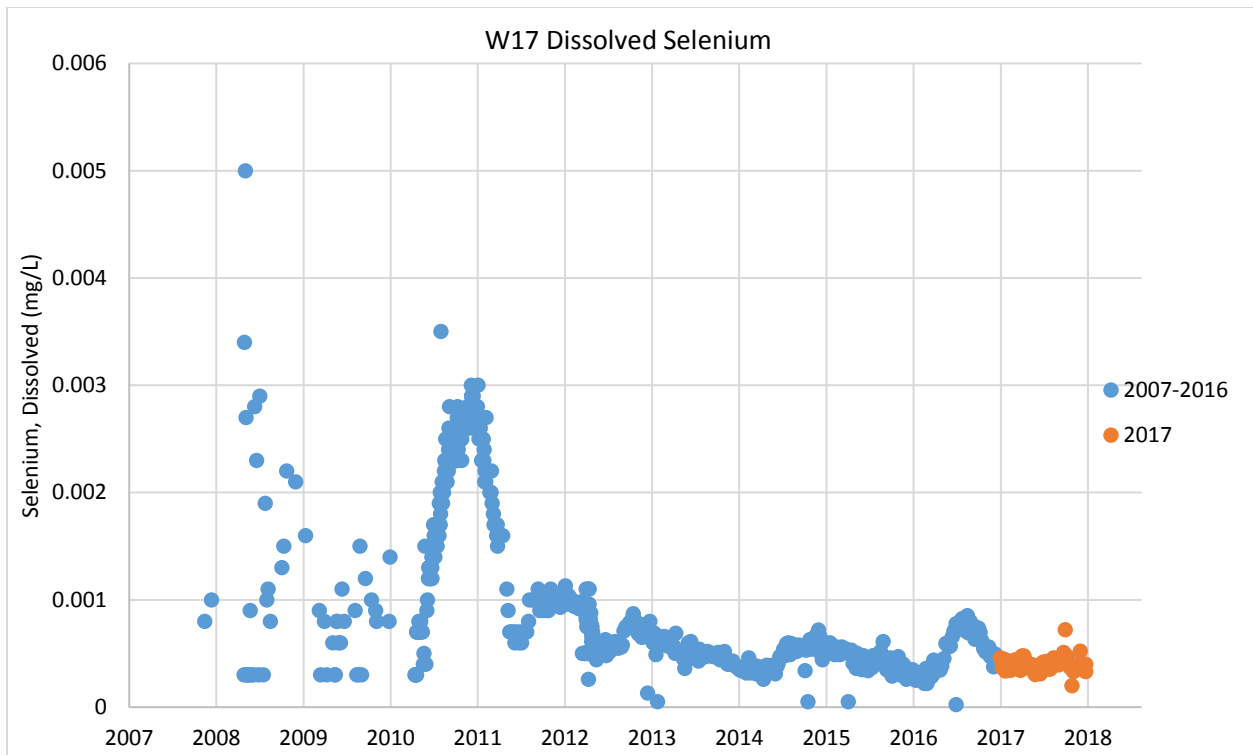


Figure 7-51: W17 Dissolved Selenium

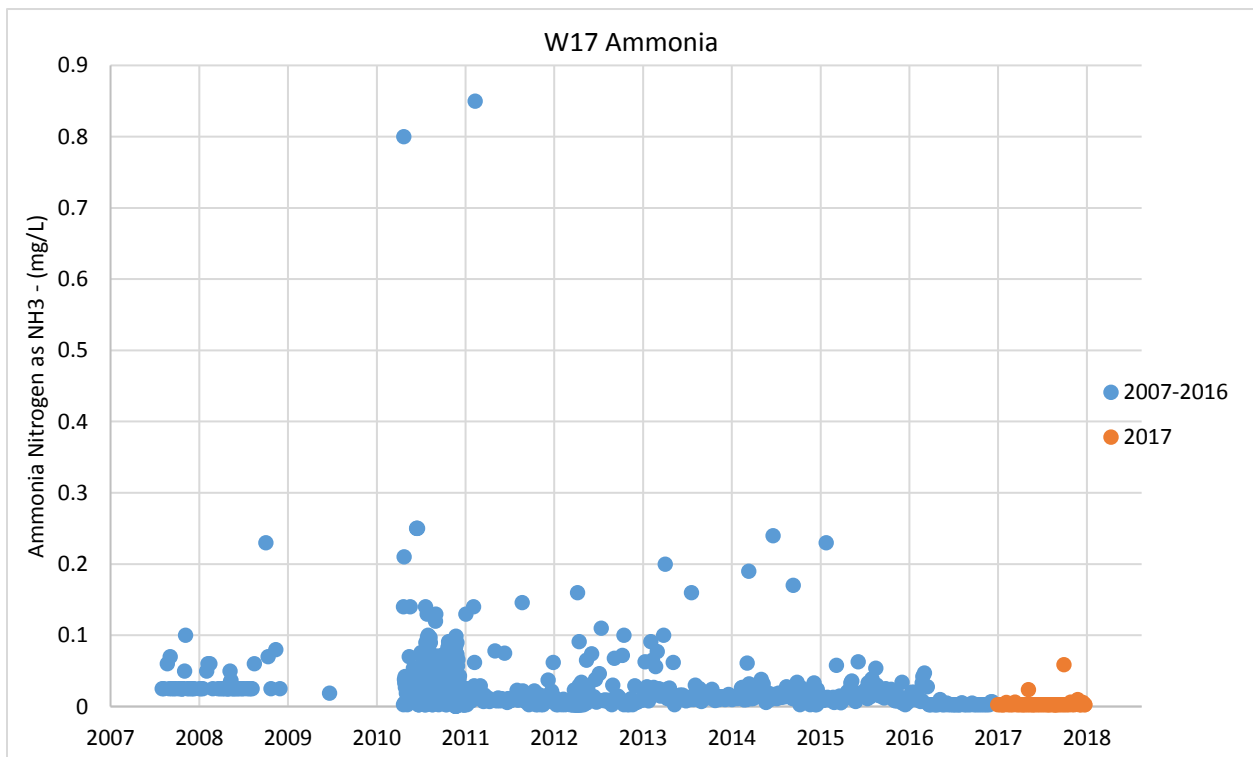


Figure 7-52: W17 Ammonia

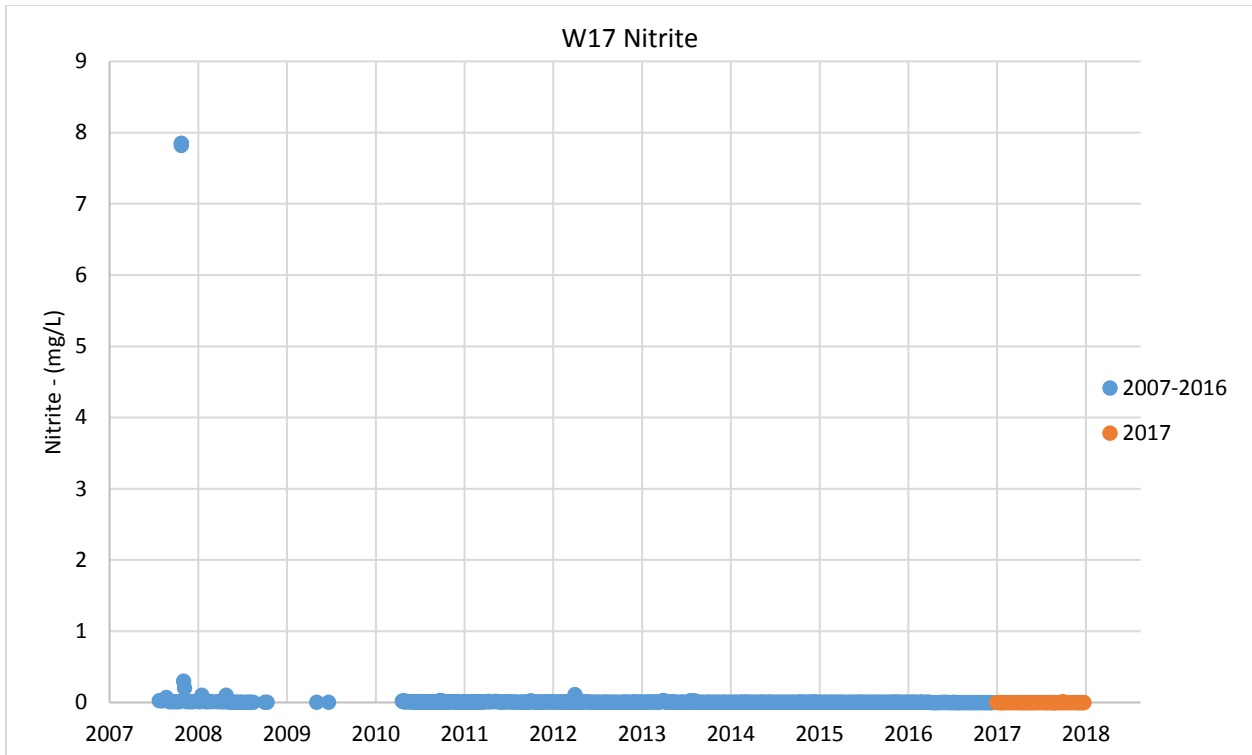


Figure 7-53: W17 Nitrite

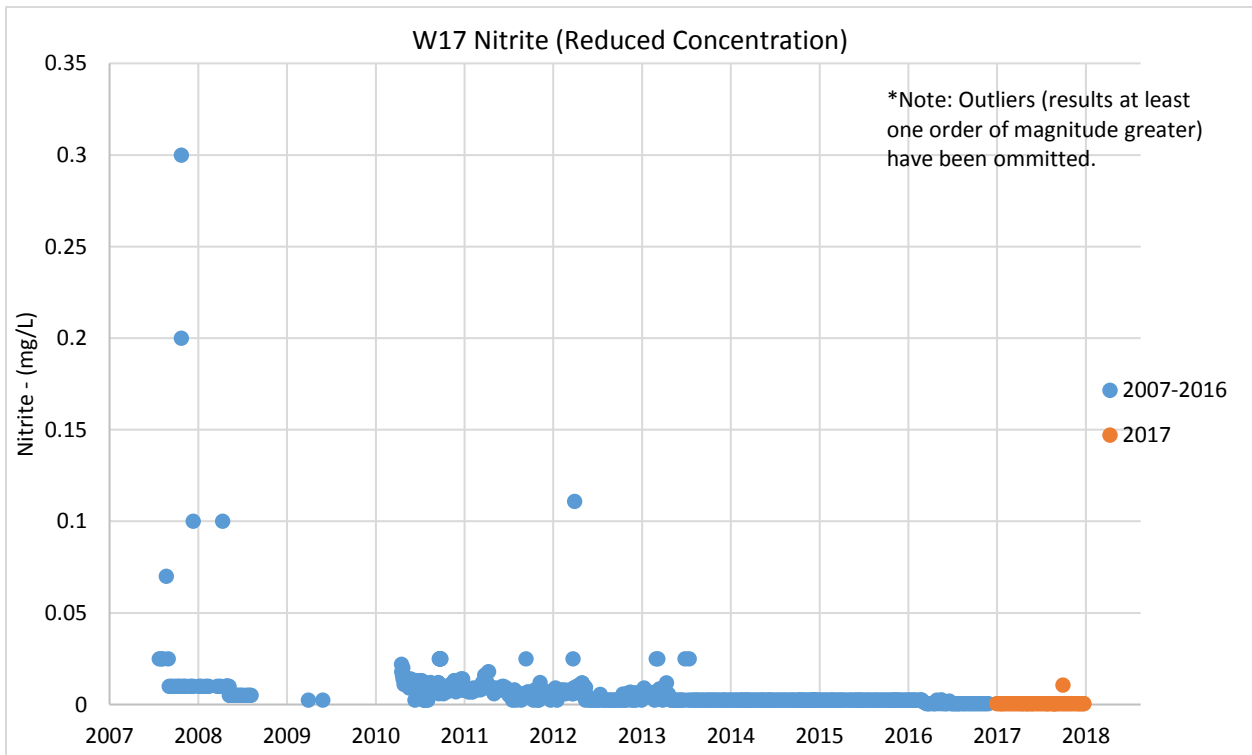


Figure 7-54: W17 Nitrite (Reduced Concentration)

7.5 Dry Stack Tailings Storage Facility (DSTSF)

Seepage flow was observed during the spring survey at SS9 and SS60. Previously, water has flowed along the tailings diversion ditch road and down the toe of the south side of the DSTSF. Historical water quality results, 2017 seepage surveys and historical results for the DSTSF-associated seepage sites (SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, and SS45) are outlined in Figure 7-56 through Figure 7-62 and include results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

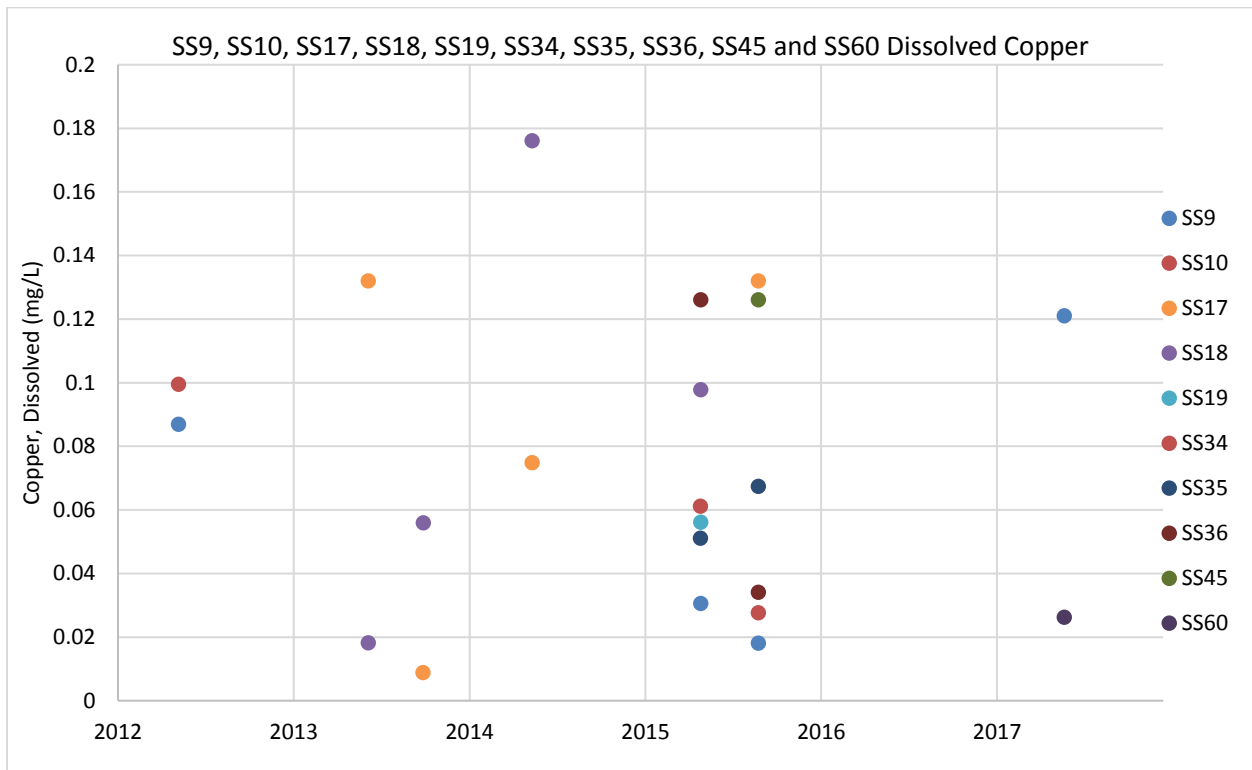


Figure 7-56: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, SS45 and SS60 Dissolved Copper

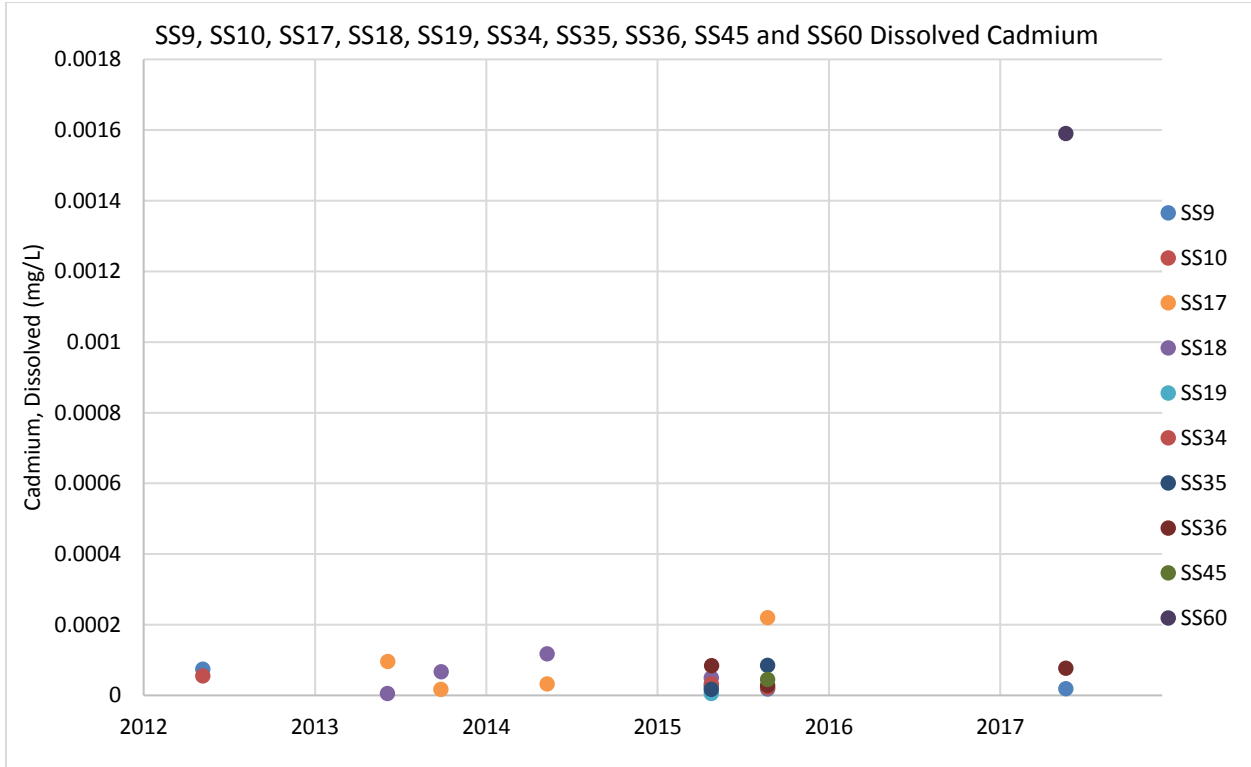


Figure 7-57: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, SS45 and SS60 Dissolved Cadmium

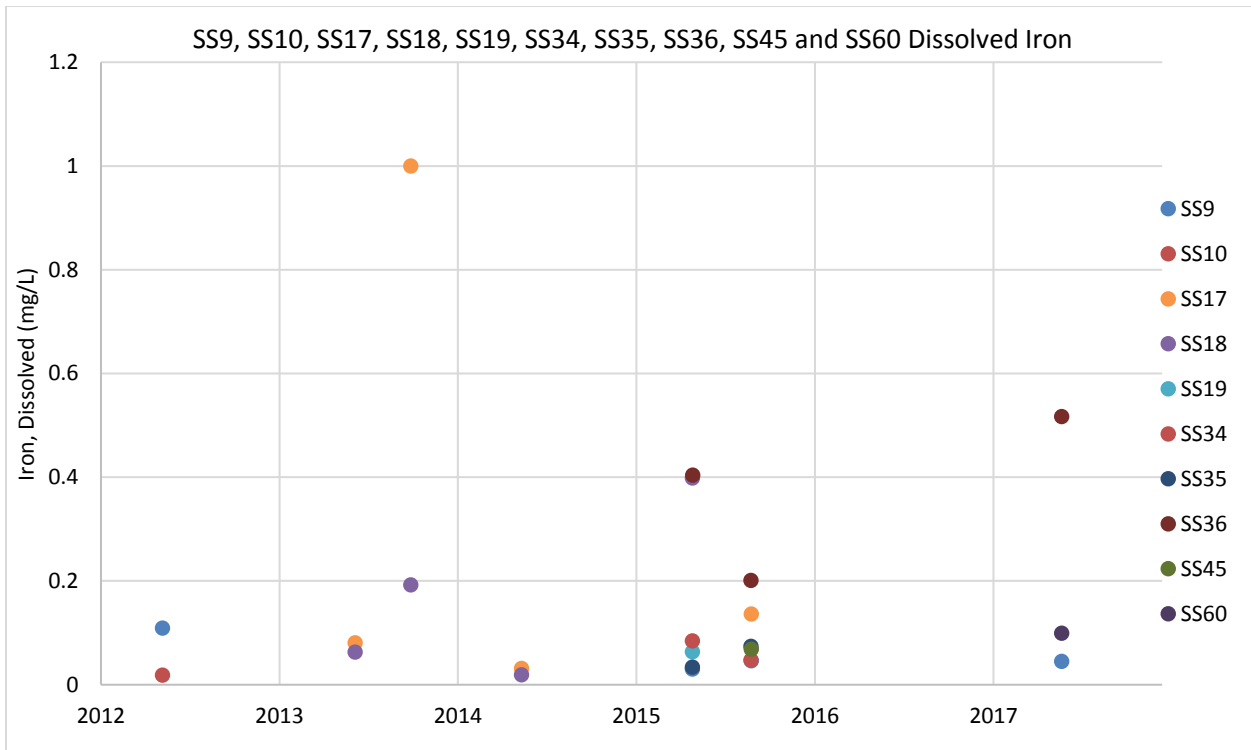


Figure 7-58: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, SS45 and SS60 Dissolved Iron

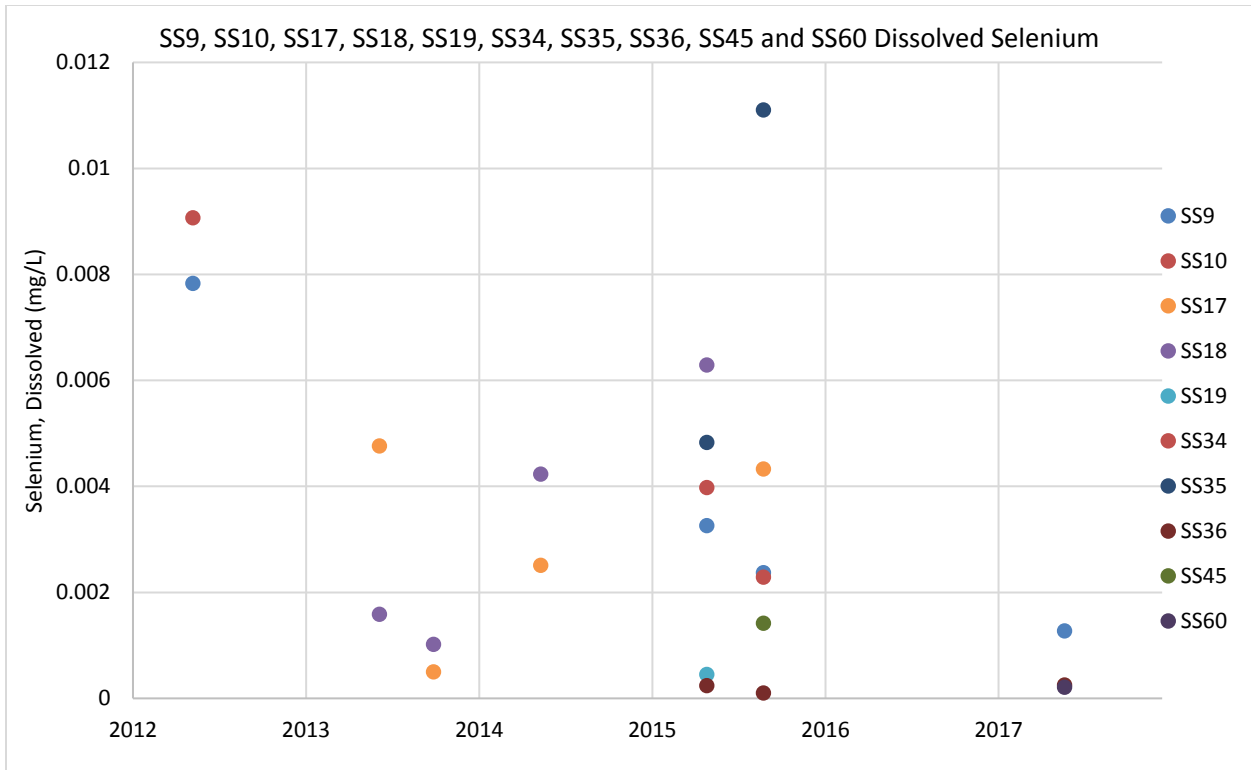


Figure 7-59: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, SS45 and SS60 Dissolved Selenium

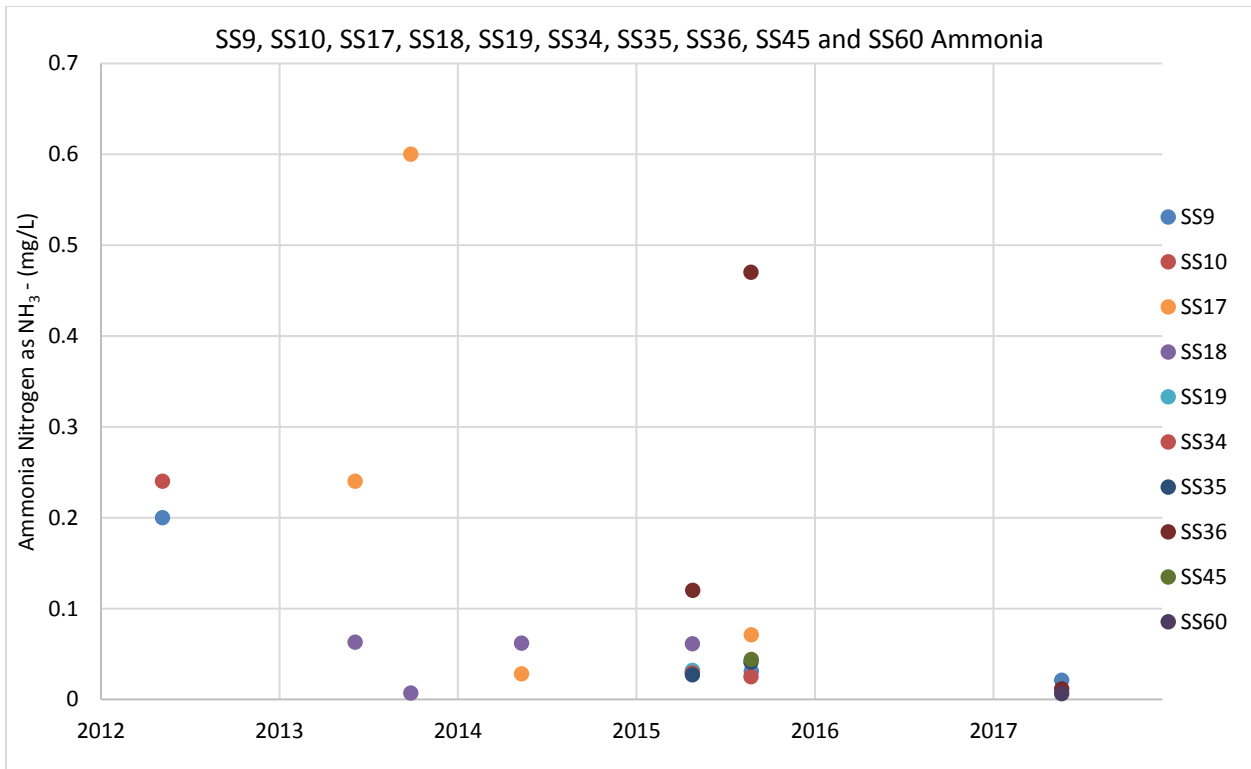


Figure 7-60: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, SS45 and SS60 Ammonia

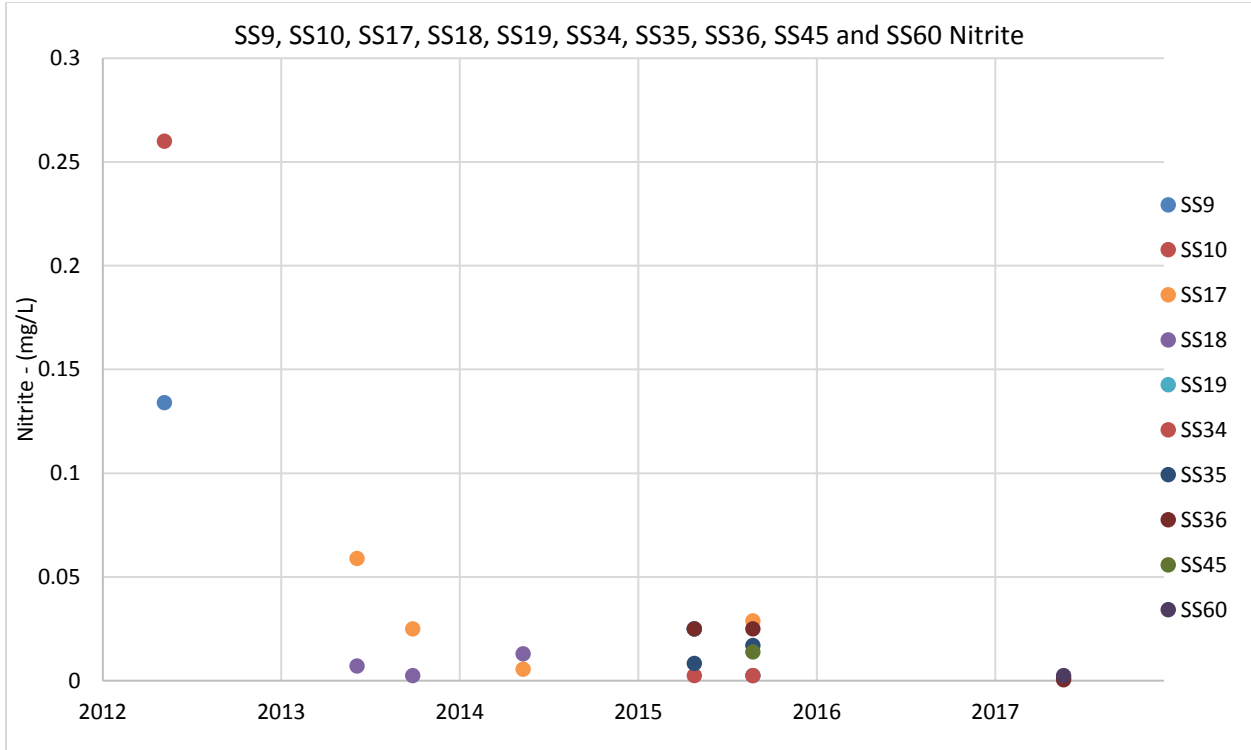


Figure 7-61: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, SS45 and SS60 Nitrite

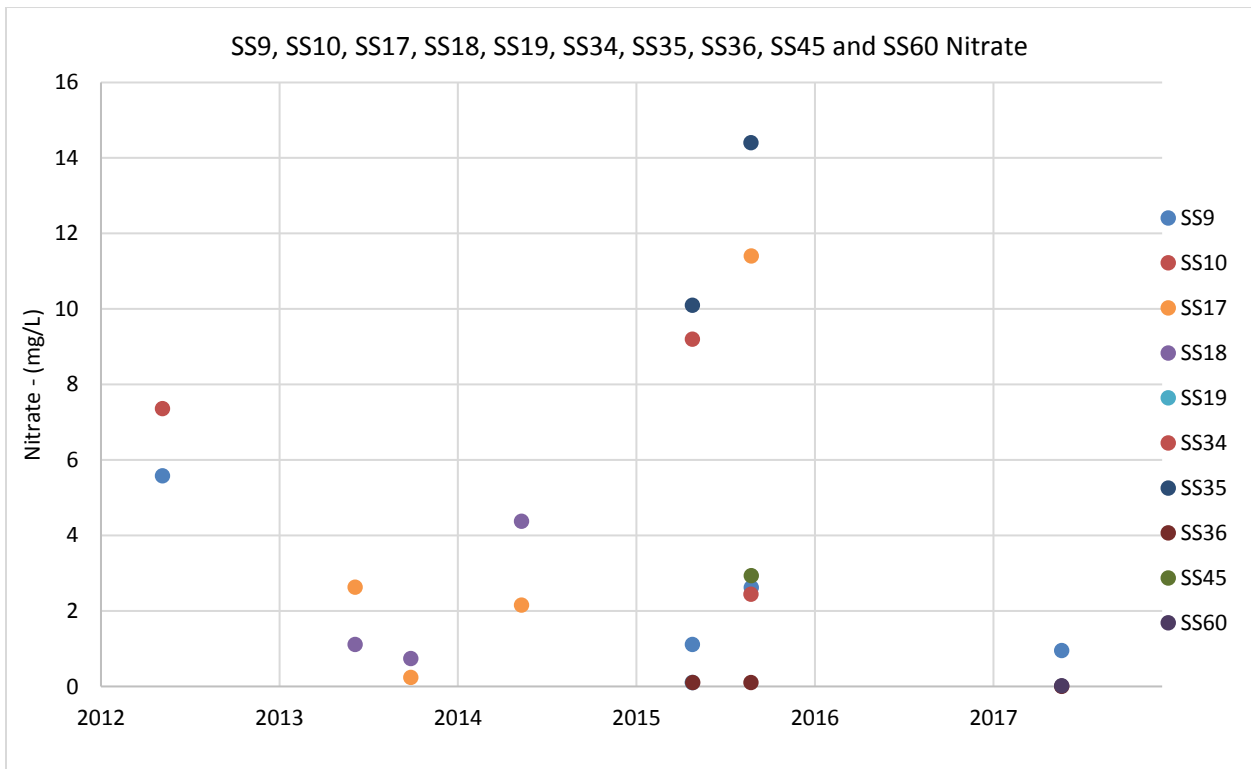


Figure 7-62: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, SS45 and SS60 Nitrate

7.6 Ore Stockpiles

Surface seepage runs along the toe of the west ore stockpile and into the ditch parallel to the heavy vehicle road. All seeps in this area drain into the west ore stockpile sump and are pumped to the Main pit. Seepage monitoring stations SS5, SS6, SS7, SS8 and SS33 capture seepage from the stockpile during spring and fall sampling program, SS59 was discovered during Spring 2017. Seepage sites SS46 and SS47 at the toe of the underground ore stockpiles were discovered and added to the network in the fall of 2015. Water quality results are outlined in Figure 7-63 through Figure 7-70 and include historic water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

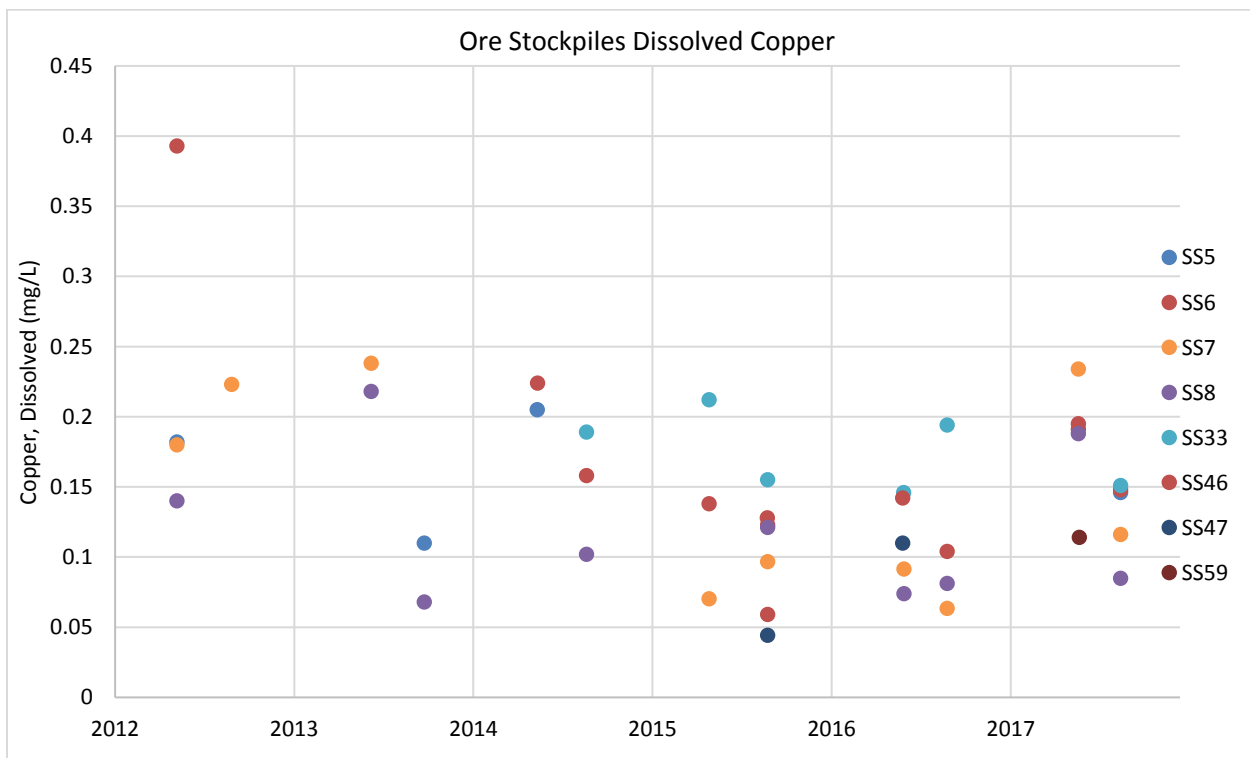


Figure 7-63: Ore Stockpile Dissolved Copper

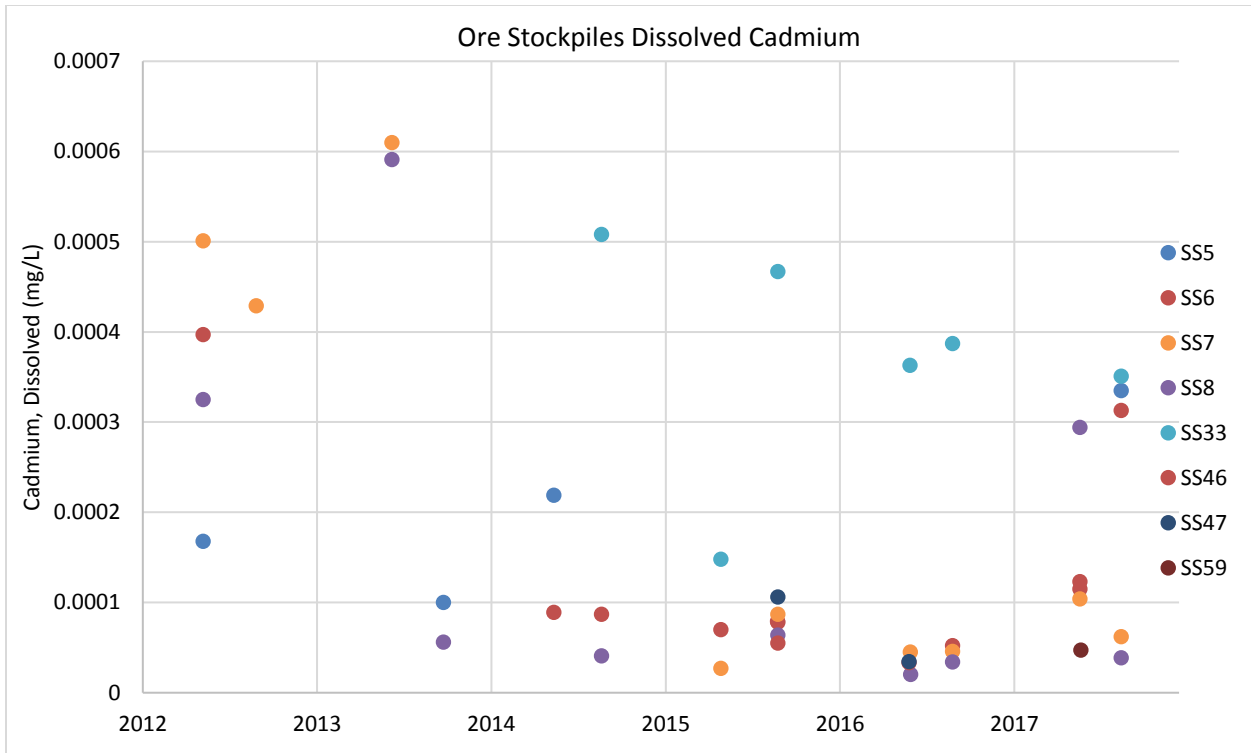


Figure 7-64: Ore Stockpile Dissolved Cadmium

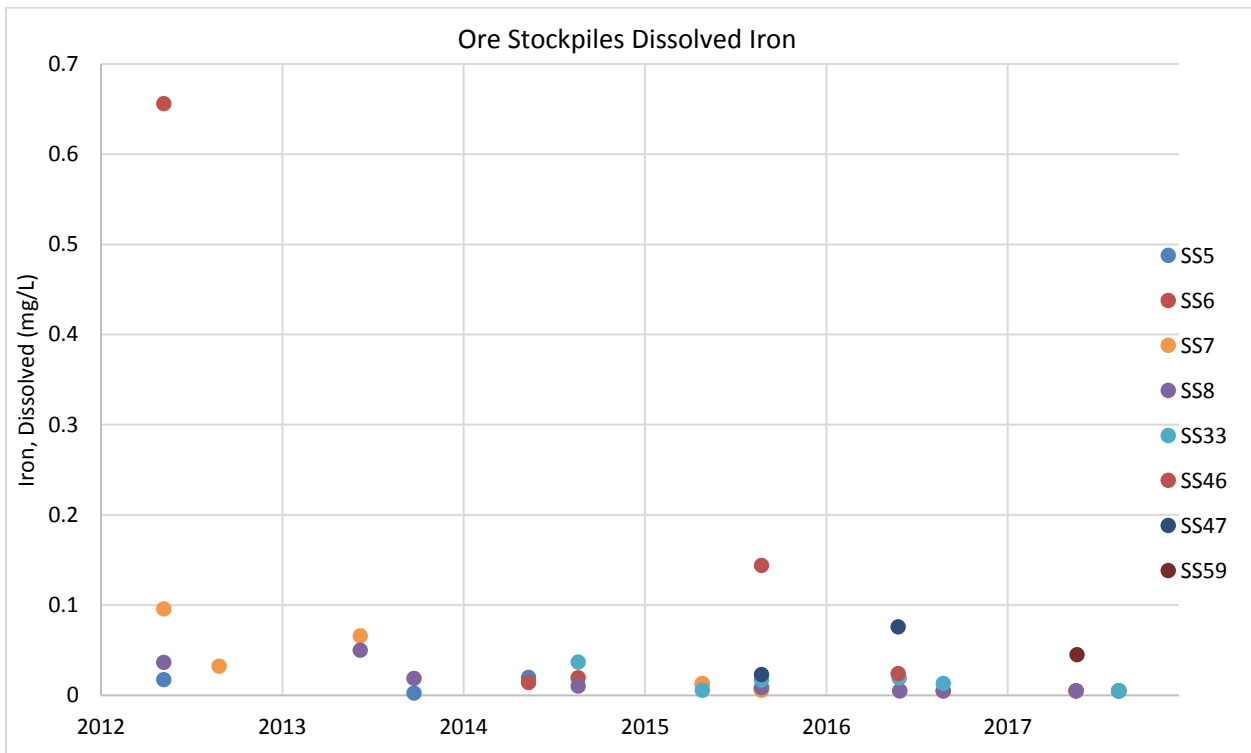


Figure 7-65: Ore Stockpile Dissolved Iron

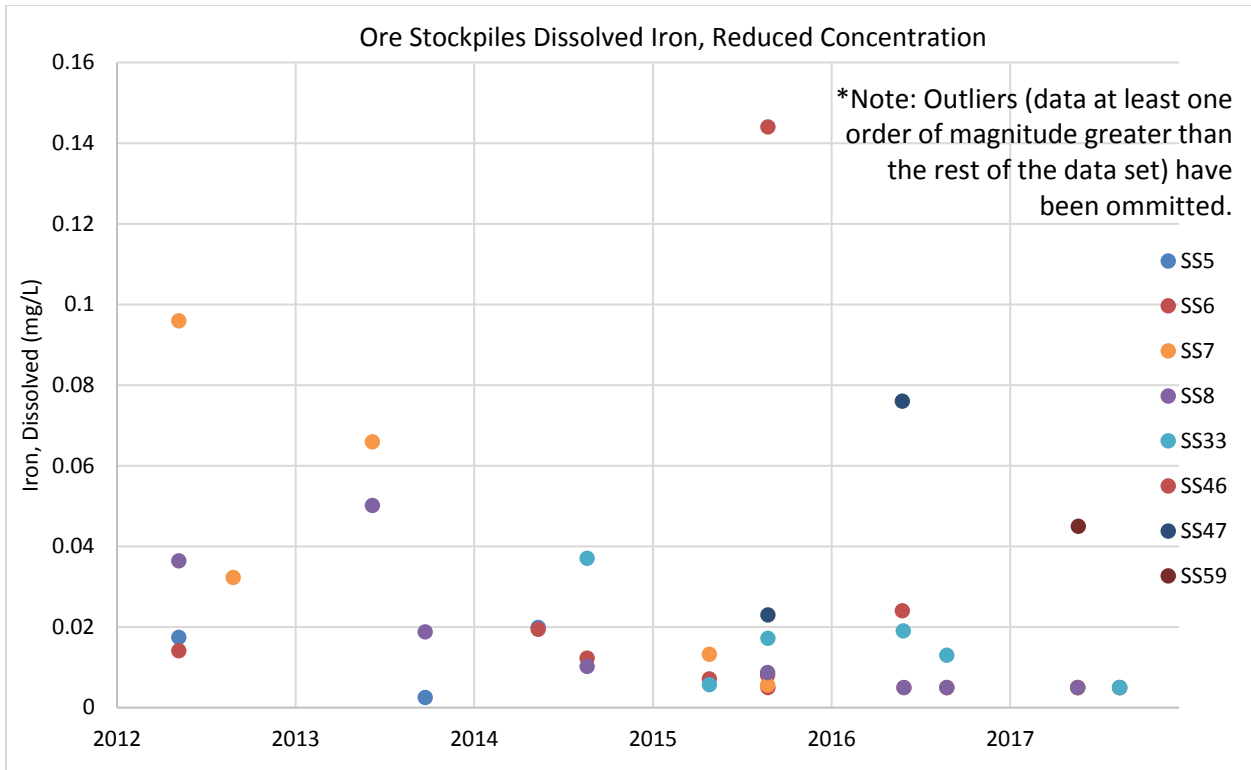


Figure 7-66: Ore Stockpile Dissolved Iron (Reduced Concentration)

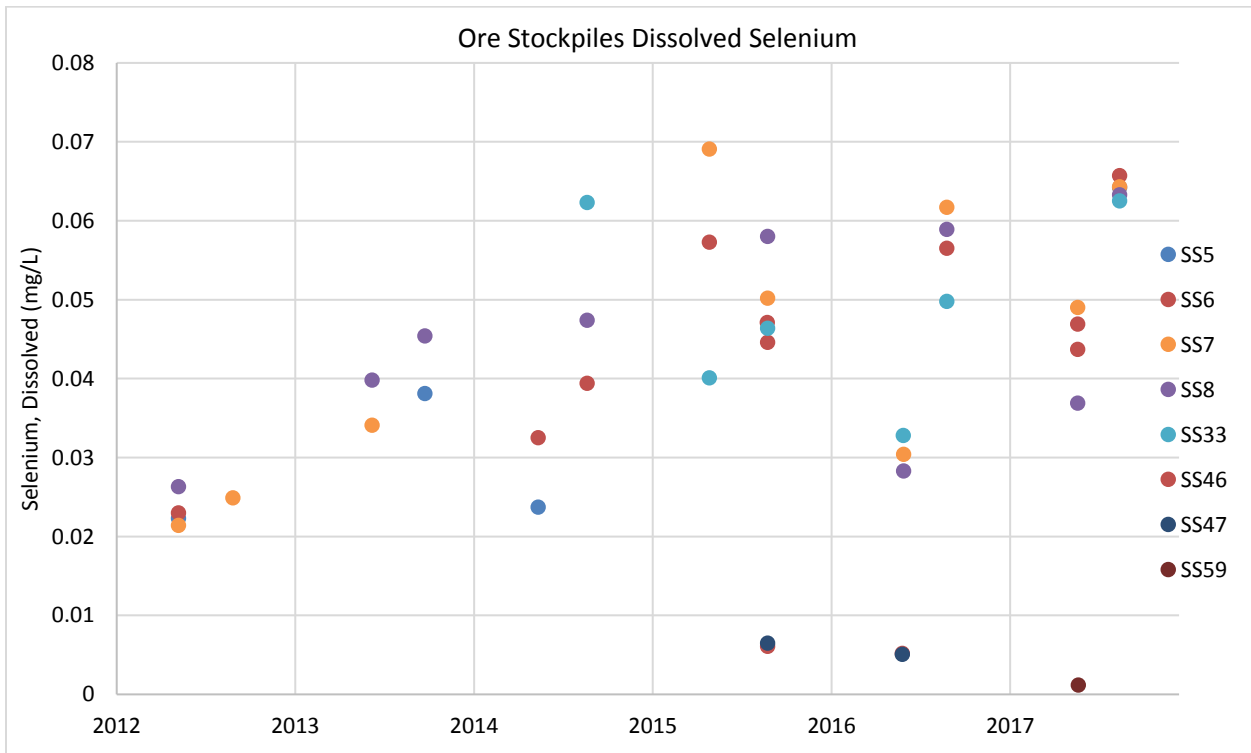


Figure 7-67: Ore Stockpile Dissolved Selenium

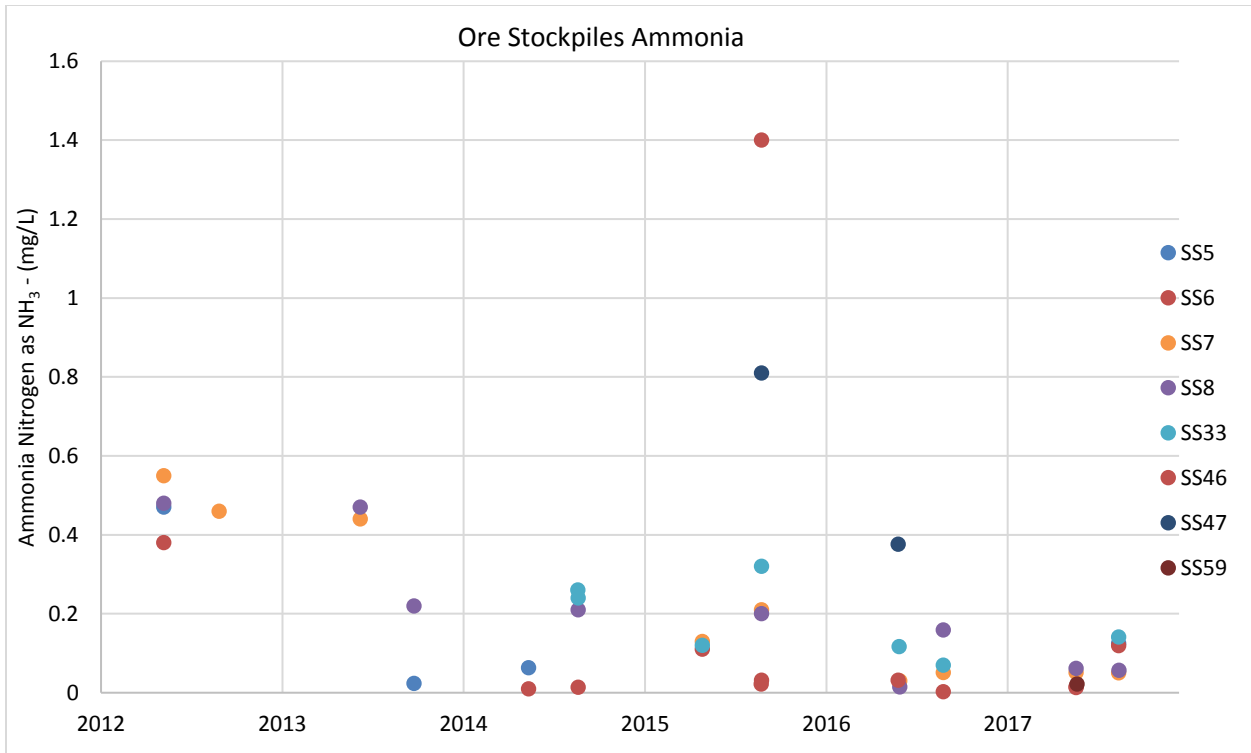


Figure 7-68: Ore Stockpile Dissolved Ammonia

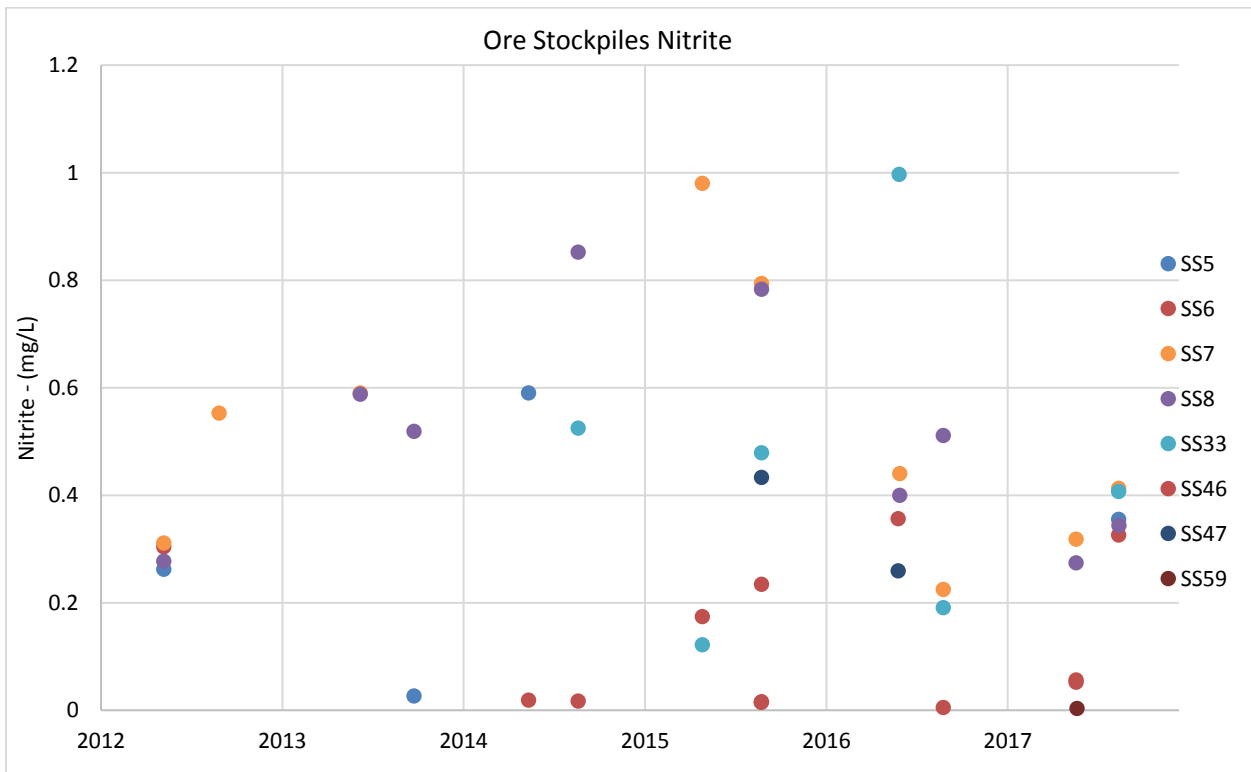


Figure 7-69: Ore Stockpile Dissolved Nitrite

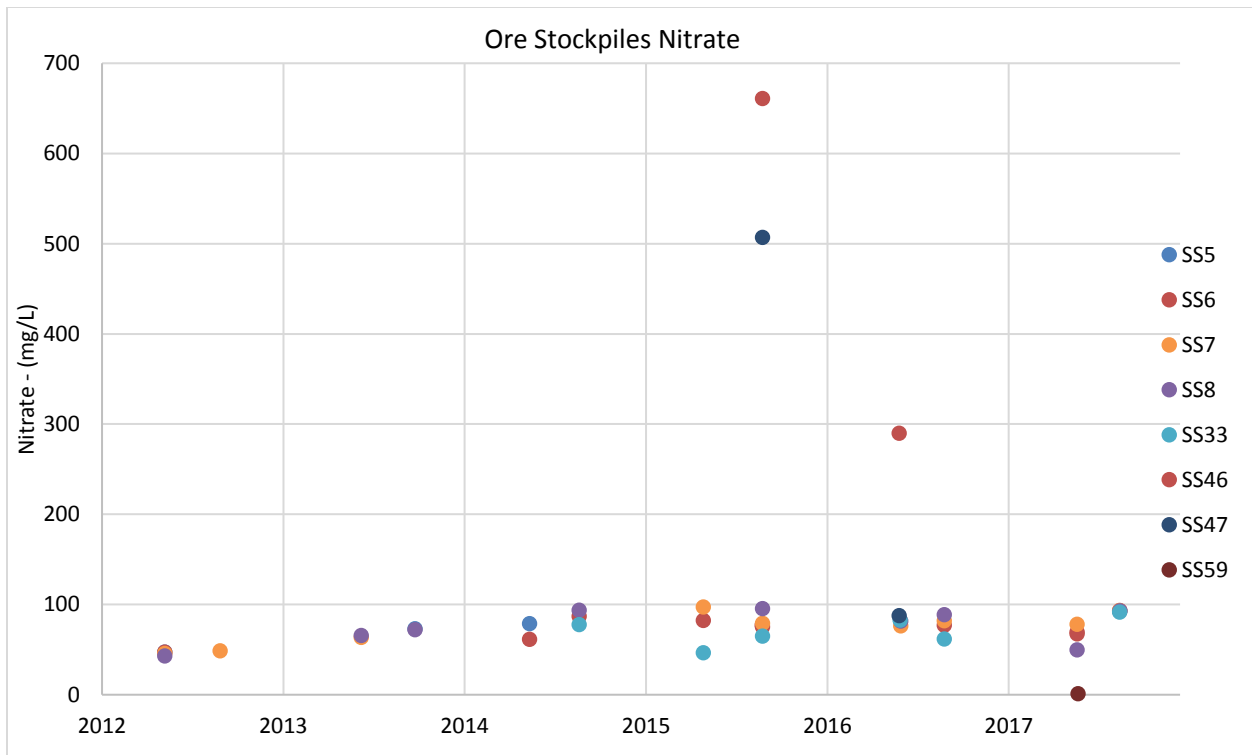


Figure 7-70: Ore Stockpile Dissolved Nitrate

7.7 Reclamation Overburden Dump (ROD)

In the 2017 Seepage Monitoring Survey, no water samples were collected from sites SS2, SS3, SS11, SS14, and SS15. All sites along the ROD were observed to be dry during the 2014, 2015, 2016 and 2017 surveys. Therefore, the Seepage Monitoring Program will no longer include surveys of the ROD.

7.8 Main Waste Dump

No new seeps were discovered along the toe of the Main Waste Dump (MWD), and existing seeps were observed to be dry during both sampling events in 2017. Historical data is presented in Figure 7-71 through Figure 7-77 and include water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

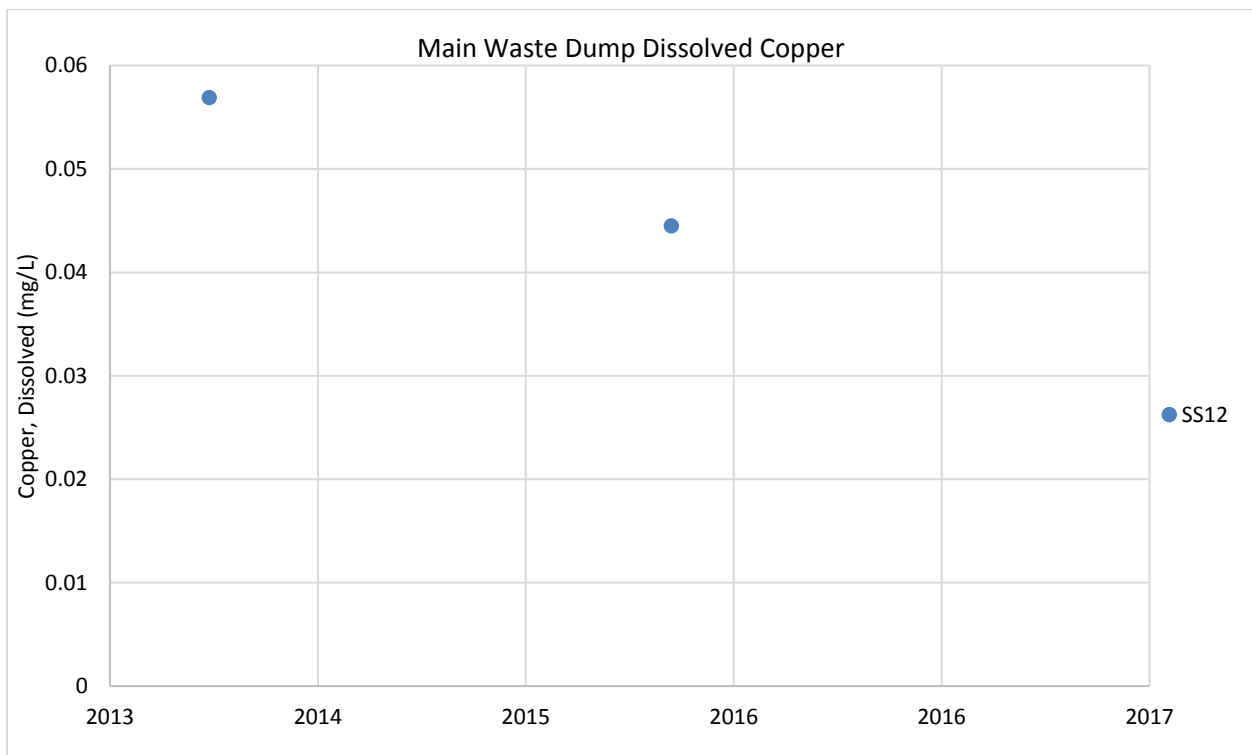


Figure 7-71: Main Waste Dump Dissolved Copper

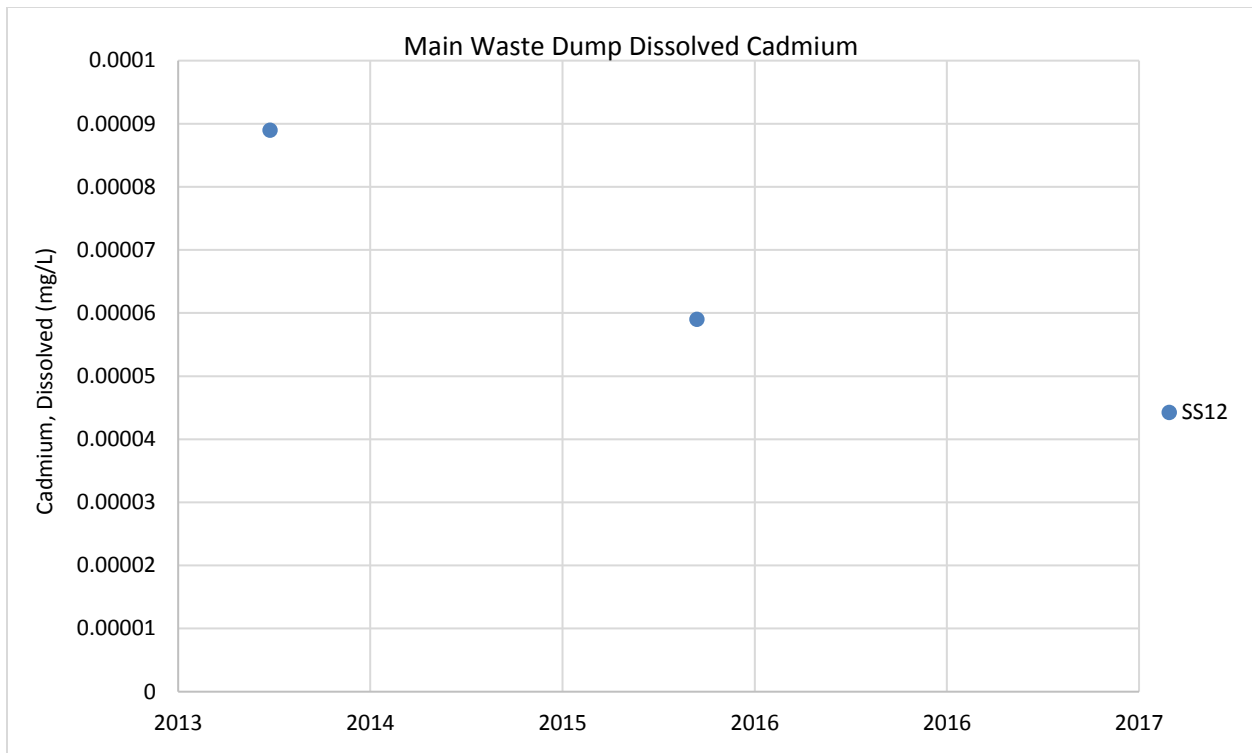


Figure 7-72: Main Waste Dump Dissolved Cadmium



Figure 7-73: Main Waste Dump Dissolved Iron

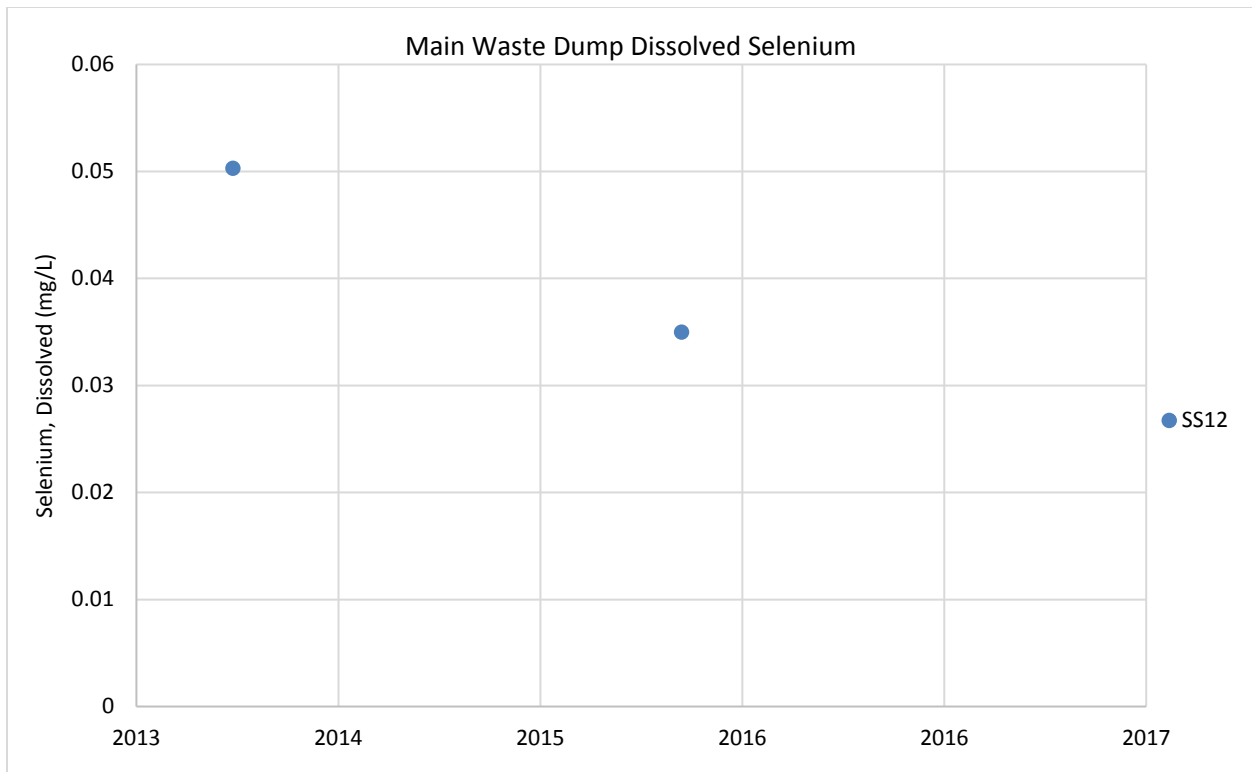


Figure 7-74: Main Waste Dump Dissolved Selenium

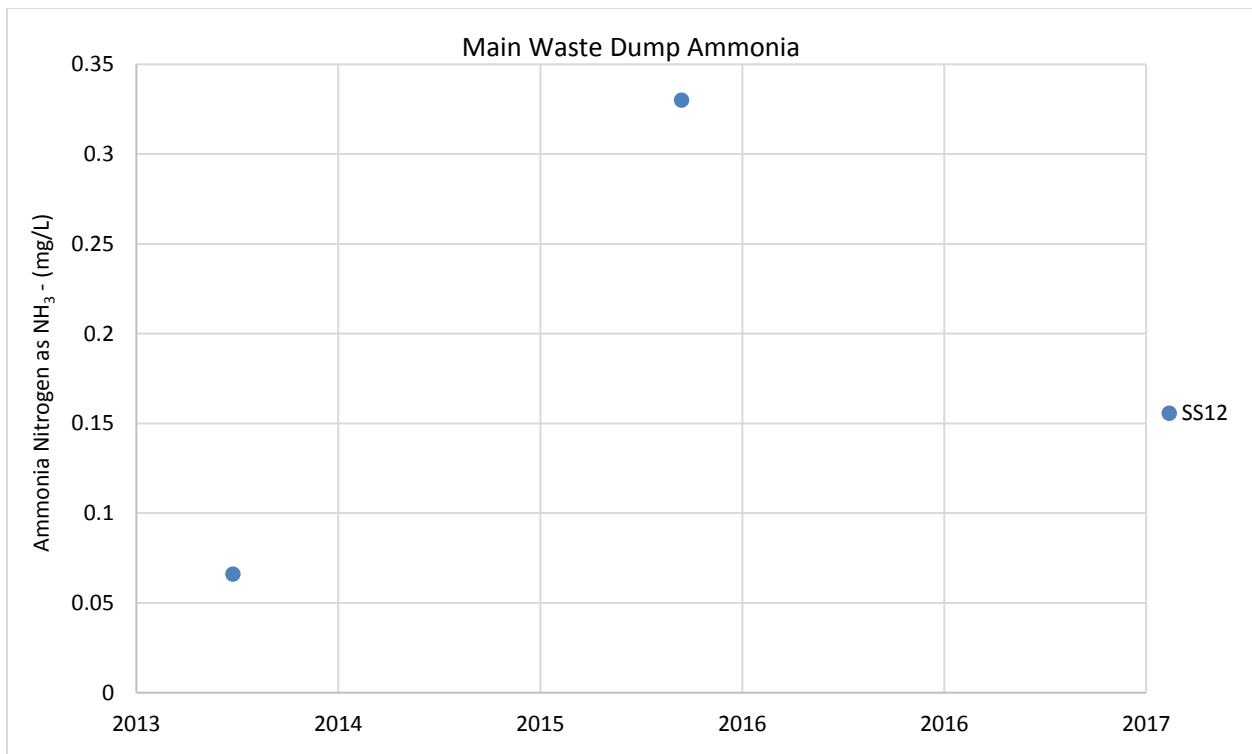


Figure 7-75: Main Waste Dump Ammonia

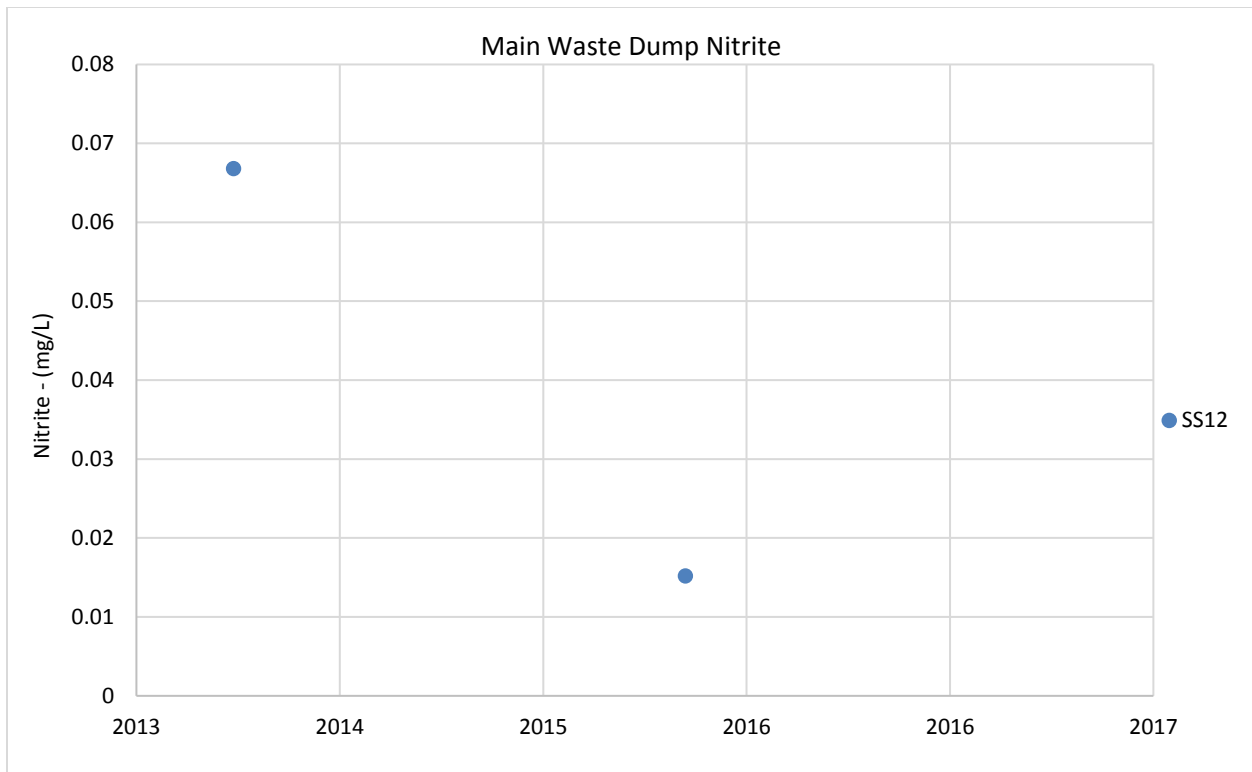


Figure 7-76: Main Waste Dump Nitrite

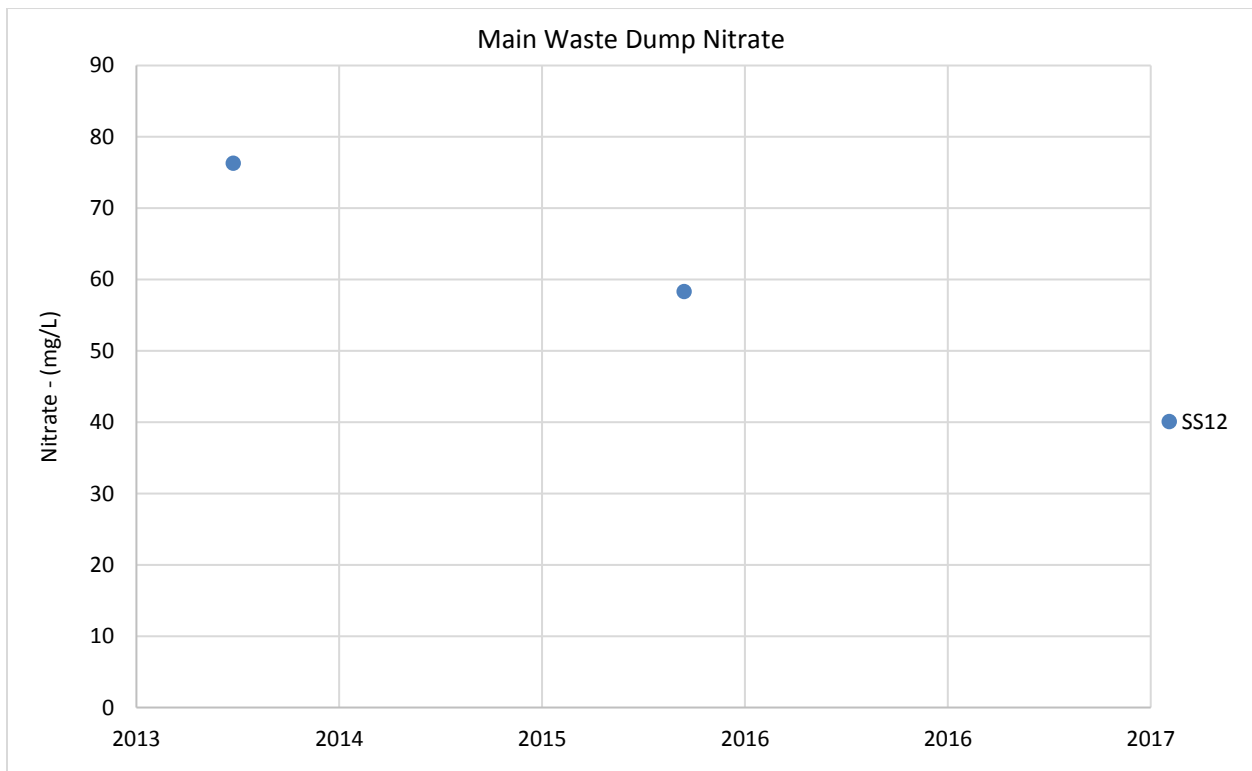


Figure 7-77: Main Waste Dump Nitrate

7.9 Mill Area

SS32 was discovered in 2014 behind the camp along the mill area survey route. SS32 was sampled in both the spring and fall of 2017 and the results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate are displayed in Figure 7-78 through Figure 7-84 along with historical results. No other seeps were identified along the toe of the north ridge behind the camp and mill.

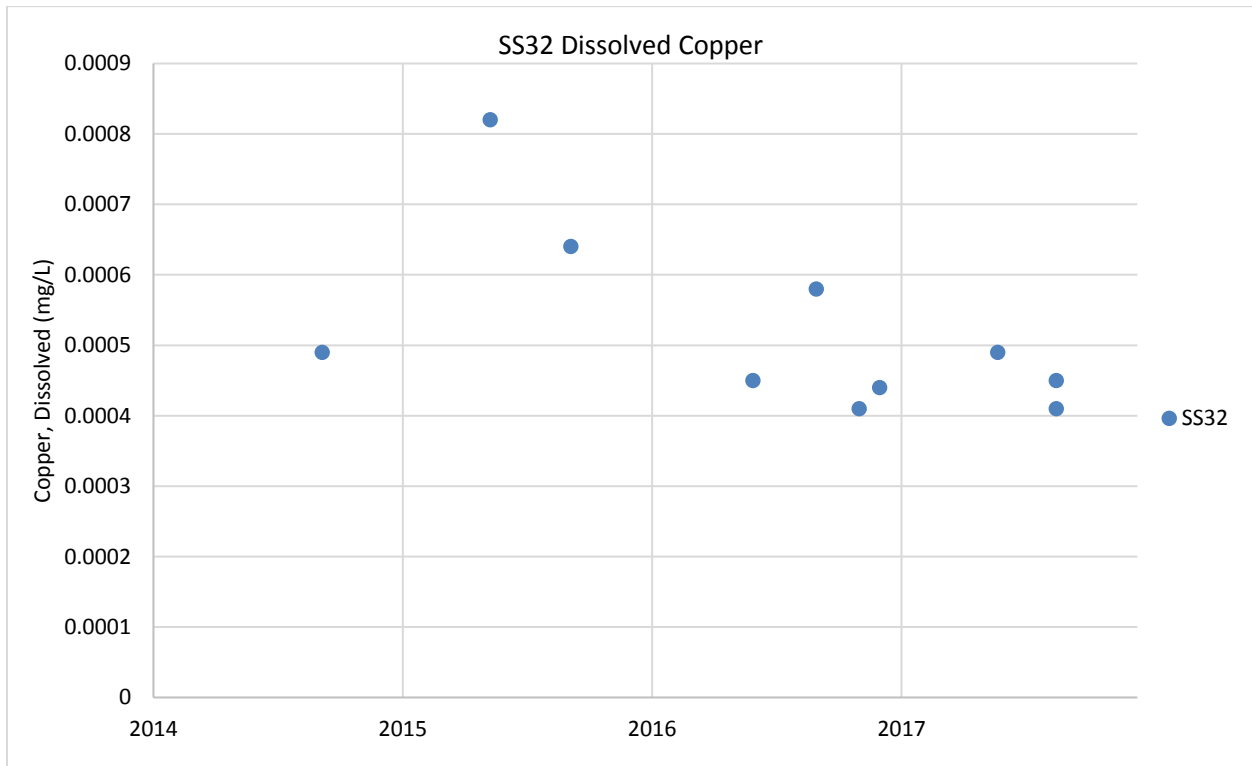


Figure 7-78: SS32 Dissolved Copper

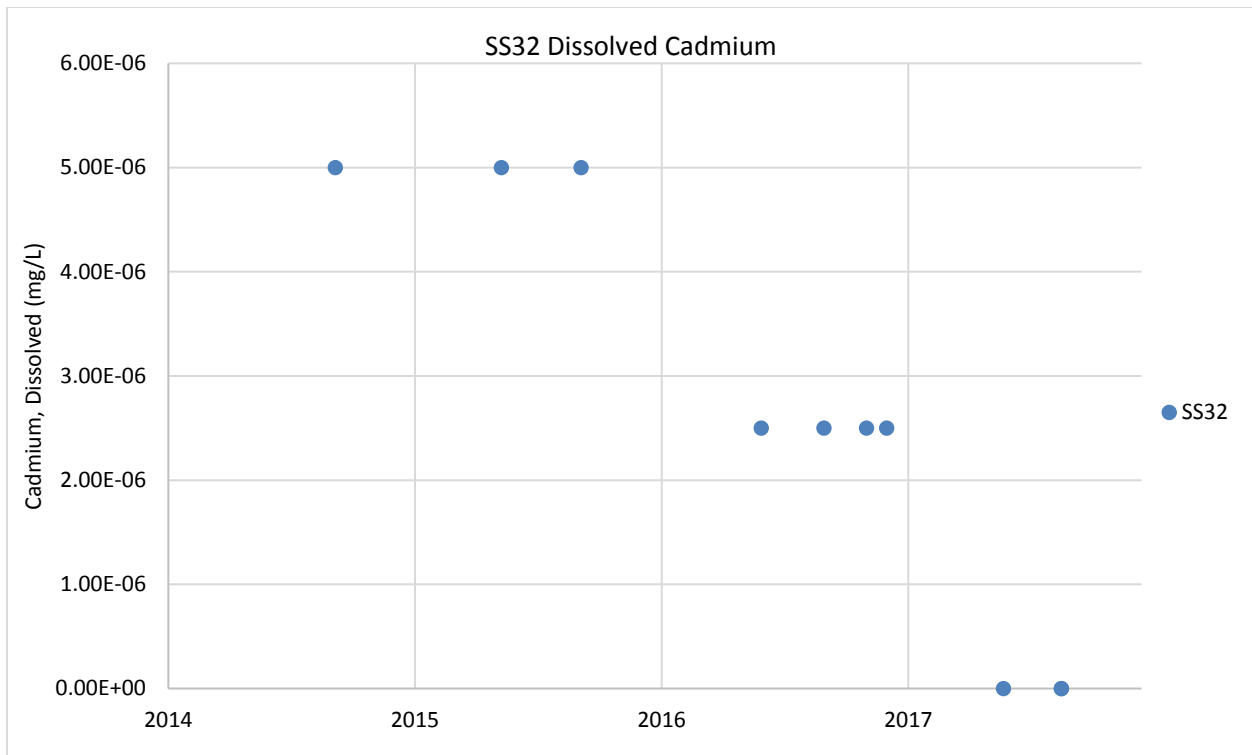


Figure 7-79: SS32 Dissolved Cadmium

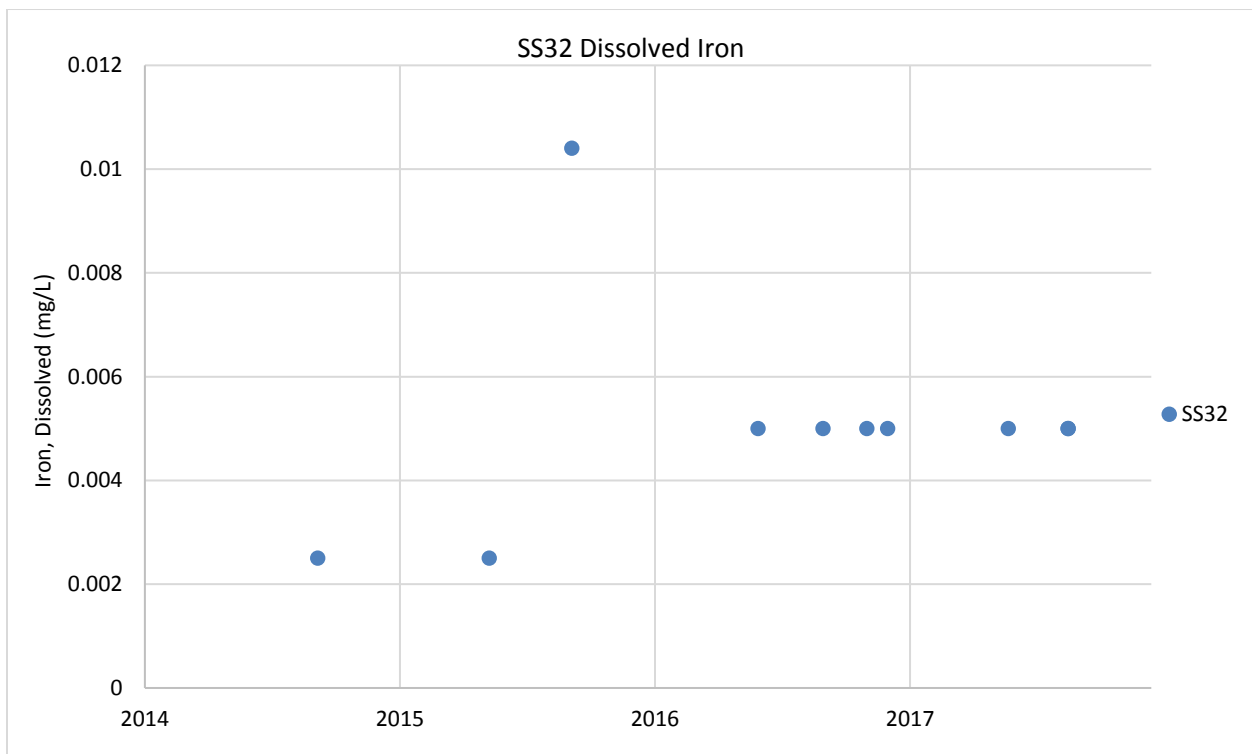


Figure 7-80: SS32 Dissolved Iron

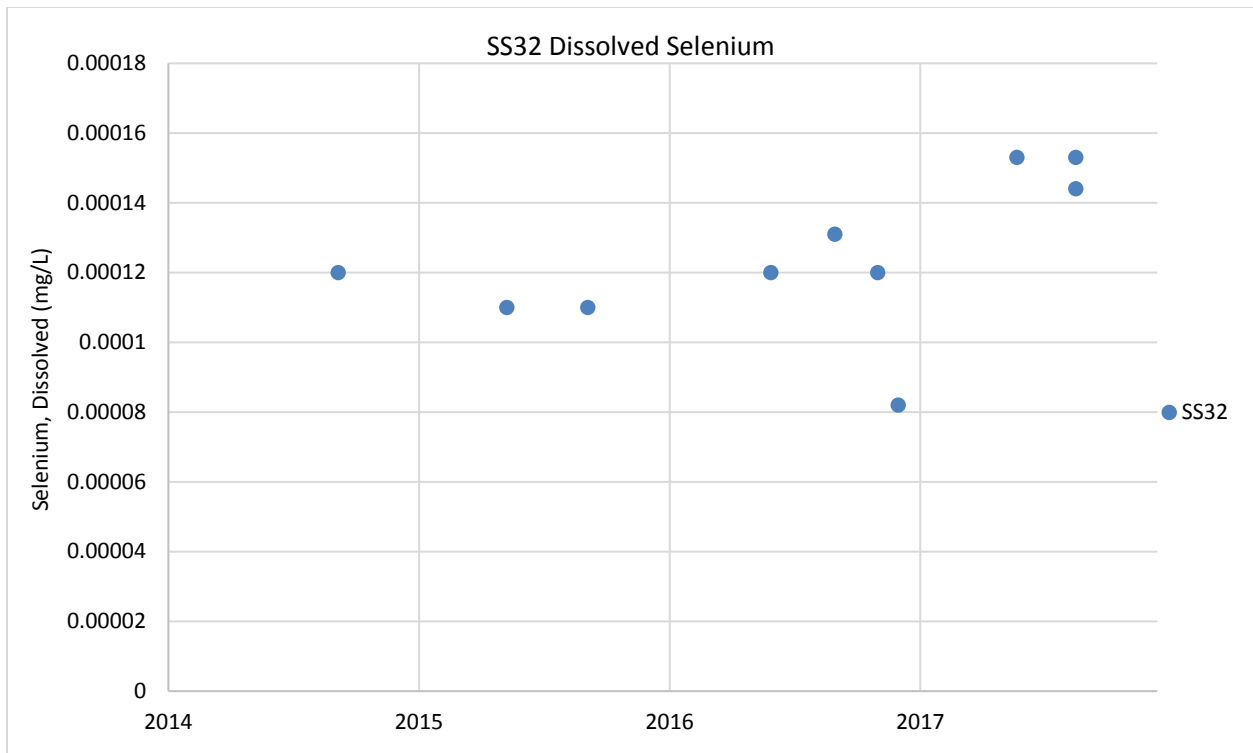


Figure 7-81: SS32 Dissolved Selenium

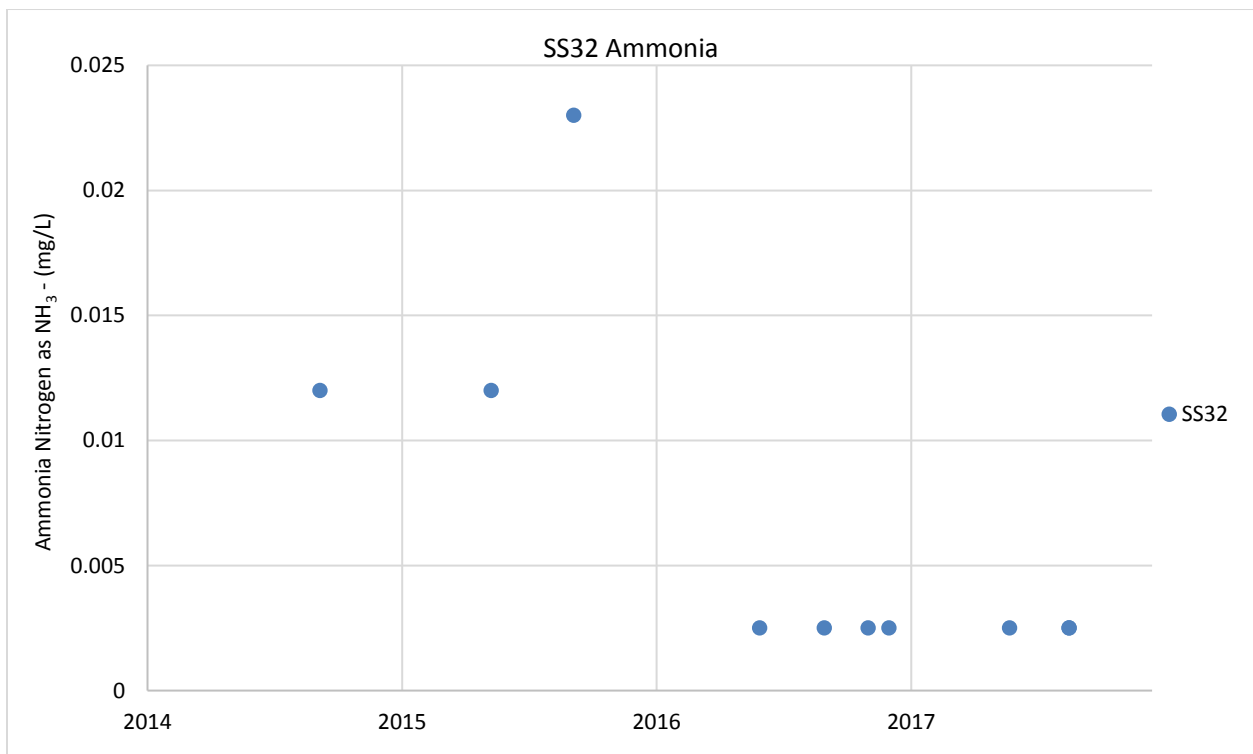


Figure 7-82: SS32 Ammonia

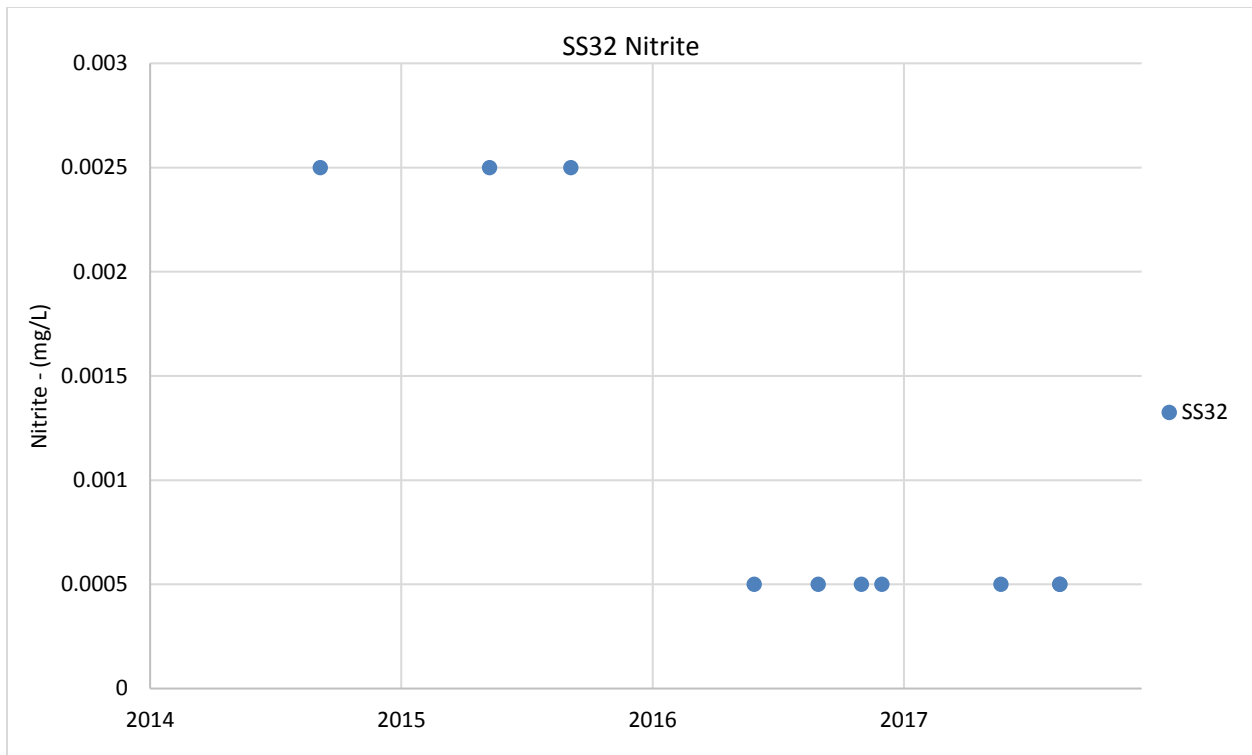


Figure 7-83: SS32 Nitrite

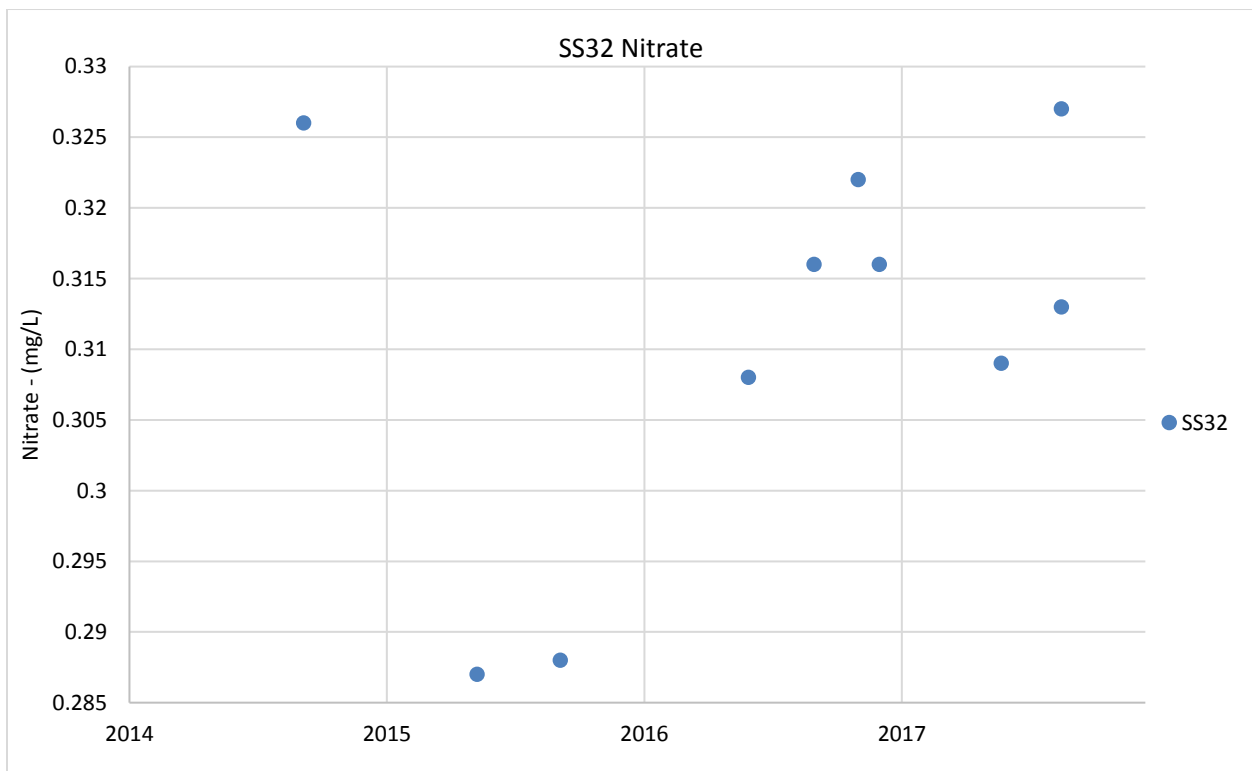


Figure 7-84: SS32 Nitrate

7.10 Pit Walls

Seepage monitoring could not be conducted at the pit walls of the Main Pit, Area 2 Pit, and Minto North Pit; all pits were too unsafe to access during the fall 2017 seepage survey due to geotechnical instability. Records were taken for each pit where seeps were observable from a distance. SS62 is a new seep in area 2 stage 3 pit that was identified in an accessible location and hence was sampled on July 8th, 2017. Results for dissolved copper, cadmium, iron, selenium as well as ammonia, nitrite and nitrate are presented in Table 7-2.

Table 7-2: SS62 Seep Water Quality Results

| SS62 | Concentration (mg/L) |
|----------------------------|----------------------|
| Parameters | |
| Dissolved Copper (Cu) | 0.0142 |
| Dissolved Cadmium (Cd) | 0.0000135 |
| Dissolved Iron (Fe) | <0.010 |
| Dissolved Selenium (Se) | 0.00102 |
| Ammonia (NH ₃) | <0.0050 |
| Nitrite (NO ₂) | <0.0050 |
| Nitrate (NO ₃) | 0.521 |

8 Water Management

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

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

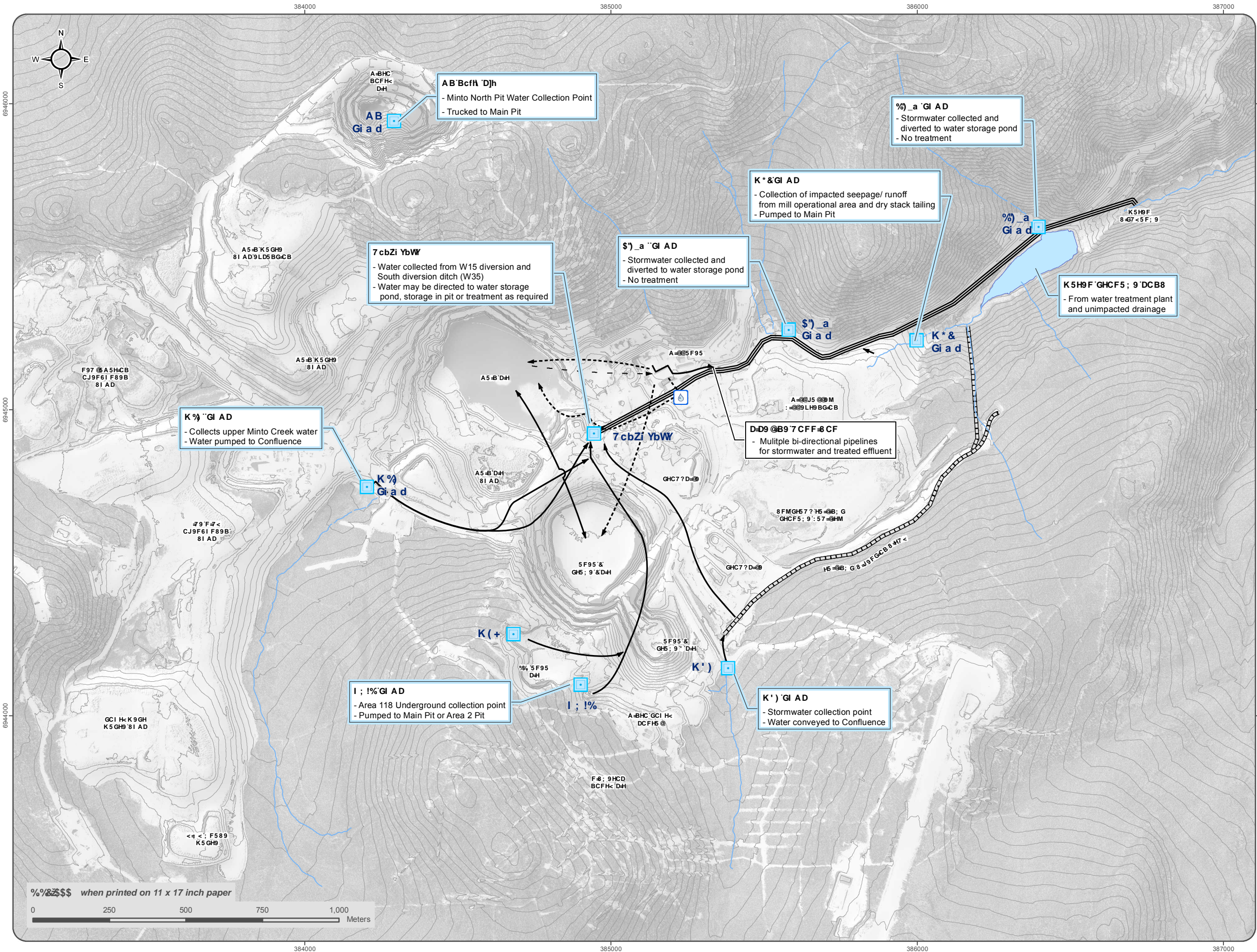
8.1 Water Storage and Conveyance Network

There were two major changes to Minto's conveyance structures in 2017.

- Due to A2S3 pit development the location of the W35 sampling station was relocated to the south, or upstream. W35 now reports via a pipe to the A2 pit or to the Tailings Diversion Ditch, the selection of which is controlled by a valve.
- Area 118 pit (W47) was backfilled with waste rock and off-spec overburden from A2S3 pit development. As such, it is no longer used for water storage.

The strategy for managing the mine water inventory was unchanged in 2017, and the water conveyance network is illustrated in Figure 8-1. Compliant (clean) surface water was collected and diverted to the WSP, and subsequently discharged to Minto Creek. Runoff from developed mine areas (mine water) was collected and stored in the Main Pit and Area 2 Pit, and was used for ore processing, deposition of tailings and feed water for the Water Treatment Plant.

In November 2017, the Main Pit and Area 2 Pit volume calculations were updated with current survey data to reflect changes in tailings and rock deposition from the previous bathymetry survey. Due to this adjustment, it is not possible to present meaningful data for water and tailings volume change over 2017. Instead, 2017 year end volumes are presented.



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- Collection Point
- Mill Water Reclaim Line
- Pipe
- Piping Corridor
- Tailings Slurry Discharge



Aerial imagery obtained from Challenger Geomatics. Imagery acquired Sept 9th 2014.
Site contours derived from 2014 aerial imagery obtained from Challenger Geomatics.

Hydrology data provided by Minto Explorations Ltd, May 2009.

Datum: NAD 83 Projection: UTM Zone 8N

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(Last edited by: amabachetta: 19/12/2017 4:52 PM)

8.2 Water Storage Volumes Movement and Tracking

Water movement is tracked with flow meters on site, monitored and inspected on a weekly basis. Table 8-1 to 8-6 provide a summary of water volumes moved by conveyance structures around site in 2017. Please note that the total and net volume for each facility (WSP, MPTMF, A2PTMF) in the following tables only account for flow meter totals and do not account for evaporation and other losses/inputs.

Table 8-1: Water Storage Pond (WSP) Conveyance for 2017

| WSP | | |
|---------------------------------|--------|---------------|
| Input Volume (m ³) | | Total |
| W15 | 53,512 | 155,087 |
| W35 | 31,947 | |
| WTP | 36,877 | |
| W17 | 32,751 | |
| Output Volume (m ³) | | Total |
| WTP | 0 | 115,646 |
| W17 Seep | 32,751 | |
| Minto Creek (Environment) | 82,895 | |
| Net | | 39,441 |

Table 8-2: Reverse Osmosis (RO) Conveyance for 2017

| WTP | | |
|---------------------------------|--------|---------------|
| Output Volume (m ³) | | Total |
| WSP | 36,877 | 36,870 |
| Output Volume (m ³) | | Total |
| Minto Creek (Environment) | 7 | 7 |
| Total | | 36,877 |

Table 8-3: Main Pit Conveyance for 2017

| Main Pit | | |
|---------------------------------|-----------|---------------|
| Input Volume (m ³) | | Total |
| W62 | 76,314 | 1,737,231 |
| Minto North | 0 | |
| Area 2 Pit | 1,567,439 | |
| W15 | 62,465 | |
| W35 | 31,013 | |
| Output Volume (m ³) | | Total |
| Mill | 1,683,934 | 1,683,934 |
| Net | | 53,297 |

Table 8-4: Area 2 Pit Conveyance for 2017

| Area 2 Pit | | |
|---------------------------------|-----------|-----------|
| Input Volume (m ³) | | Total |
| UG1 | 81,130 | 1,624,309 |
| Mill | 1,543,179 | |
| Output Volume (m ³) | | Total |
| Main Pit | 1,567,439 | 1,567,439 |
| Net | | 56,870 |

Table 8-5: Water Truck Deliveries on Site for 2017

| Water Trucks | | Total (m ³) |
|--------------------------|-------|-------------------------|
| Drills | 566 | 10,886 |
| Nuway/ Mill crusher | 50 | |
| Pit (for cleaning) | 176 | |
| Steamer trailer | 6 | |
| Core shack | 2 | |
| Driftwood | 245 | |
| Dust Suppression | 9,772 | |
| Truck | 36 | |
| Safescape - Construction | 33 | |

The reported volumes are estimates only.

Table 8-6: Well Usage in 2017

| Wells | | Total (m ³) |
|-------|-----------|-------------------------|
| Camp | 10,644.90 | 12,574 |
| ERT | 1929.48 | |

8.2.1 Water Conveyance Tracking

Diversion of W35 water (SDD): Water was diverted from the south catchment (collected at station W35) to the Main Pit and the WSP. An estimated total of 62,960 m³ moved through the SDD in 2017 as measured by a Mace FloSeries® 3 open pipe flow measuring device. The Mace Flo Series device was calibrated to the pipe diameter size before operating, however due to ongoing issues with sediment deposit from haul road on the flow meter, readings were less accurate at times. During periods of heavy hauling in this area, the SDD was diverted to the Main Pit. In September 2017, the SDD was removed due to changes in the construction of the A2S3 pit. New conveyance infrastructure was installed to reroute water from W35 to the TDD or A2 Pit depending on water quality.

Diversion of W15 water: The W15 sump collects surface runoff from adjacent undisturbed catchments, the SWD and part of the MWD. A total of 115,977 m³ was conveyed through the W15 conveyance structure in 2017. The W15 flows were measured and recorded using a Seametrics® mag flow meter with digital head relay module.

Pump Back of W62 water (MVFES2 Sump): Water collected downstream of the mill area, ore stockpiles and DSTSF is collected at the MVFES2 Sump (which replaced the MCDS in 2016) and pumped back to the Main Pit for treatment. A total of 76,314 m³ was conveyed through this structure in 2017. The flow volumes were measured and recorded using a Seametrics® mag flow meter with digital head relay module.

8.2.2 Water Storage Tracking

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

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

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

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

Table 8-7a: Minto Mine Water Storage Inventory, 2017

| Month/ Year | MPTMF Volume Occupied (Water + Tailings) ^A m ³ | Change in MPTMF Water Inventory m ³ /month | Tailings Solids Deposition in MPTMF BCM/month | A2PTMF Volume Occupied (Water + Tailings) ^A m ³ | Change in A2PTMF Water Inventory m ³ /month | Tailings Solids Deposition in A2PTMF BCM/month | WSP Volume ^A m ³ | Change in WSP Water Inventory m ³ /month |
|----------------|---|---|---|--|--|--|--|---|
| Jan-17 | 3,924,000 | 41,000 | 0 | 2,077,000 | -2,000 | 45,000 | 67,000 | -4,000 |
| Feb-17 | 3,965,000 | 48,000 | 0 | 2,120,000 | 5,000 | 40,000 | 63,000 | -5,000 |
| Mar-17 | 4,013,000 | 32,000 | 0 | 2,164,000 | 20,000 | 48,000 | 58,000 | -3,000 |
| Apr-17 | 4,046,000 | -140,000 | 0 | 2,231,000 | 147,000 | 43,000 | 55,000 | 18,000 |
| May-17 | 3,906,000 | 68,000 | 0 | 2,421,000 | 43,000 | 47,000 | 73,000 | 5,000 |
| Jun-17 | 3,974,000 | 71,000 | 0 | 2,511,000 | -29,000 | 47,000 | 78,000 | 6,000 |
| Jul-17 | 4,045,000 | 17,000 | 0 | 2,529,000 | 24,000 | 43,000 | 84,000 | -5,000 |
| Aug-17 | 4,061,000 | 63,000 | 0 | 2,596,000 | -17,000 | 40,000 | 79,000 | -7,000 |
| Sep-17 | 4,124,000 | -8,000 | 0 | 2,618,000 | 98,000 | 41,000 | 72,000 | 6,000 |
| Oct-17 | 4,116,000 | -162,000 | 0 | 2,757,000 | 162,000 | 45,000 | 77,000 | 0 |
| Nov-17 | 3,954,000 | -100,000 | 0 | 2,964,000 | 89,000 | 39,000 | 77,000 | -4,000 |
| Dec-17 | 3,854,000 | 49,000 | 0 | 3,092,000 | -37,000 | 42,000 | 74,000 | -2,000 |
| Jan-18 | 3,903,000 | | 0 | 3,098,000 | | | 72,000 | |
| SUM | | -22,000 | 0 | | 501,000 | 524,000 | | 6,000 |

Table 8-8b: Water Balance Summary for the Minto Mine Site 2017 (Jan to Dec)

| | Units | Main Pit TMF | Area 2 Pit TMF | WSP |
|---|----------------------|----------------|----------------|-------|
| Volume Change 2017 (water + tailings) | m ³ | -22,000 | 1,021,000 | 6,000 |
| Tailings Deposited, total | BCM | - | 524,000 | - |
| Water Volume Change 2017 | m ³ | -22,000 | 501,000 | 6,000 |
| Estimated Groundwater Inflow | m ³ | - | 30,000 | - |
| Total Water Inventory Increase in 2017 | m³ | 515,000 | | |
| Total Water Discharged to Minto Creek | m ³ | 80,000 | | |
| Total Site-Wide Yield in 2017 | m³ | 595,000 | | |

8.2.3 Water Conveyance Construction

Maintenance activities consisted of routine maintenance on water conveyance structures. In September 2017, the SDD was removed due to changes in the construction of the A2S3 pit. New conveyance infrastructure was installed to reroute water from W35 to the TDD or A2 Pit depending on water quality.

W47 (Area 118 Pit Sump) was backfilled with waste rock and off-spec overburden from the A2S3 pit.

At the end of 2017 the W45 piping from A2 pit to the Main pit was moved from the west side to the east side of the pit to improve access and facilitate pumping.

8.2.4 Water Balance and Water Quality Predictions Modeling

As per the WUL Clause 108, Minto is required to update the Water Balance and Water Quality Model. Minto retained SRK Consulting to complete a 2017 site water balance and water quality prediction model update. An updated 2017 Water Balance and Water Quality Model Summary for the Minto Mine is provided by SRK Consulting in [Appendix E](#).

8.3 Water treatment

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

Minto has the option of treating for:

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

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

8.3.1 Operations Overview

The water treatment plant operated 62 days in 2017. From April 14 to May 31, 2017 and again from June 7 to June 21, 2017. The RO units operated for 729.6 hours producing 36,877.7 m³ of permeate. A total of 36,877.7 m³ of water was discharged to the WSP. The water treatment plant was shut down on June 21 because the nitrite concentrations in the effluent were above discharge criteria due to contaminant build up and membrane fouling.

Recovery for the water treatment plant in 2017 was low at 27.7% due to the high nitrite levels in the permeate.

Table 8-9: WTP Operating Statistics (2017)

| WTP Statistics 2017 | |
|---|---------|
| Plant Feed (m ³) | 132,910 |
| RO Treated (m ³) | 36,877 |
| Discharged to WSP (including blending) (m ³) | 36,877 |
| Runtime (hour) (Discharge hours) | 729.6 |
| Recovery (%) | 27.7 |
| Reagent Consumption | |
| Polyclear 2528 (floc) (m ³) | 7 |
| Average Flow Rate floc (average ml/min) | 2200 |
| Hydrex (m ³) | 12 |
| Average Flow Rate Hydrex (average ml/min) | 52 |
| Actisand (85 micron sand) kg | 365 |
| Sodium Bicarbonate (m ³) | 27 |
| Antiscalant liters | 911 |
| 1 micron filters each | 492 |
| RO membranes each | 120 |
| CUNO 10 micron filters each | 96 |

Table 8-10: WTP Constituent Removal Summary (2017)

| Parameter | Units | Average WTP Intake | Average WTP Product (RO) |
|--------------------------------|----------|--------------------|--------------------------|
| pH-L | pH units | 7.3 | 6.4 |
| Cond-L | µS/cm | 2137 | 158.7 |
| TDS | mg/L | 1792 | 101.4 |
| TSS | mg/L | 5.57 | 1.0 |
| Nutrients (mg/L) | | | |
| Ammonia | mg/L | 5.08 | .8852 |
| N-NO2 | mg/L | .9974 | .51 |
| N-NO3 | mg/L | 15.31 | 5.731 |
| Dissolved Metals (mg/L) | | | |
| Al-D | mg/L | 0.027 | 0.02 |
| Cd-D | mg/L | 0.00006966 | 0.00007 |
| Cr-D | mg/L | 0.00016 | 0.00010 |
| Cu-D | mg/L | 0.0414 | 0.0063 |
| Fe-D | mg/L | 0.021 | 0.011 |
| Pb-D | mg/L | 0.000093 | 0.000055 |
| Mo-D | mg/L | 0.0686 | 0.00184 |
| Ni-D | mg/L | 0.00276 | 0.0005 |
| Se-D | mg/L | 0.01119 | 0.00150 |
| Zn-D | mg/L | 0.0044 | 0.0037 |

8.4 Water Discharge

8.4.1 Discharge Volumes

Minto Mine discharged approximately 81,303.68 m³ of water to Minto Creek from the WSP via W16A in 2017. An additional 7 m³ was discharged from the WTP/RO to Minto Creek, this is discussed in the water quality section.

8.4.2 Compliance

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

The calculated maximum allowable discharge was exceeded on one occasion in 2017. On May 31st the mine discharged 1554 m³ while the calculated allowable volume was 1553m³. This exceedance was believed to be due to a fluctuation in the pumping and was reported in the monthly WUL report. When the calculations were reviewed in July, the actual discharge was determined to be 1550 m³, with a maximum allowable discharge of 1379 m³. There were no other exceedances, before or after the

calculation correction. The 2017 daily discharge corrected values are presented in Table 8-10 and is presented graphically in Figure 8-2 below.

Table 8-11: 2017 Discharge Data

| Date | Daily flow rate in Minto Creek | Treated water from RO to Minto Creek, <i>day previous</i> | Daily water discharged WSP to Environment, <i>day previous</i> | Actual Daily Discharge | Qeff-c, Maximum Allowable Daily Discharge |
|-----------|--------------------------------|---|--|------------------------|---|
| 1-May-17 | 0.145 | 0 | 0 | 818 | 4176 |
| 2-May-17 | 0.079 | 0 | 818 | 1070 | 2003 |
| 3-May-17 | 0.171 | 0 | 1070 | 1068 | 4568 |
| 4-May-17 | 0.110 | 0 | 1068 | 1066 | 2812 |
| 5-May-17 | 0.296 | 0 | 1066 | 1070 | 8169 |
| 6-May-17 | 0.202 | 0 | 1070 | 1074 | 5461 |
| 7-May-17 | 0.113 | 0 | 1074 | 1076 | 2896 |
| 8-May-17 | 0.113 | 0 | 1076 | 838 | 2896 |
| 9-May-17 | 0.123 | 0 | 838 | 1084 | 3263 |
| 10-May-17 | 0.085 | 0 | 1084 | 1085 | 2087 |
| 11-May-17 | 0.079 | 0 | 1085 | 1094 | 1913 |
| 12-May-17 | 0.093 | 0 | 1094 | 1095 | 2314 |
| 13-May-17 | 0.122 | 0 | 1095 | 1091 | 3149 |
| 14-May-17 | 0.121 | 0 | 1091 | 1096 | 3121 |
| 15-May-17 | 0.093 | 0 | 1096 | 1101 | 2313 |
| 16-May-17 | 0.102 | 0 | 1101 | 1107 | 2571 |
| 17-May-17 | 0.130 | 0 | 1107 | 1100 | 3375 |
| 18-May-17 | 0.066 | 0 | 1100 | 1118 | 1534 |
| 19-May-17 | 0.100 | 0 | 1118 | 1118 | 2507 |
| 20-May-17 | 0.079 | 0 | 1118 | 1134 | 1903 |
| 21-May-17 | 0.070 | 0 | 1134 | 1142 | 1638 |
| 22-May-17 | 0.081 | 0 | 1142 | 1159 | 1952 |
| 23-May-17 | 0.093 | 0 | 1159 | 1161 | 2292 |
| 24-May-17 | 0.074 | 0 | 1161 | 1165 | 1744 |
| 25-May-17 | 0.070 | 0 | 1165 | 1116 | 1628 |
| 26-May-17 | 0.270 | 0 | 1116 | 1161 | 7404 |
| 27-May-17 | 0.171 | 0 | 1161 | 1153 | 4538 |
| 28-May-17 | 0.103 | 0 | 1153 | 1152 | 2582 |
| 29-May-17 | 0.083 | 0 | 1152 | 1623 | 2006 |
| 30-May-17 | 0.086 | 0 | 1623 | 1653 | 1936 |
| 31-May-17 | 0.067 | 0 | 1653 | 1550 | 1379 |
| 1-Jun-17 | 0.068 | 0 | 1550 | 676 | 1442 |

| Date | Daily flow rate in Minto Creek | Treated water from RO to Minto Creek, <i>day previous</i> | Daily water discharged WSP to Environment, <i>day previous</i> | Actual Daily Discharge | Qeff-c, Maximum Allowable Daily Discharge |
|--------------|--------------------------------|---|--|------------------------|---|
| 2-Jun-17 | 0.039 | 0 | 676 | 483 | 898 |
| 3-Jun-17 | 0.072 | 0 | 483 | 1677 | 1913 |
| 4-Jun-17 | 0.268 | 0 | 1677 | 3516 | 7160 |
| 5-Jun-17 | 0.191 | 0 | 3516 | 3909 | 4329 |
| 6-Jun-17 | 0.144 | 0 | 3909 | 2516 | 2844 |
| 7-Jun-17 | 0.1 | 0 | 2516 | 1812 | 2041 |
| 8-Jun-17 | 0.074 | 0 | 1812 | 717 | 1527 |
| 9-Jun-17 | 0.045 | 0 | 717 | 261 | 1057 |
| 10-Jun-17 | 0.047 | 0 | 261 | 619 | 1067 |
| 11-Jun-17 | 0.04 | 0 | 619 | 291 | 586 |
| 12-Jun-17 | 0.343 | 0 | 291 | 3459 | 9461 |
| 13-Jun-17 | 0.227 | 0 | 3459 | 4411 | 5384 |
| 14-Jun-17 | 0.165 | 0 | 4411 | 2095 | 3282 |
| 15-Jun-17 | 0.097 | 0 | 2095 | 1777 | 2095 |
| 16-Jun-17 | 0.081 | 0 | 1777 | 1499 | 1740 |
| 17-Jun-17 | 0.081 | 0 | 1499 | 1666 | 1833 |
| 18-Jun-17 | 0.071 | 0 | 1666 | 1277 | 1489 |
| 19-Jun-17 | 0.054 | 0 | 1277 | 960 | 1130 |
| 20-Jun-17 | 0.053 | 0 | 960 | 1096 | 1207 |
| 21-Jun-17 | 0.05 | 0 | 1096 | 778 | 1075 |
| 22-Jun-17 | 0.034 | 0 | 778 | 474 | 720 |
| 23-Jun-17 | 0.036 | 0 | 474 | 663 | 879 |
| 24-Jun-17 | 0.036 | 0 | 663 | 672 | 816 |
| 25-Jun-17 | 0.03 | 0 | 672 | 628 | 640 |
| 26-Jun-17 | 0.029 | 0 | 628 | 223 | 626 |
| 27-Jun-17 | 0.019 | 0 | 223 | 0 | 473 |
| No discharge | | | | | |
| 11-Jul-17 | 0.04 | 0 | 0 | 642 | 1152 |
| 12-Jul-17 | 0.045 | 0 | 642 | 967 | 1082 |
| 13-Jul-17 | 0.038 | 0 | 967 | 296 | 772 |
| 14-Jul-17 | * | 0 | 296 | 0 | 0 |
| No discharge | | | | | |
| 25-Jul-17 | 0.008 | 0 | 0 | 0 | 230 |
| 26-Jul-17 | 0.028 | 0 | 0 | 333 | 806 |
| 27-Jul-17 | 0.047 | 0 | 333 | 955 | 1243 |
| 28-Jul-17 | 0.05 | 0 | 955 | 772 | 1122 |

| Date | Daily flow rate in Minto Creek | Treated water from RO to Minto Creek, day previous | Daily water discharged WSP to Environment, day previous | Actual Daily Discharge | Qeff-c, Maximum Allowable Daily Discharge |
|--------------|--------------------------------|--|---|------------------------|---|
| 29-Jul-17 | 0.056 | 0 | 772 | 660 | 1355 |
| 30-Jul-17 | 0.038 | 0 | 660 | 673 | 875 |
| 31-Jul-17 | 0.037 | 0 | 673 | 662 | 841 |
| 1-Aug-17 | 0.046 | 0 | 662 | 657.6 | 1104 |
| 2-Aug-17 | 0.031 | 0 | 658 | 434.2 | 674 |
| 3-Aug-17 | 0.023 | 0 | 434 | 313.2 | 518 |
| 4-Aug-17 | 0.022 | 0 | 313 | 309.5 | 529 |
| 5-Aug-17 | 0.015 | 0 | 310 | 137.3 | 329 |
| No discharge | | | | | |

* not measured, not discharging

Water Quality monitoring stations are discussed in Section 5.2.

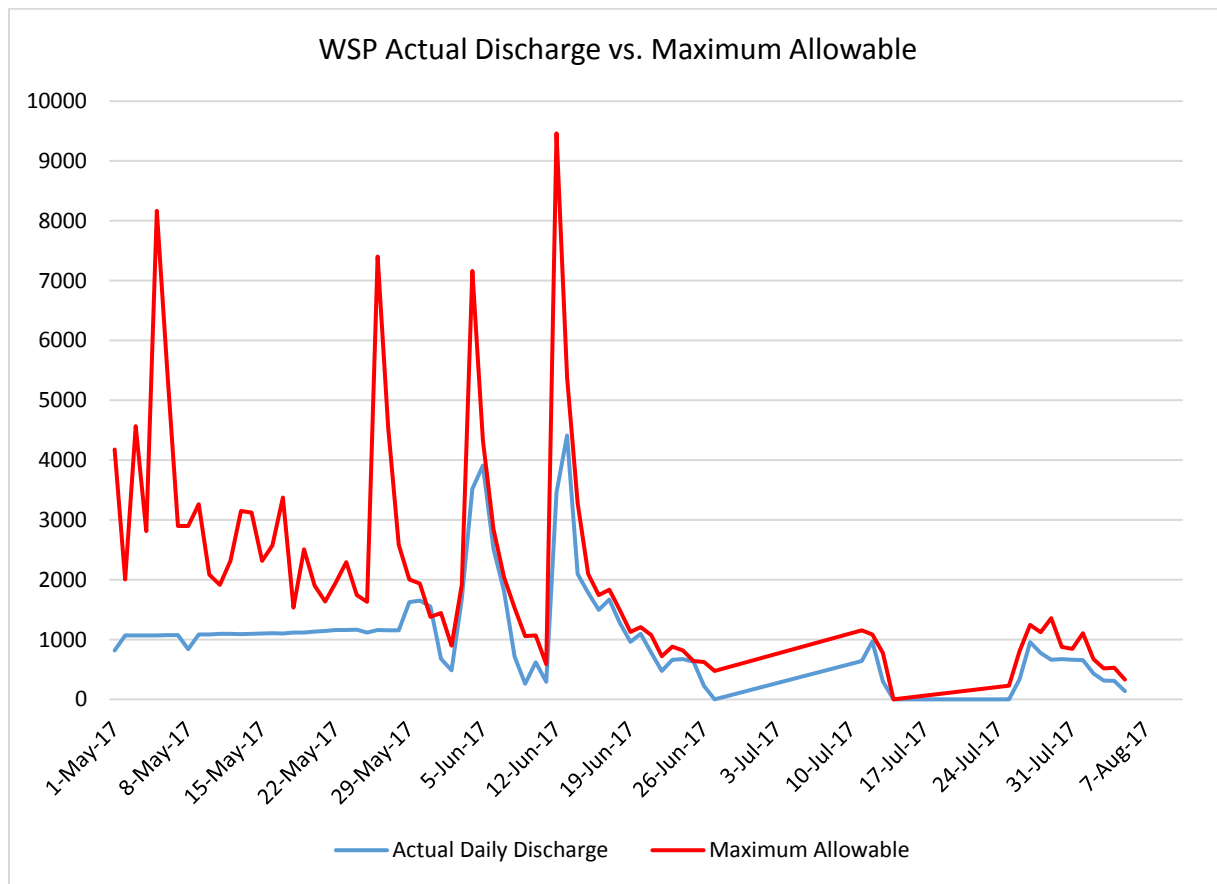


Figure 8-2: 2017 Discharge to Minto Creek

8.5 Hydrology

In 2017, and as part of the EMSRP, Minto monitored hydrological conditions at water quality stations including the following: stations within the operational mine area; stations downstream from the mine operational area that are influenced by mine effluent discharge; and reference stations downstream from the mine operational area that are not exposed to effluent. Hydrological monitoring is performed using a variety of methods including: manual discrete discharge measurements with combinations of flow meters, continuous stage measurements through the deployment of Solinst Level Loggers and Barometric Loggers and monitoring of an engineered flume.

8.5.1 Minto Creek Hydrology

Hydrological monitoring on Minto Creek is conducted in accordance with the requirements outlined in the WUL. During the 2017 monitoring period, Minto Mine maintained and collected data from the following four hydrometric stations along Minto Creek.

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

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

For details on the 2017 results of Minto Creek hydrology see the *Summary of Minto and McGinty Creek 2017 Surface Hydrology Memo* in [Appendix F](#).

8.5.2 McGinty Creek Hydrology

In 2017, hydrological monitoring on McGinty Creek was not conducted as per the schedule outlined in the EMSRP. It was noted late in the season that MN-1.5 was not monitored for continuous flow as there was no suitable location to set up a station in this area, however MN-0.5 was monitored instead. During the 2017 monitoring period, Minto Mine maintained and collected data from the following three hydrometric stations along McGinty Creek.

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

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

For details on the 2017 results of McGinty Creek hydrology see the *Summary of Minto and McGinty Creek 2017 Surface Hydrology Memo* in [Appendix F](#).

8.5.3 Hydrology QA/QC

Detailed procedures for hydrology monitoring at the Minto Mine are detailed in the *Minto Mine Surface Water Hydrology SOP*. No changes were made to the hydrology SOP in 2017.

9 Physical Monitoring Program

Minto's physical monitoring program consists of a combination of instrumentation and visual inspections. Site wide inspections are carried out semi-annually - May/June post thaw and September pre freeze-up. Q2 inspection must be completed by an external geotechnical engineering consultant in accordance with Clause 13.2 of the QML. As specified in the WUL and *Minto Physical Monitoring Plan*, the following additional inspections are also performed:

- Active waste rock and overburden dumps – daily during construction;
- Active open pits – weekly;
- Diversion ditch – daily during water conveyance;
- Dry Stack Tailings Storage Facility, Mill Valley Fill Extension and Mill Valley Fill Extension 2 – monthly;
- Main Pit and Area 2 Pit tailings storage facilities – quarterly; and
- WSP dam – weekly (seepage), monthly (stability).

Deformation monitoring instrumentation includes survey hubs and borehole inclinometers, described in the following sections. A layout of physical monitoring instrumentation is provided in Figure 9-1, below. The updated *Physical Monitoring Plan* can be found in [Appendix G](#).

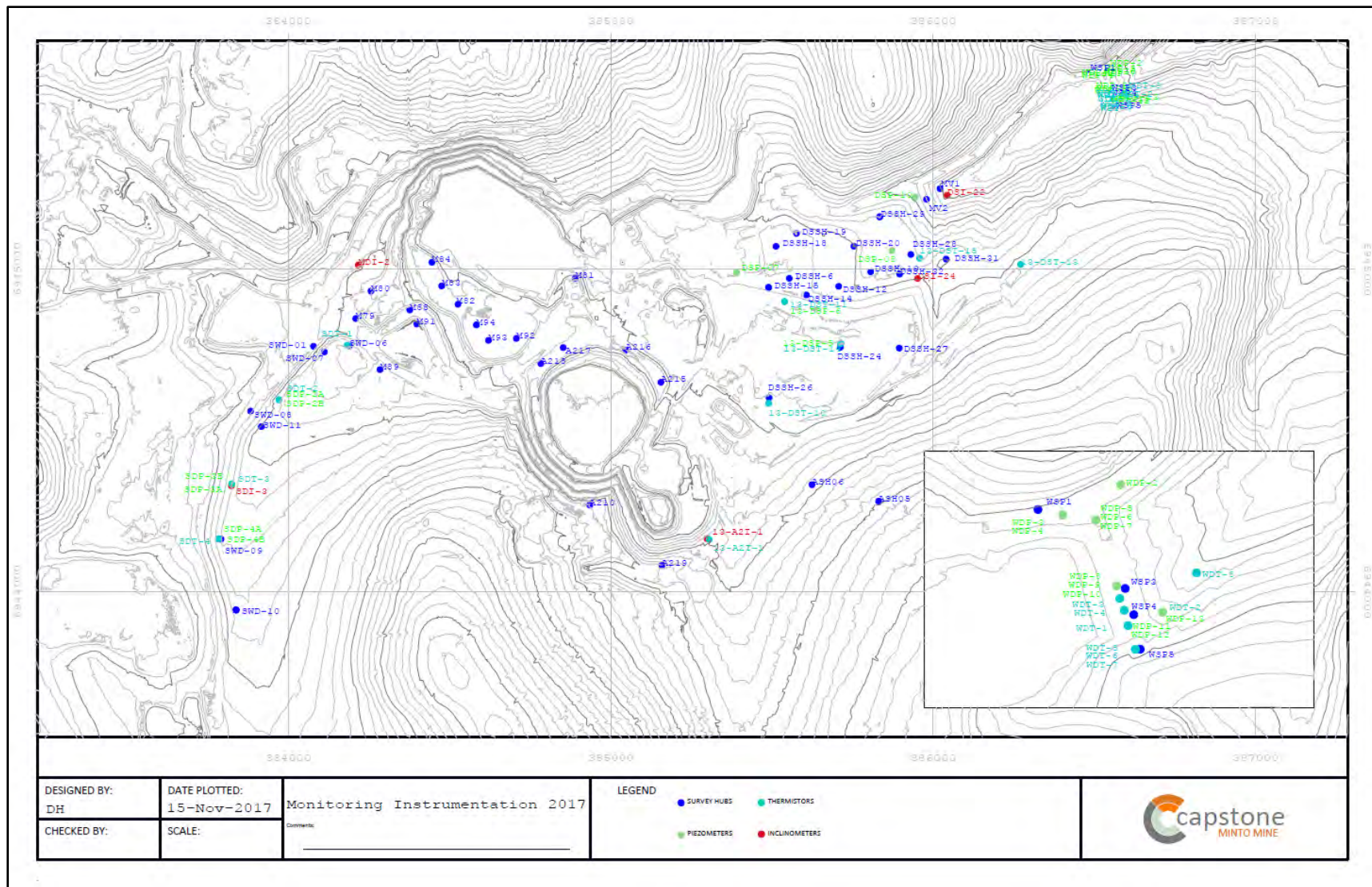


Figure 9-1: Physical Monitoring Program Installation (2017)

9.1 Physical Deformation Monitoring Instrumentation

9.1.1 Survey Hubs

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

9.1.1.1 Main Pit/South Wall Buttress Survey Hubs

There are currently 11 operating survey hubs on the Main Pit south wall buttress. Data collected are presented in Figure 9-2. Data was collected weekly for hubs M79, M80, M81, M89, M92, M93, M94. Data was collected weekly for hubs M82, M83, M84 and M88, and increased to twice-weekly when required as per the Adaptive Management Plan.

In general, the movement rates continued a gradual decrease in 2017, with rates now nearing zero movement in some of the hubs. The in-pit survey hubs indicated relatively consistent movement rates in 2017 as presented in Figure 9-3. M82 and M83 saw an increase in movement in May during the construction of the Main Pit Dump (MPD), prompting the installation of additional hubs and review of the data by the SRK Consulting (the Engineer of Record). This movement is associated with settlement of the in-pit dump, not part of the south wall buttress. M82, M83, M93, and M94 still show higher rates of movement, however, these rates are significantly less than those observed in survey hubs prior to the south wall failure and are not considered to be a stability concern.

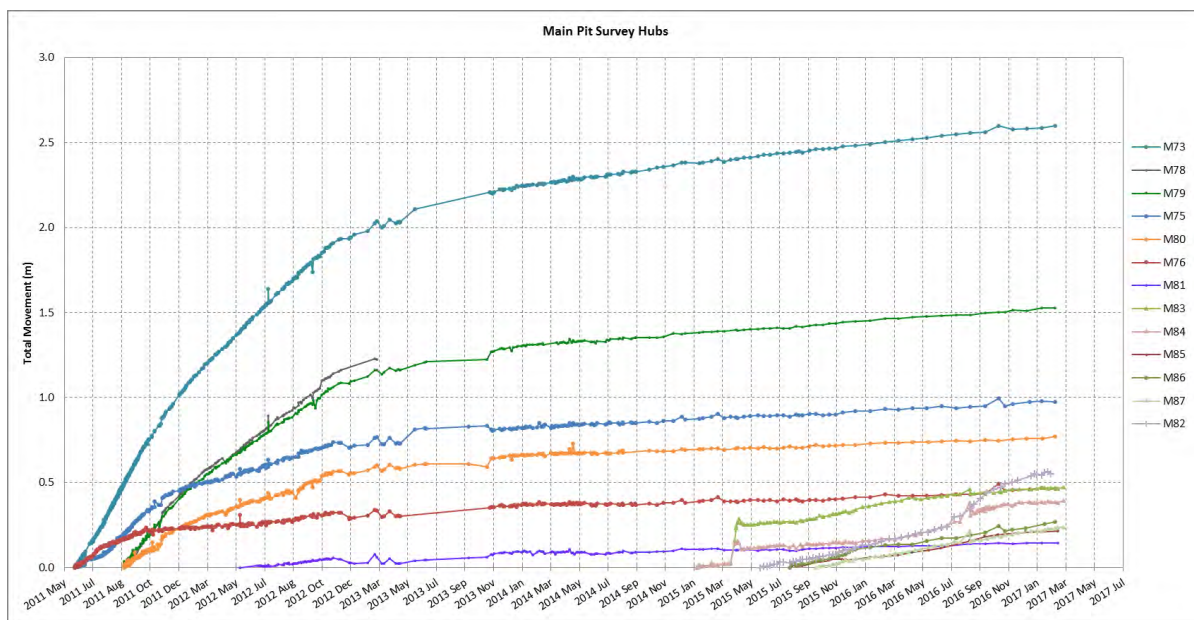


Figure 9-2: Main Pit/South Wall Buttress Survey Hub Data (2011-2017)

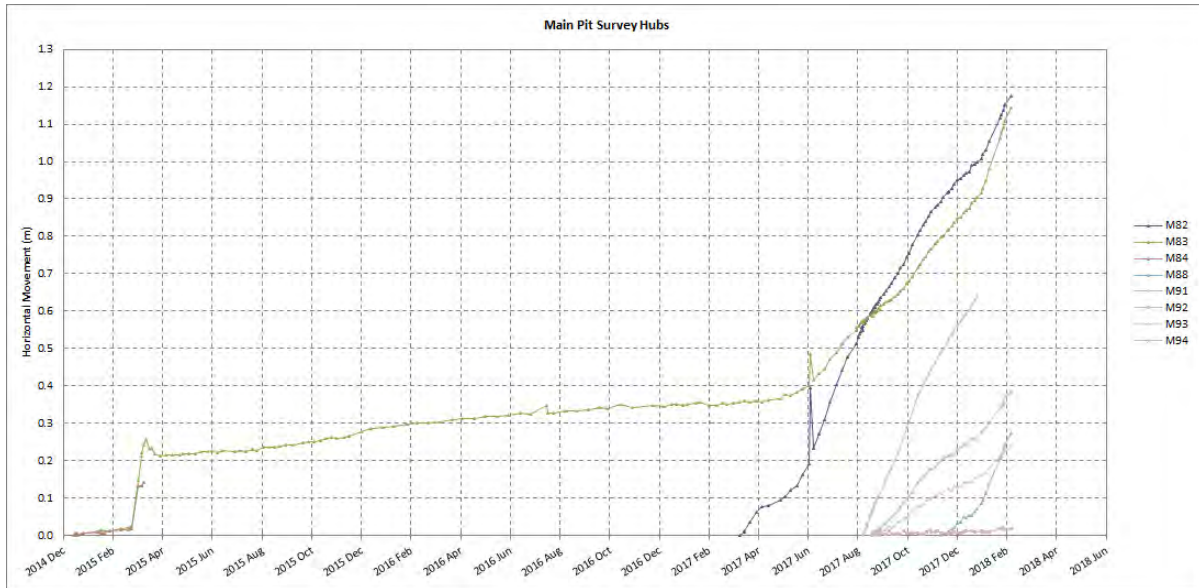


Figure 9-3: Main Pit/South Wall Buttress Survey Hub Data (2014-2017)

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

There are currently 17 operating survey hubs on the DSTSF and MVFE2. Data collected are presented in Figures 9-4 and 9-5. Data are collected weekly. All hubs indicated a continued gradual decrease in movement rates in 2017. Most hubs have shown a decrease in movement rate since the construction of the MVFE2 in summer, 2016.

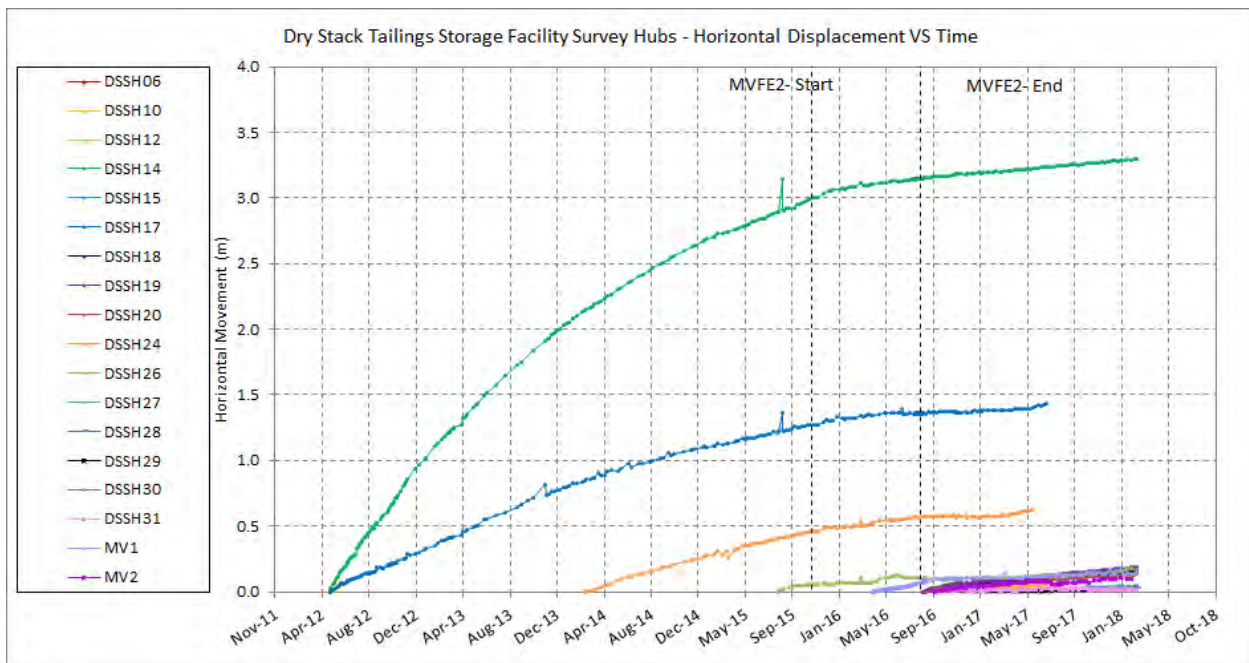


Figure 9-4: DSTSF Survey Hub Data (2012-2017)

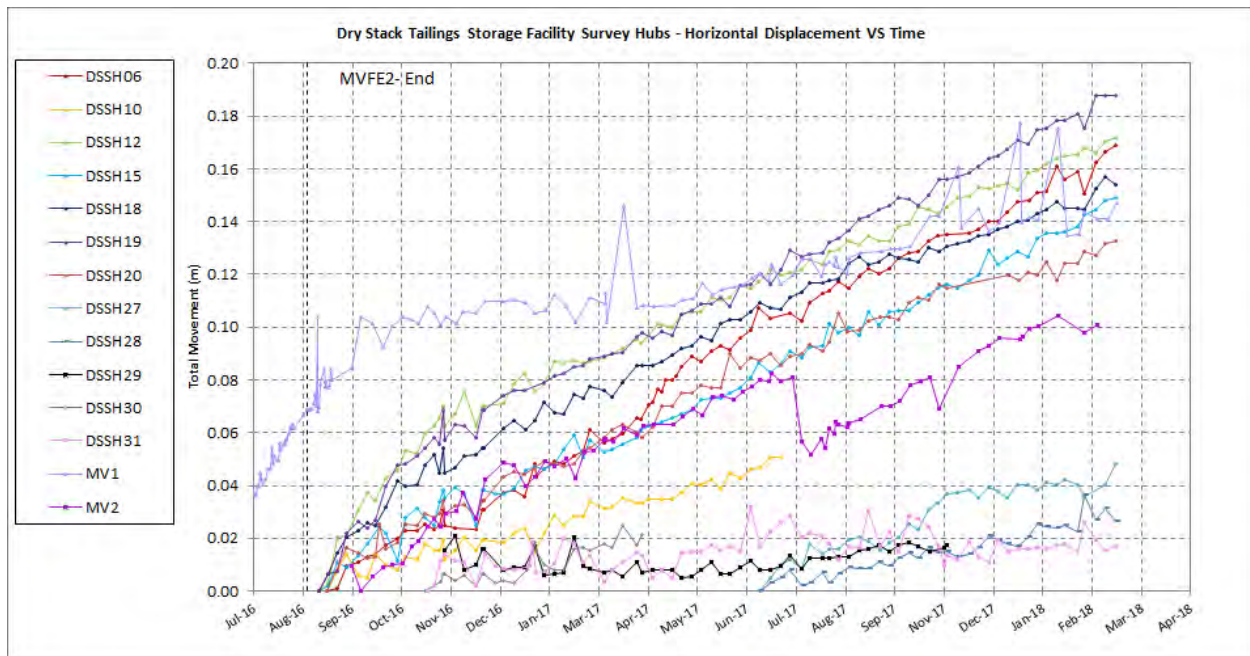


Figure 9-5: DSTSF Survey Hub Data (2016-2017)

9.1.1.3 Southwest Dump Survey Hubs

There are currently 7 operating survey hubs on the SWD. SWD-03A and SWD-05A were replaced in July 2017 with SWD-10 and SWD-11. Data collected are presented in Figure 9-6. Data are collected monthly. Hubs indicated relatively consistent movement rates in 2017.

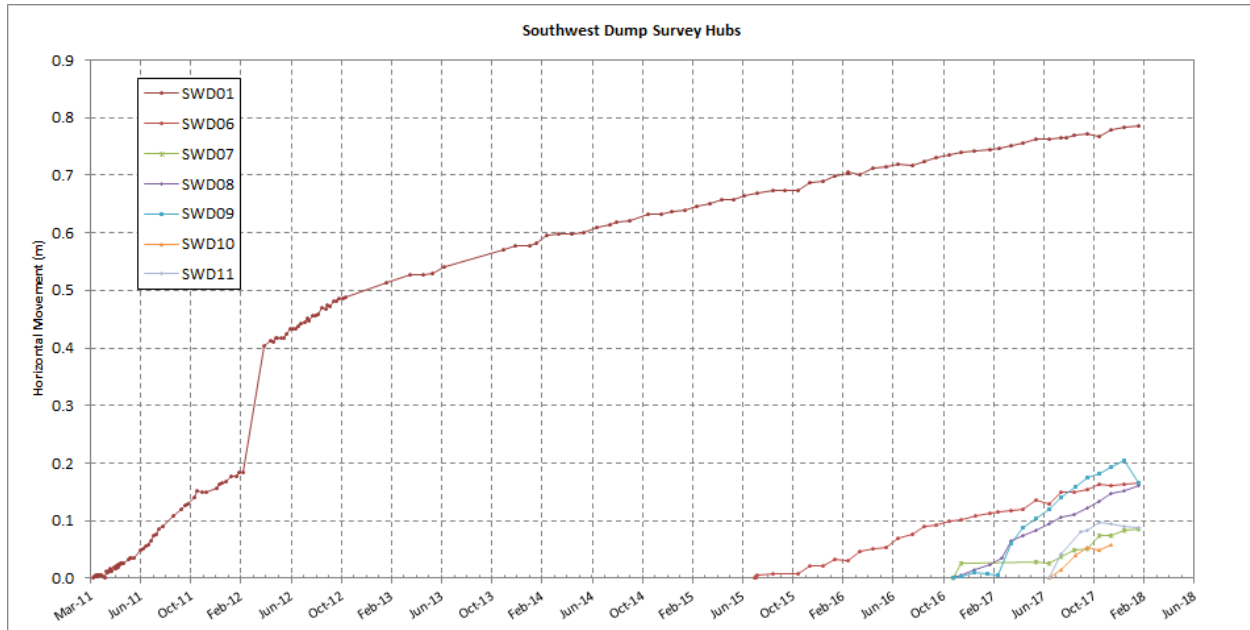


Figure 9-6: SWD Survey Hub Data (2011-2017)

9.1.1.4 Water Storage Pond Dam Survey Hubs

There are currently four operating survey hubs on the WSP dam. There was no change to the operational status of any the hubs in 2017. Data collected are presented in Figure 9-7. Data are collected monthly. Data continue to indicate no movement.

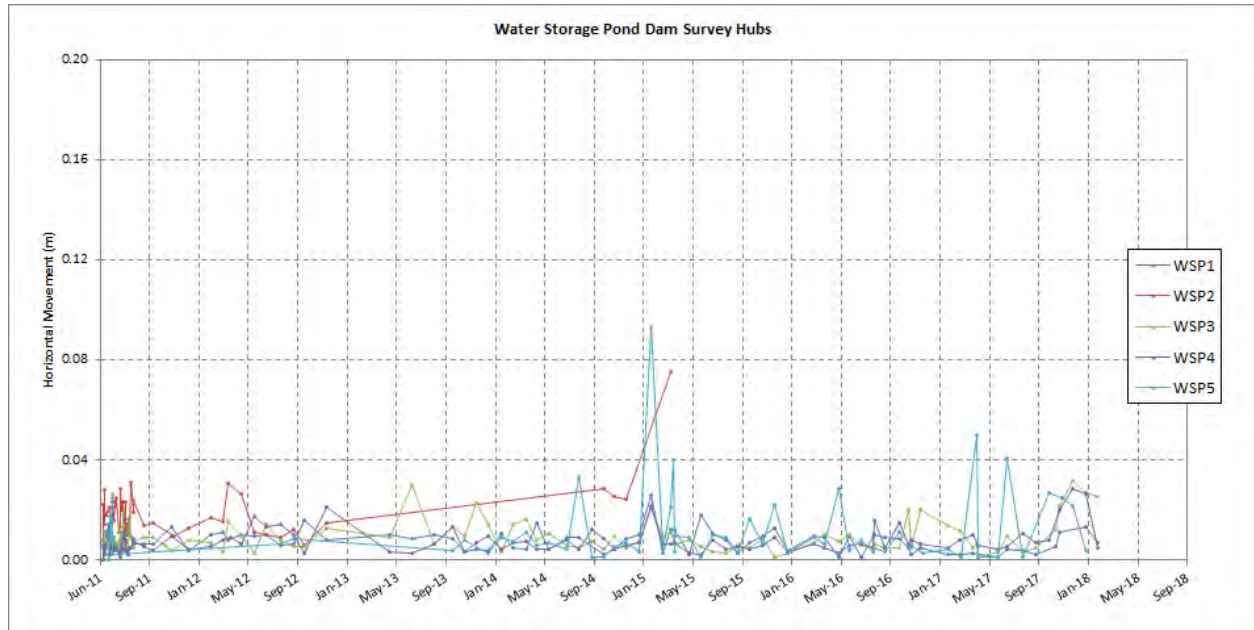


Figure 9-7: Water Retention Dam Survey Hub Data (2011-2017)

9.1.2 Inclinerometers

Physical deformation monitoring consists of monitoring of inclinometers at the DSTSF and Main Pit. The monitoring results are summarized below.

9.1.2.1 DSTSF Inclinometers

There are currently three operating inclinometers in the DSTSF area. DSI-23 sheared off in April 2017. The inclinometer probe was stuck in DSI-23 from April 2017 to July 2017 and was damaged in December 2017. Data collected are presented in Figure 9-8 through Figure 9-11. A2I-1 is monitored quarterly. DSI-22 and DSI-24 are monitored monthly.

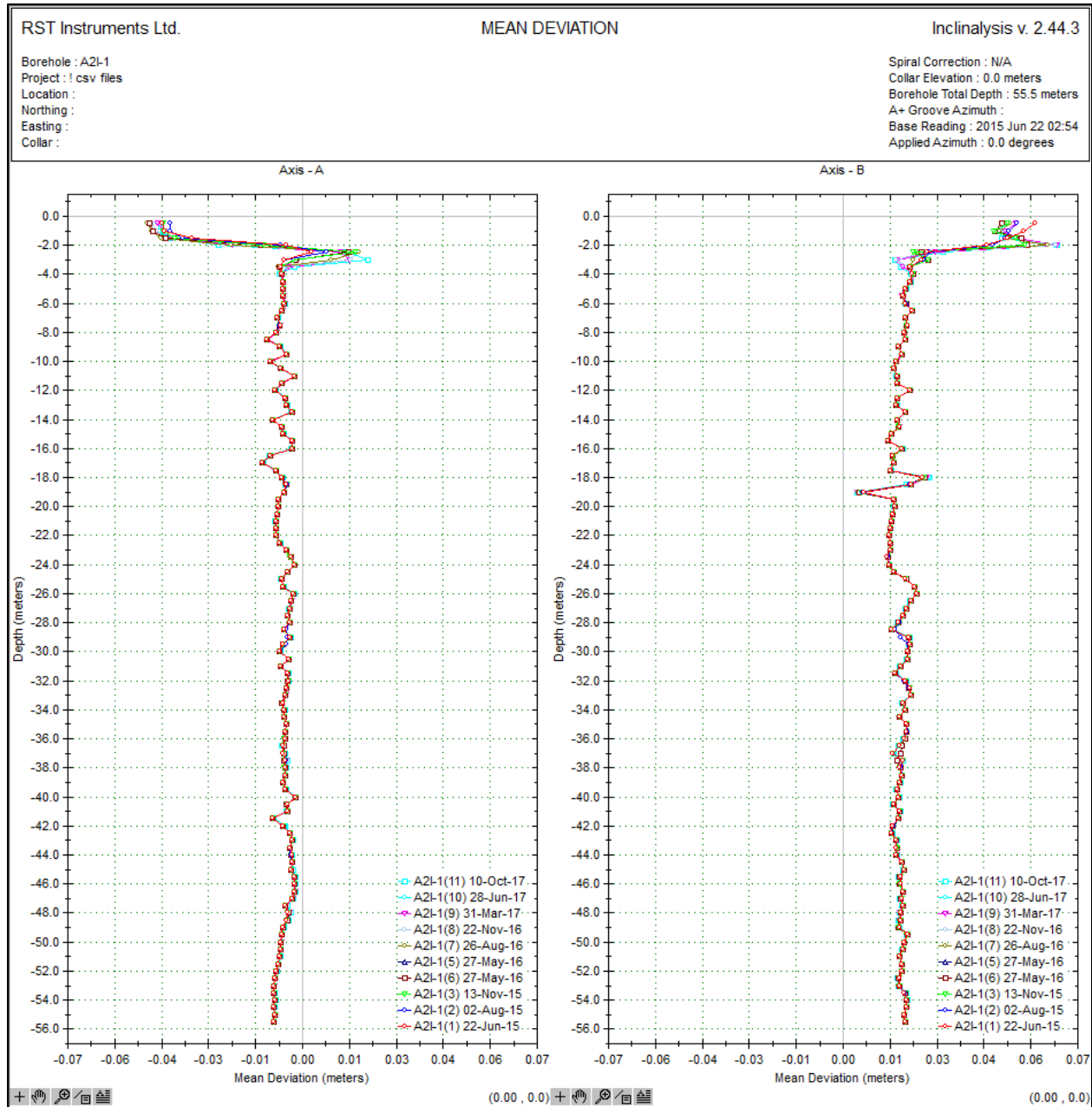


Figure 9-8: DSTSF Inclinometer A2I-1 (2015-2017)

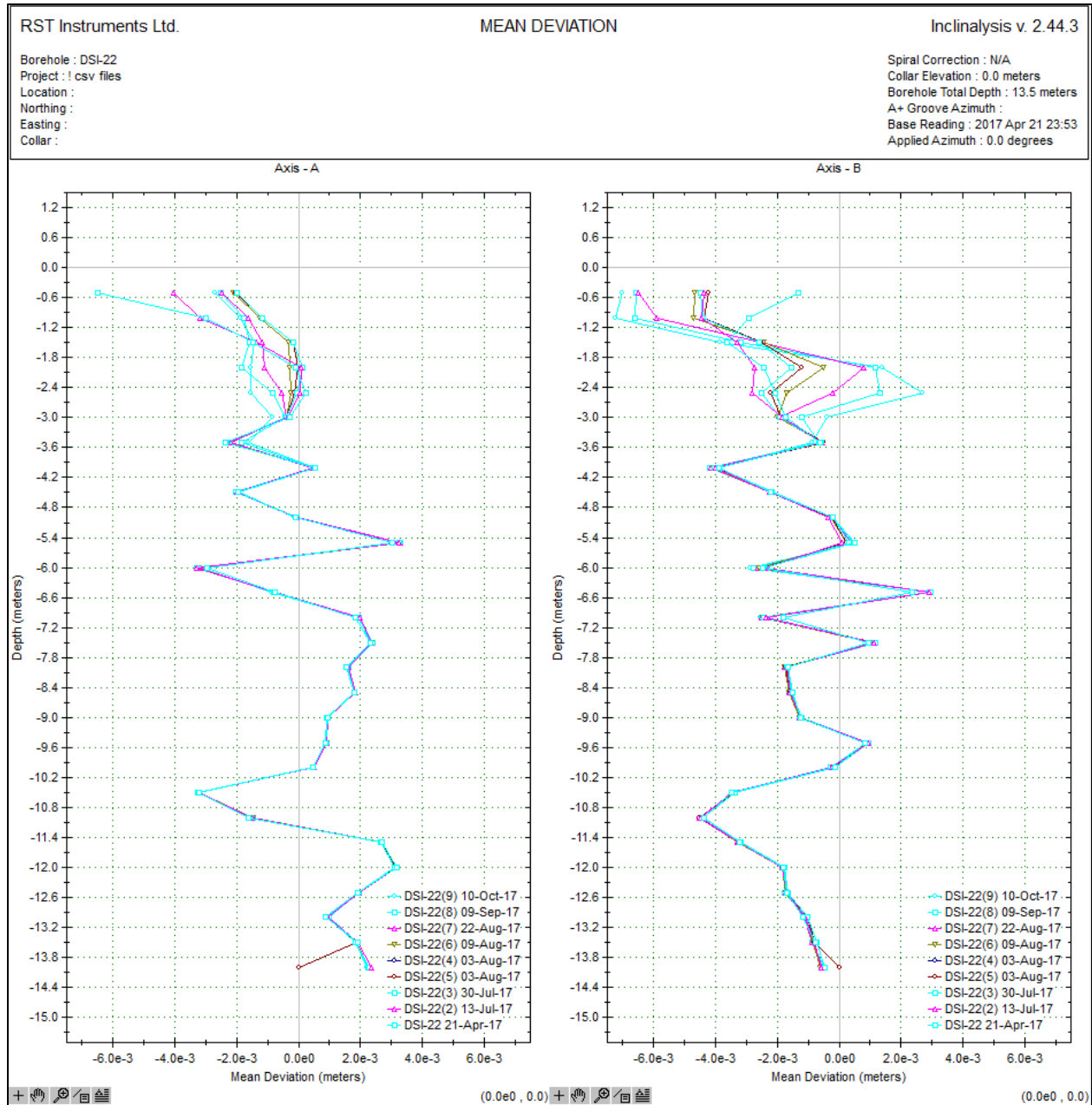


Figure 9-9: DSTSF Inclinometer DSI-22 (2017)

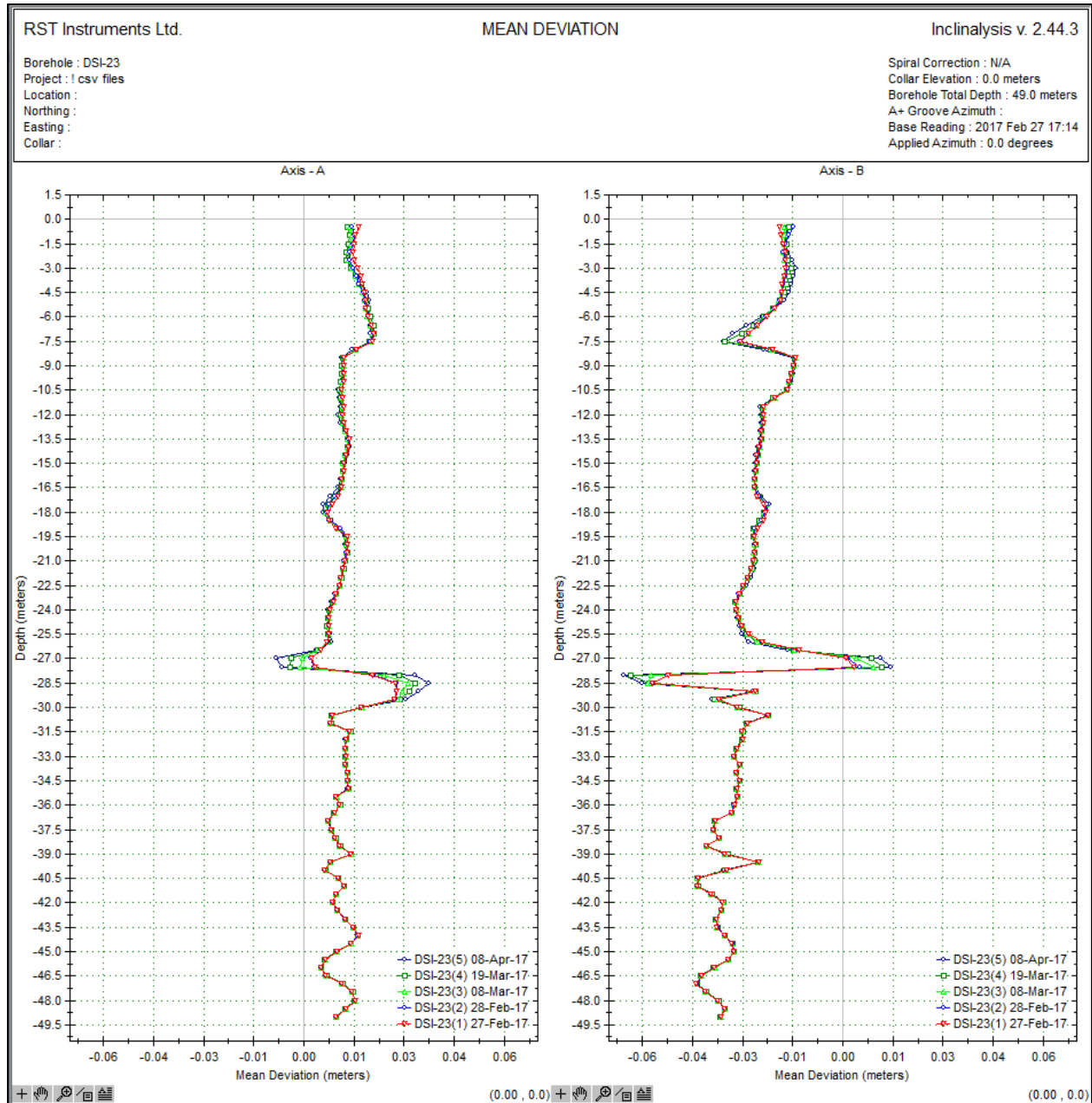


Figure 9-10: DSTSF Inclinometer DSI-23 (2017)

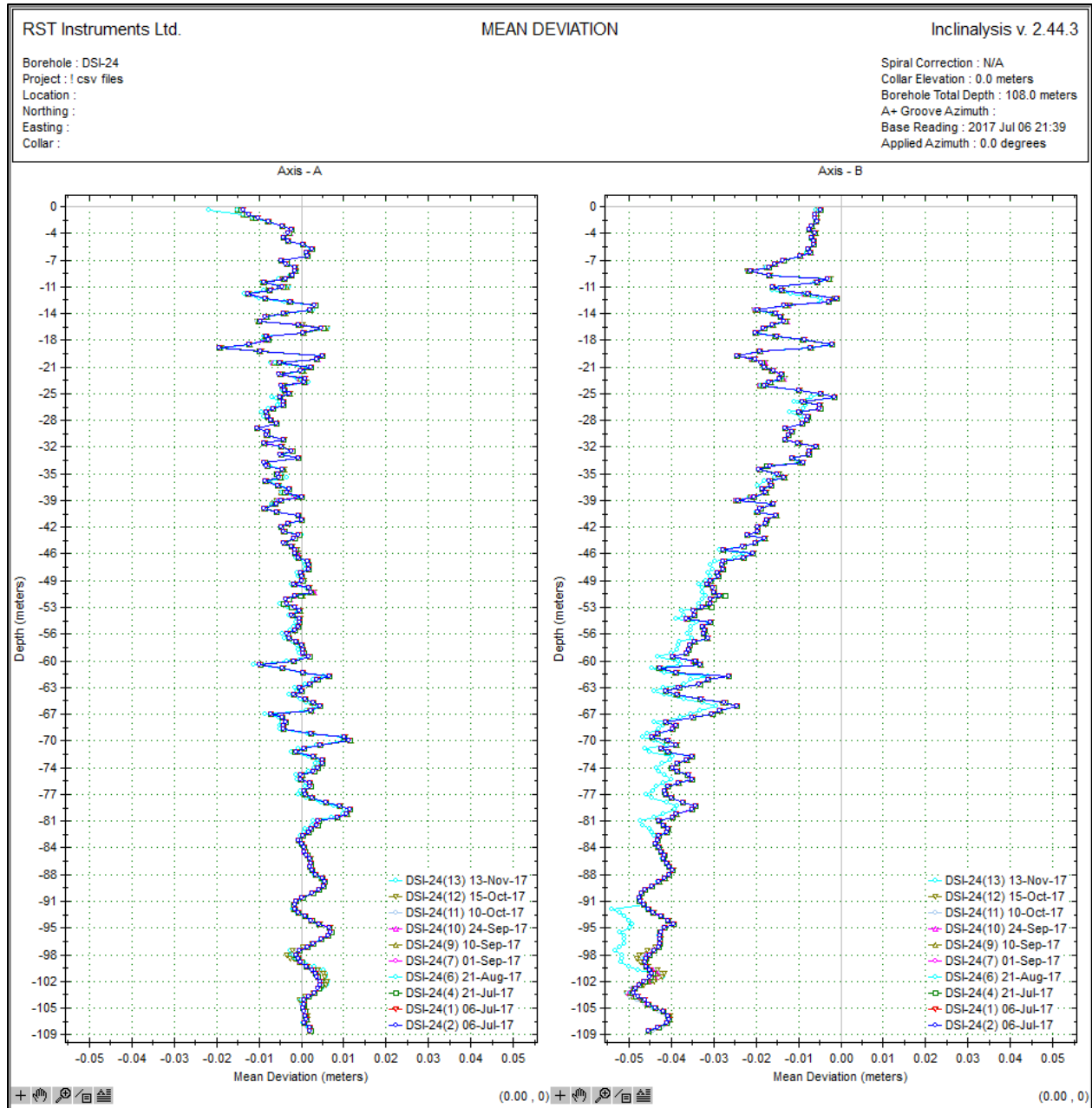


Figure 9-11: DSTSF Inclinometer DSI-24 (2017)

9.1.2.2 Main Pit Inclinometers

There is currently one operating inclinometer in the Main Pit west/south wall area. Readings recommenced in October 2013 after not having been recorded since November 2012. Data are collected quarterly. Data collected are presented in Figure 9-12.

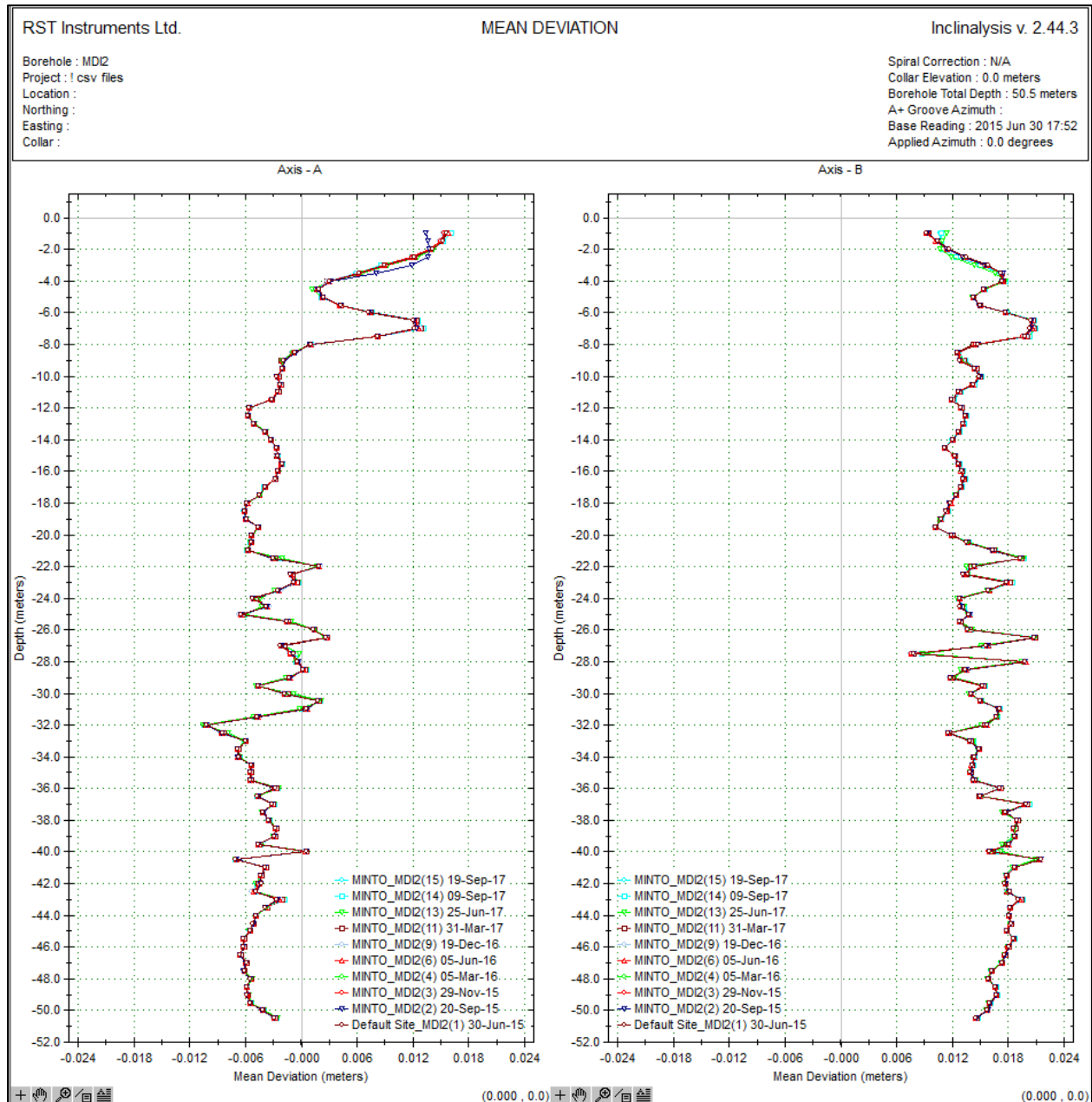


Figure 9-12: Main Pit Inclinometer MDI-2 (2015-2017)

9.1.2.3 Southwest Dump Inclinometers

There is currently one operating inclinometer in the Southwest Dump area. Readings re-commenced in April 2014 after not having been recorded since November 2012. Data are collected quarterly. Data collected are presented in Figure 9-13.

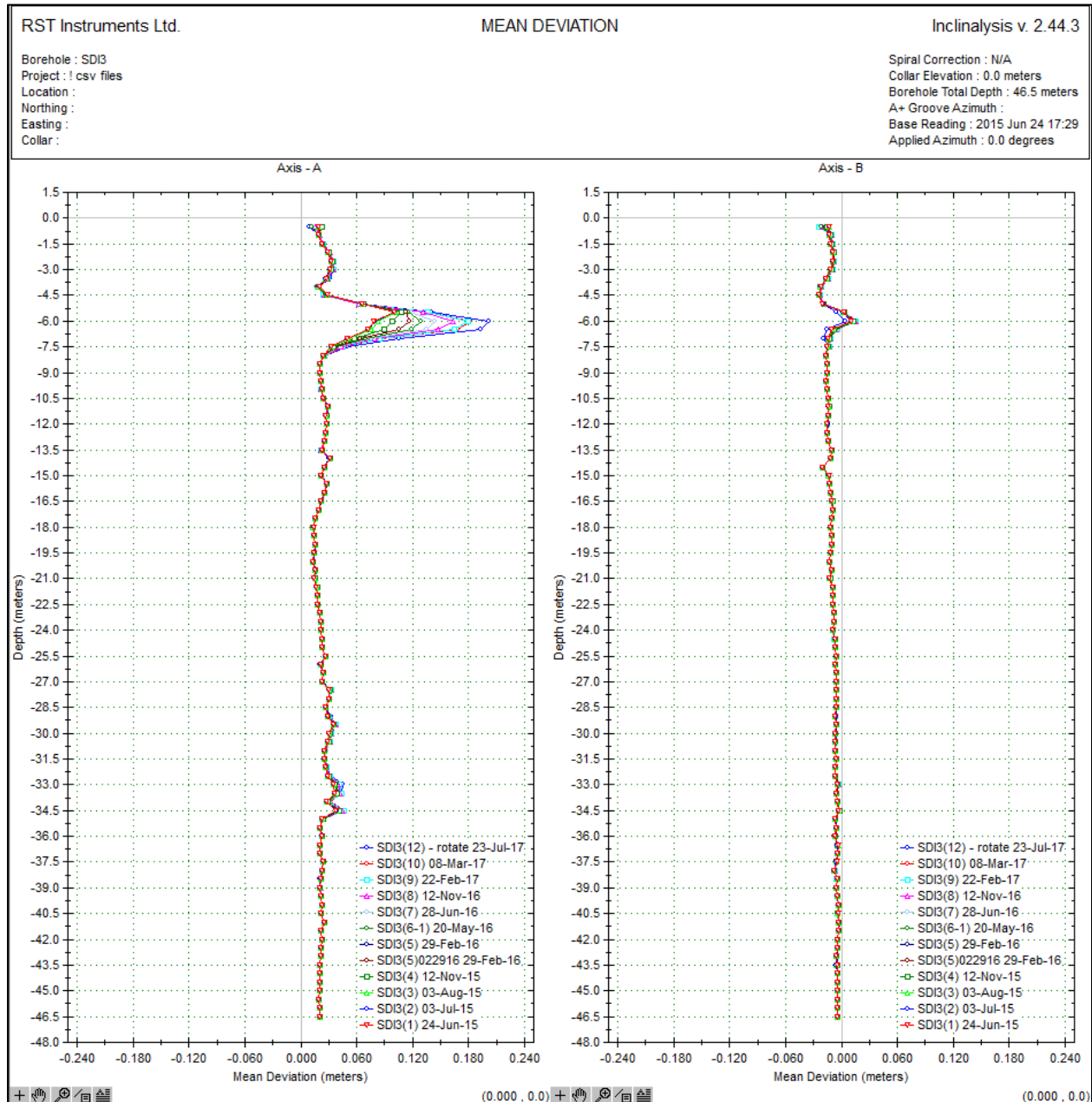


Figure 9-13: Main Pit Inclinometer SDI-3 (2015-2017)

9.2 Engineer’s Annual Physical Inspection Reports

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

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

Table 9-1 summarizes the recommendations from the most recent external inspection conducted June 26-28, 2017 and the associated planned actions.

Table 9-1: Annual Physical Inspection Report Summary (2017)

| Area | Recommendation | Action |
|---------------------------------|---|--|
| DSTSF/MVFE2 | <p>Two readings should be collected from DSI-24 on the same day confirm accuracy of the readings, and readings collected on a weekly basis until the quality of inclinometer data can be confirmed.</p> <p>Additional fill should be placed in the pooled depression at the south end of the facility to prevent ponding.</p> <p>Continue to monitor the exposed slope south of the Minto Creek Seepage Collection System for signs of retrogressive failure to determine if any slope stabilization measures are required.</p> | <p>Readings were collected on DSI-24 as per recommendation. No concerns about data quality, additional training of monitoring technicians was required.</p> <p>Additional fill was placed in August 2017.</p> <p>Slope has been monitored monthly during the MFE2 inspections. No changes have been noted.</p> |
| Tailings Diversion Ditch | <p>The vegetation in the western portion of the channel should be removed prior to the planned diversion of the South Diversion Ditch into the Tailings Diversion Ditch.</p> | <p>Completed in November 2017.</p> |

| Area | Recommendation | Action |
|--|---|--|
| Camp Site | Continue to monitor the slough at the west end of the camp area and the erosion channels below the camp pad following large rainfall events. | Monitoring of erosion channels already apart of the Camp Site inspection carried out bi-annually. |
| South Diversion Ditch | <p>No actions are required provided the SDD is decommissioned in August 2017, as planned. However, should the SDD not be decommissioned the followings actions are recommended:</p> <ul style="list-style-type: none"> o Clean the overflow spillway on both sides of the access road and clear the inlet to the culverts. o Clear the vegetation within the SDD prior to 2018 freshet. | SDD was decommissioned in August 2017. |
| WSP Dam | Continue regular monitoring of the dam as per the OMS Manual. | Monitored during monthly inspections as per OMS Manual. |
| South Wall Buttress / In Pit Dump | <p>Clear the loose rocks beneath M82</p> <p>During SAT material placement, truck traffic is to be maintained a minimum of 5 meters away from the dump face, or a spotter is to be present.</p> <p>Continue to limit access to the In-Pit Dump area near M84.</p> | <p>M82 was inspected and data reviewed. Determined there was no need to move the hub.</p> <p>Recommendations were already apart of the SAT dumping Safe Work Practice.</p> <p>Access has remained limited to the Geotechnical EITs and Mine Technical Assistants</p> |
| Area 2 pit | Review radar data of the Area 2 Stage 3 Pit to confirm any areas of movement and the rate of movement. Based on the results, establish a survey hub(s) to monitor area. | Radar date was reviewed in June 2017. No movement of the overburden was observed. One survey hub was installed along the pit crest to monitor for any movement. |
| Instrumentation | <p>More attention needs to be paid to the stability of the inclinometer readings during collection to ensure quality data is collected. Data should be reviewed following collection and new readings should be taken if data is of poor quality.</p> <p>All survey hubs mounted on lock-blocks should be inspected to determine if readings may be affected by uneven ground conditions. The ground should be level and clear of all debris/loose rocks.</p> | <p>Additional training of monitoring technicians was required; training was completed in July 2017.</p> <p>Inspection of all survey hubs completed in July 2017.</p> |

10 Adaptive Management Plan - Operations

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

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

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

10.1 Surface Water Quality – Minto Creek

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

10.1.1 Minto Creek – W2

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

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

| Date | Parameter | Exceedance Threshold Triggered | Context |
|-----------|-----------|--------------------------------|---|
| 30-Apr-17 | Al | SPT1 | 1 out of 37 samples exceeded threshold concentration, prior to the discharge period |
| 24-May-17 | As | SPT3 | 3 out of 37 samples exceeded threshold concentration, during the discharge period |
| 6-Jun-17 | | SPT3 | |
| 13-Jun-17 | | SPT3 | |
| 18-Apr-17 | Cu | SPT1 | 3 out of 37 samples exceeded threshold concentration, prior to the discharge period |
| 30-Apr-17 | | SPT3 | |
| 1-May-17 | | SPT1 | |
| 24-May-17 | Mo | SPT3 | 8 out of 37 samples exceeded threshold concentration, during the discharge period. |
| 31-May-17 | | SPT3 | |
| 13-Jun-17 | | SPT3 | |
| 20-Jun-17 | | SPT3 | |
| 27-Jun-17 | | SPT3 | |
| 11-Jul-17 | | SPT3 | |
| 27-Jul-17 | | SPT3 | |
| 1-Aug-17 | | SPT3 | |
| 13-Jun-17 | NH3 | SPT1 | 1 out of 37 samples exceeded threshold concentration, during a period of high precipitation |

Ongoing events are addressed specifically as follows:

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

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

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

10.1.2 Minto Creek – W50

Minto monitored the specific performance thresholds for surface water quality in Minto Creek at WQO station W50 after October 30, 2017. There was no water and therefore no samples collected after October 30th, 2017 at W50. No adaptive management was required.

10.2 Surface Water Quality – McGinty Creek

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

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

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

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

| Date | Parameter | Exceedance Threshold Triggered | Context |
|-----------|-----------|--------------------------------|--|
| 26-May-17 | Cu | SPT1 | 1 out of 7 samples exceeded threshold concentration |
| 21-Oct-17 | Mo | SPT1 | 1 out of 7 samples exceeded threshold concentration |
| 26-May-17 | Ni | SPT2 | 1 out of 7 samples exceeded threshold concentration |
| 26-May-17 | NO3 | SPT3 | 4 out of 7 samples exceeded threshold concentration |
| 16-Sep-17 | | SPT3 | |
| 21-Oct-17 | | SPT3 | |
| 10-Nov-17 | | SPT2 / SPT3 | |
| 24-Jun-17 | Se | SPT1 | 5 out of 7 samples exceeded threshold concentration |
| 7-Jul-17 | | SPT1 | |
| 16-Sep-17 | | SPT3 | |
| 21-Oct-17 | | SPT3 | |
| 10-Nov-17 | | SPT3 | |
| 26-May-17 | TSS | SPT1 | 1 out of 7 samples exceeded threshold concentration, single event likely due to freshet conditions |

Ongoing events are addressed specifically as follows:

The 12-month average CTE for nitrates was an on-going threshold exceedance of the AMP Specific Threshold 3, however the monthly samples were below all thresholds, except for November. A consistent natural increase is observed during the summer months at both locations. The comparative examination of the results from MN-1.5 indicated mine loadings were not likely responsible for the exceedance, as MN-1.5 is closer to the mine than MN-4.5, yet values are consistently below all AMP thresholds. It was

determined that the source of nitrates is not likely mine related and therefore does not trigger Specific Response Threshold 3.

The 12-month average CTE for dissolved selenium remained above the AMP Specific Threshold 3 at the end of 2017. The comparative examination of the results from MN-1.5 indicated mine loadings were not likely responsible for the exceedance, as Station MN-1.5 is closer to the mine than MN-4.5, the source of selenium does not appear to be mine related, therefore the Specific Response Threshold 3 is not triggered. No further investigation is required at this time.

10.3 Groundwater Quality – Minto Creek

Various exceedances of AMP levels triggered a review of the groundwater data by the qualified professional. All groundwater data was forwarded to SRK Consulting for review and recommendations. See Appendix H, *2017 Minto Groundwater Quality AMP Review Memo - SRK*, for details.

10.4 Groundwater Quality - McGinty Creek

Minto monitored the specific performance thresholds for McGinty Creek groundwater. Various exceedances of AMP levels triggered a review of the groundwater data by the qualified professional. All groundwater data was forwarded to SRK Consulting for review and recommendations. See Appendix H, *2017 Minto Groundwater Quality AMP Review Memo - SRK*, for details.

10.5 Water Management AMP

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

10.6 Physical Monitoring Program AMP

The results of the Physical Monitoring Program are compared to the thresholds set out in the 2017 Adaptive Management Plan (AMP) on a weekly basis by the Geotechnical EIT. Table 10-3 and 10-4 below, summarize the threshold statuses for the Category 1 and Category 2 facilities.

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

Table 10-3: Category 1 Facilities – Threshold Status, December 2017

| Specific Performance Thresholds | Thresholds Exceeded | Response |
|--|---|--|
| <p>Specific Threshold 1</p> <ul style="list-style-type: none"> • Observation of unusual occurrence including: <ul style="list-style-type: none"> ○ tension cracks, settlement, or sloughing; ○ a seismic event that exceeds the 1:475 return period event¹; ○ abnormal seepage from any area of the slopes; ○ increased turbidity from seepage; • Physical damage. | <p>Main Pit In-Pit Dump/Main Pit Dump (MPD)</p> | <p>Tension cracking and settling has propagated for several years across the in-pit dump. The engineer of record (SRK) has reviewed and determined that the cracking is not a stability concern for the buttress. Cracking along NW corner noted on August 19, 2017, design engineer notified and monitoring plan put into place. SRK has reviewed and determined that the cracking is not a stability concern.</p> <p>Current conditions: Cracking is now covered in snow, no new cracking observed. The engineer of record (SRK) was notified and monitoring plan put in place</p> |
| <p>Specific Threshold 2</p> <ul style="list-style-type: none"> • One survey hub or inclinometer reading indicating an increase in the movement rate greater than the long-term trend and outside the range of instrumentation error. | <p>M82, M84</p> | <p>April 2016: Main Pit survey hubs M82 and M84 showing increase in long-term trend. SRK notified. M84 reading frequencies initially increased to daily, and have since been reduced to weekly. Inspections of the area daily during SAT dump construction.</p> <p>Current conditions: movement rate for M84 has decreased back to the long-term trend. Movement rates for M82 are greater than the long-term trend.</p> |
| <p>Specific Threshold 3</p> <ul style="list-style-type: none"> • For DSTSF and MVFE piezometers 13-DSP-05a, 13-DSP-06, 15-DSP-07, and 15-DSP-08, an increase in piezometric pressures under unfrozen or thawing conditions such that Ru^2 exceeds 0.44. • For MVFE2 piezometer 15-DSP-10, an increase in piezometric pressures under unfrozen or thawing conditions such that the equivalent water elevation is 3 m above the original ground surface. | <p>DSP-07 (2, 3, 4, 5, and 6)</p> | <p>December 2015: DSP-07 has displayed Ru values higher than 0.44 for sensors 2, 3, 4 and 5 since installation. This piezometer is outside the MVFE2 footprint and is not considered a stability concern. Reading frequency was increased to every two weeks (from monthly). High initial values may have been due to grout curing.</p> <p>Current conditions: Readings have been slowly increasing, sensor 2-6 have an $Ru > 0.44$.</p> |

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

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

| Specific Performance Thresholds | Thresholds Exceeded | Response |
|---|-----------------------------------|--|
| <p>Or</p> <p>Temperature greater than zero at a depth of 2 m below original ground (<i>all SWD ground temperature cables, and DSTSF ground temperature cables DST-10, DST-11, and DST-14 only</i>)</p> | <p>DSP-08 (1)</p> | <p>April 2016: DSP-08 displayed Ru values higher than 0.4 for sensor 1 (@5m depth). The design engineer was notified. No instability was noted during inspections. Reading frequency was increased to bi-weekly (from monthly), and increased to daily while dumping in the immediate vicinity.</p> <p>Current conditions: Ru value is still >0.44, however, has been decreasing since June 30, 2016.</p> |
| | <p>DSP-08 (2, 3, 5 and 6)</p> | <p>May 31, 2016: An additional spike was noted on sensors 2, 3, 5 and 6. Again, the design engineer was notified and no instability was noted on inspection.</p> <p>Current conditions: no change, readings have been slowly increasing. Sensors 2, 3, 5, and 6 have Ru values >0.44.</p> |
| | <p>DSP-10</p> | <p>DSP-10 has displayed a water elevation >1m above ground surface depth since March 8th, 2016. The design engineer was contacted, and reading frequencies were immediately increased to weekly. Reading frequency was further increased to daily on March 14. On Sept 1, 2016 reading frequency was reduced to weekly, see response to Specific Threshold 4 for more details.</p> <p>Current conditions: equivalent water level is >3m.</p> |
| <p>Specific Threshold 4</p> <ul style="list-style-type: none"> For DSTSF and MVFE piezometers 13-DSP-05, 13-DSP-06, 15-DSP-07, and 15-DSP-08, an increase in piezometric pressures under unfrozen or thawing conditions such that Ru exceeds 0.6. For MVFE2 piezometer 15-DSP-10, an increase in piezometric pressures under unfrozen or thawing conditions such that the equivalent water elevation is 10 m above the original ground surface | <p>DSP-07 (2, 3, 4, 5, and 6)</p> | <p>February 3, 2016: DSP-07 sensors 2 and 3 are above the 0.6 threshold.</p> <p>May 15, 2016: DSP-07 sensor 5 is above the 0.6 threshold.</p> <p>January 14, 2017: DSP-07 sensor 4 is above the 0.6 threshold.</p> <p>December 5, 2017: DSP-07 sensor 6 is above the 0.6 threshold.</p> <p>This piezometer is outside the MVFE2 footprint and is not considered a stability concern.</p> <p>Current conditions: no change, readings have been slowly increasing.</p> |
| | <p>DSP-08 (1)</p> | <p>April 29, 2016: DSP-08 sensor 1 is above 0.6 threshold. Review of conditions by the Geotechnical EIT and engineer of record, SRK Consulting. Conditions have stabilized. Construction complete, inspections reduced to monthly. Reading frequency maintained at bi-weekly. No stability concerns identified.</p> |

| Specific Performance Thresholds | Thresholds Exceeded | Response |
|---------------------------------|---------------------|---|
| | | Current conditions: Ru value is still >0.6, however, has been decreasing since June 30, 2016. |
| | DSP-08 (2) | <p>July 1, 2016: DSP-08 sensor 2 is above 0.6 threshold. Review of conditions by the Geotechnical EIT and engineer of record, SRK Consulting. Conditions have stabilized. Construction complete, inspections reduced to monthly. Reading frequency maintained at bi-weekly. No stability concerns identified.</p> <p>Current conditions: no change, readings have been slowly increasing.</p> |
| | DSP-08 (3) | <p>February 25, 2017: DSP-08 sensor 3 is above 0.6 threshold. Construction complete, inspections reduced to monthly. Reading frequency maintained at bi-weekly. No stability concerns identified.</p> <p>Current conditions: no change, readings have been slowly increasing.</p> |
| | DSP-08 (5) | <p>December 17, 2017: DSP-08 sensor 5 is above 0.6 threshold. No stability concerns identified.</p> <p>Current conditions: no change, readings have been slowly increasing.</p> |

| Specific Performance Thresholds | Thresholds Exceeded | Response |
|---|------------------------------|---|
| | DSP-10 | <p>DSP-10 has displayed an equivalent water level >3m above ground surface depth since April 1st, 2016. Since September 2016 the equivalent water level has been >10m above ground surface.</p> <p>Summary of actions below:</p> <ul style="list-style-type: none"> • April 1, 2016: Design engineer notified. Inspection frequency increased to daily. Dumping on the lower tier was suspended. • April 4, 2016: Two survey hubs were installed on the eastern slope to monitor for movement with a daily reading frequency. • April 5, 2016: The lower tier was re-opened for dumping after stabilization of piezometer values. Going forward, piezometer data was reviewed prior to dumping each subsequent lift. • May 3, 2016: Inspections were reduced to weekly, with a daily review of monitoring data. • When working along the eastern edge of the final lift, a daily inspection was conducted. • August 25, 2016: Survey hub reading frequency reduced to weekly as construction was complete. • Sept 1: Piezometer reading frequency was reduced to weekly as the data had stabilized and construction was complete. • Once the facility construction was complete, the inspections were reduced back to monthly. Piezometer readings remain on a weekly schedule. <p>Current conditions: equivalent water level is >10m.</p> |
| <p>Specific Threshold 5</p> <ul style="list-style-type: none"> • Three consecutive survey hub or inclinometer readings indicating an increase in the movement rate movement greater than the long-term trend. <p>Or</p> <ul style="list-style-type: none"> • Three consecutive survey hub readings indicating a change in horizontal direction of movement greater than 15 degrees from the long-term trend, | M82, M84 | <p>April 2016: Main Pit Dump survey hubs M82 and M84 showing increase in long-term trend. SRK notified. M84 reading frequencies initially increased to daily, and have since been reduced to weekly. Inspections of the area daily during SAT dump construction.</p> <p>Current conditions: movement rate for M84 has decreased back to the long-term trend. Movement rates for M82 are greater than the long-term trend</p> |
| | M82, M83, M88, M91, M93, M94 | <p>August 2017: High rates in both M82 and M83. SRK notified, reading frequency for all Main Pit hubs increased to daily. Six new survey hubs installed. There is some indication that rates are now decreasing. SRK has reviewed the current conditions and determined that the movement rates are not an immediate stability concern.</p> <p>Current conditions: Moderate movement rate for M82, M83, M88, M91, M93, and M94. Rates are</p> |

| Specific Performance Thresholds | Thresholds Exceeded | Response |
|---------------------------------|---------------------|--|
| | | greater than 1 mm/day but are significantly less than rates seen prior to the South wall failure (>20 mm/day). |
| | M81, M82, M83, M84 | <p>M81, M82, M83 and M84 have all displayed a change in horizontal movement greater than 15 degrees from the long-term trend. These directional changes occurred in January 2013 (M81), April 2016 (M82 and M83) and May 2016 (M84). Inspection of all hubs conducted with no change in conditions noted. Reading frequency increased to weekly. Increase in movement for M82 and M83 observed in May 2017. The engineer of record (SRK) was notified and monitoring plan has been put in place.</p> <p>Current conditions: no further change in the direction of movement observed. Movement rates for M82 and M83 have remained steady.</p> |
| | SWD-06 | <p>SWD-06 has displayed a change in horizontal movement greater than 15 degrees from the long-term trend.</p> <ul style="list-style-type: none"> • September 2016: the long-term trend changed from 132 degrees to 171 degrees. An inspection was conducted, and the change is likely due to differential settlement of the hub during spring thaw. • November 2016: the long-term trend changed from 171 to 85 degrees. An inspection was conducted, and the change is likely due to frost heave along the western edge of the survey hub; similar trend in movement was observed during the previous winter. • June 2017: the long-term trend changed from 085 to 180 degrees as glaciated ice melted below the western edge of the survey hub. <p>Current conditions: no further change in the direction of movement observed.</p> |

Table 10-4: Category 2 Facilities – Threshold Status, December 2017

| Specific Performance Thresholds | Thresholds Exceeded | Response |
|---|---------------------|---|
| <p>Specific Threshold 1</p> <ul style="list-style-type: none"> • Observation of unusual occurrence including: <ul style="list-style-type: none"> • tension cracks, settlement, or sloughing; • a seismic event that exceeds the 1:475 return period event; • abnormal seepage from any area of the slopes; • increased turbidity from seepage; • physical damage. | MWD | <p>1m-deep depression formed in May 2016 in on the 905m-elevation pad of the MWD, currently being used as a POX stockpile. No bulging noted at toe and no other stability concerns noted. Monthly inspections continued during active MWDE construction. MDI-2 showing no change in trend.</p> <p>Current conditions: no further changes observed. MWDE construction is now complete and progressive reclamation activities are underway.</p> |
| <p>Specific Threshold 2</p> <p>WSP Dam:</p> <ul style="list-style-type: none"> • One survey hub reading indicating an increase of movement outside range of instrumentation error. <p>All other Category 2 Facilities: Survey hub cumulative displacements between 150 mm and 500 mm.</p> | None | N/A |
| <p>Specific Threshold 3</p> <p>WSP Dam:</p> <ul style="list-style-type: none"> • One piezometer reading outside of its long-term trend (in comparison to the reservoir pond elevation). <p>All other Category 2 Facilities: Survey hub cumulative displacements greater than 500 mm.</p> | None | N/A |
| <p>Specific Threshold 4</p> <p>WSP Dam:</p> <ul style="list-style-type: none"> • Three consecutive survey hub readings indicating increase in movement outside range of instrumentation error. | None | N/A |

11 Aquatic Environmental Monitoring Program

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

11.1 Metal Mine Effluent Regulations Monitoring Programs

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

11.1.1 Effluent Monitoring Program

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

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

Radium 226 and acute lethality tests are conducted quarterly due to the reduced frequency guidelines outlined in the MMER.

The Effluent Monitoring Program results are submitted to Environment Canada quarterly and are presented in [Appendix I](#).

11.1.2 Environmental Effects Monitoring Water Quality Monitoring

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

The EEM Water Quality Monitoring Program results submitted to Environment Canada annually, are presented in [Appendix I](#).

11.1.3 Environmental Effects Monitoring Biological Monitoring

The EEM Biological Monitoring Program outlines fish population, fish tissue and benthic invertebrate tests conducted under Schedule 5, Part 2 of the MMER. Minto Mine has submitted the results of the Phase 4 EEM Study Design Report as required to Environment Canada in January 2018. The *Phase 4 EEM Interpretive Report* is included in [Appendix J](#).

11.2 Biological Monitoring Program

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

11.2.1 Sediment Monitoring Program

The objectives of the sediment monitoring program were to characterize particle size, total organic carbon content, and concentrations of metals, metalloids, and nutrients in sediments. A 10-day *Chironomus dilutus* and a 14-day *Hyalella azteca* sediment toxicity test were conducted in 2017 to evaluate survival and growth.

Sediments collected in 2017 were largely composed of fine particles in the silt and sand size categories (Table 11-1). Mean total organic carbon (TOC) content of sediment collected from upper Minto Creek (2.8%) was slightly higher than at the upper McGinty Creek (2.6%) reference area (Table 11-1). Lower Minto Creek had lower TOC (5.2%) than the reference area, lower Wolverine Creek (6.5%; Table 11-1). Arsenic and copper were the only analytes with mean concentrations greater than Interim Sediment Quality Guidelines (ISQG) for the protection of aquatic life (CCME 1999) in an effluent-exposed area (upper and/or lower Minto Creek; Table 11-1). However, mean arsenic concentrations in upper Minto Creek were below ISQG and lower than the reference area, upper McGinty Creek (which was greater than ISQG). This suggests that arsenic concentrations were unrelated to the mine. Mean copper concentrations in upper and lower Minto Creek were greater than the ISQG, and maximum copper concentration at upper Minto Creek was above the Probable Effect Level (PEL). Both areas had higher concentrations than the corresponding reference areas, which were lower than the ISQG (Figure 11-1). With progression from upper to lower Minto Creek, sediment copper concentrations decreased from a mean of 155 to 49 mg/kg, indicating improvement with distance downstream. Due to the predominantly erosional habitat in upper Minto Creek, relatively few areas had deposited sediment and even this occurred only in small quantities that likely wash away each year during freshet. Therefore, elevated sediment copper in fine sediment in the upper reaches of Minto Creek may be of limited importance in terms of exposure and potential effects to biota. In lower Minto Creek, fine sediment deposits are somewhat more common and therefore more relevant to aquatic life.

No effects to *H. azteca* survival or growth were observed during the sediment toxicity testing (Table 11-2). Survival of *C. dilutus* was significantly lower in sediment collected from lower Minto Creek than in laboratory control sediment (sand) and field reference sediment (lower Wolverine Creek; Table 11-2). Growth of *C. dilutus* was significantly greater in lower Minto Creek sediment compared to the reference sediment. In 2016, growth of *C. dilutus* was greater at lower Minto Creek but not significantly so. *H. azteca* results (no effects in 2017) were similar to those of 2011, 2015, and 2016 (Minnow 2012, 2016, 2017). Differences from previous years observed at lower Minto Creek in *C. dilutus* survival and growth suggest a possible adverse effect, but are not consistent with the results of previous years despite similar sediment chemistry.

Table 11-1: Sediment Chemistry Data Collected at Exposed and Reference Areas, Minto Mine (2017)

| Analytes | Units | CSQG ^a | | Upper McGinty Creek (Reference) | | | | Upper Minto Creek (Exposed) | | | | Lower Wolverine Creek (Reference) | | | | Lower Minto Creek (Exposed) | | | | |
|--|--|-------------------|------|---------------------------------|--------------------|---------|---------|-----------------------------|--------------------|---------|---------|-----------------------------------|--------------------|---------|---------|-----------------------------|--------------------|---------|---------|--------|
| | | ISQG | PEL | Mean | Standard Deviation | Minimum | Maximum | Mean | Standard Deviation | Minimum | Maximum | Mean | Standard Deviation | Minimum | Maximum | Mean | Standard Deviation | Minimum | Maximum | |
| | | | | | | | | | | | | | | | | | | | | |
| Particle size, TKN, carbon analytes and pH | Loss on Ignition | % | - | - | 5.8 | 2.5 | 4.0 | 10 | 5.6 | 2.6 | 2.0 | 9.0 | 14 | 2.8 | 10 | 17 | 10 | 2.3 | 8.0 | 14 |
| | pH (1:2 soil:water) | pH units | - | - | 7.09 | 0.45 | 6.63 | 7.69 | 7.88 | 0.26 | 7.46 | 8.16 | 6.92 | 0.19 | 6.69 | 7.18 | 7.86 | 0.12 | 7.70 | 8.02 |
| | % Gravel (>2mm) | % | - | - | - | - | - | - | - | - | - | - | <1.0 | - | <1.0 | <1.0 | 1.0 | - | <1.0 | 1.2 |
| | % Sand (2.0mm - 0.063mm) | % | - | - | - | - | - | - | - | - | - | - | 30 | 18 | 11 | 57 | 15 | 12 | 3.3 | 33 |
| | % Silt (0.063mm - 4µm) | % | - | - | - | - | - | - | - | - | - | - | 65 | 17 | 40 | 84 | 75 | 13 | 55 | 87 |
| | % Clay (<4µm) | % | - | - | - | - | - | - | - | - | - | - | 5.1 | 1.0 | 3.4 | 6.0 | 10 | 0.85 | 9.1 | 11 |
| | Total Kjeldahl Nitrogen | % | - | - | 0.13 | 0.042 | 0.096 | 0.20 | 0.13 | 0.058 | 0.049 | 0.19 | 0.31 | 0.073 | 0.21 | 0.39 | 0.26 | 0.044 | 0.22 | 0.33 |
| | Inorganic Carbon | % | - | - | 0.081 | 0.019 | 0.055 | 0.11 | 0.12 | 0.041 | 0.064 | 0.16 | 0.14 | 0.024 | 0.11 | 0.16 | 0.16 | 0.021 | 0.14 | 0.19 |
| | Inorganic Carbon (as CaCO ₃ Equivalent) | % | - | - | 0.68 | 0.16 | 0.46 | 0.91 | 1.0 | 0.34 | 0.54 | 1.3 | 1.1 | 0.20 | 0.93 | 1.4 | 1.4 | 0.17 | 1.2 | 1.6 |
| | Total Carbon by Combustion | % | - | - | 2.7 | 0.99 | 1.8 | 4.4 | 2.9 | 1.5 | 0.99 | 4.6 | 6.7 | 1.7 | 5.1 | 9.4 | 5.4 | 1.5 | 4.0 | 7.6 |
| Total Organic Carbon | % | - | - | 2.6 | 0.97 | 1.8 | 4.3 | 2.8 | 1.5 | 0.93 | 4.4 | 6.5 | 1.7 | 5.0 | 9.2 | 5.2 | 1.5 | 3.9 | 7.4 | |
| Total Metals | Aluminum (Al) | mg/kg | - | - | 8,100 | 1,733 | 6,050 | 10,700 | 10,658 | 1,133 | 9,060 | 11,800 | 15,540 | 1,989 | 13,000 | 18,500 | 13,820 | 1,152 | 12,300 | 15,200 |
| | Antimony (Sb) | mg/kg | - | - | 0.30 | 0.052 | 0.26 | 0.39 | 0.49 | 0.13 | 0.38 | 0.71 | 0.49 | 0.031 | 0.46 | 0.54 | 0.52 | 0.056 | 0.45 | 0.58 |
| | Arsenic (As) | mg/kg | 5.9 | 17 | 6.5 | 1.6 | 4.1 | 8.1 | 5.8 | 0.32 | 5.5 | 6.3 | 5.6 | 0.98 | 4.3 | 6.7 | 7.3 | 0.67 | 6.6 | 8.2 |
| | Barium (Ba) | mg/kg | - | - | 141 | 46 | 87 | 213 | 202 | 70 | 127 | 281 | 202 | 12 | 187 | 220 | 236 | 20 | 214 | 257 |
| | Beryllium (Be) | mg/kg | - | - | 0.26 | 0.049 | 0.21 | 0.34 | 0.41 | 0.037 | 0.36 | 0.45 | 0.80 | 0.031 | 0.77 | 0.85 | 0.48 | 0.049 | 0.41 | 0.53 |
| | Bismuth (Bi) | mg/kg | - | - | <0.20 | - | <0.20 | <0.20 | <0.20 | - | <0.20 | <0.20 | <0.20 | - | <0.20 | <0.20 | <0.20 | - | <0.20 | <0.20 |
| | Boron (B) | mg/kg | - | - | <5.0 | - | <5.0 | <5.0 | <5.0 | - | <5.0 | <5.0 | <5.0 | - | <5.0 | <5.0 | <5.0 | - | <5.0 | <5.0 |
| | Cadmium (Cd) | mg/kg | 0.60 | 3.5 | 0.11 | 0.056 | 0.076 | 0.21 | 0.20 | 0.086 | 0.10 | 0.30 | 0.26 | 0.036 | 0.23 | 0.31 | 0.22 | 0.036 | 0.17 | 0.25 |
| | Calcium (Ca) | mg/kg | - | - | 6,150 | 1,938 | 4,850 | 9,560 | 7,754 | 1,393 | 5,770 | 9,120 | 10,776 | 908 | 9,580 | 11,700 | 10,830 | 1,372 | 8,650 | 12,100 |
| | Chromium (Cr) | mg/kg | 37 | 90 | 16 | 3.2 | 12 | 21 | 26 | 1.9 | 25 | 29 | 48 | 4.7 | 42 | 55 | 32 | 2.2 | 29 | 34 |
| | Cobalt (Co) | mg/kg | - | - | 7.2 | 1.9 | 5.8 | 10 | 10 | 1.1 | 9.2 | 12 | 13 | 0.33 | 13 | 13 | 11 | 0.53 | 10 | 12 |
| | Copper (Cu) | mg/kg | 36 | 197 | 14 | 3.6 | 11 | 20 | 155 | 96 | 46 | 274 | 30 | 4.3 | 28 | 38 | 49 | 5.5 | 44 | 57 |
| | Iron (Fe) | mg/kg | - | - | 19,820 | 3,175 | 15,400 | 23,800 | 23,080 | 1,361 | 21,700 | 25,200 | 27,000 | 587 | 26,200 | 27,700 | 25,140 | 1,563 | 23,800 | 27,700 |
| | Lead (Pb) | mg/kg | 35 | 91 | 3.4 | 0.61 | 2.8 | 4.5 | 5.6 | 0.56 | 4.9 | 6.3 | 6.5 | 0.47 | 6.0 | 7.3 | 6.0 | 0.47 | 5.5 | 6.6 |
| | Lithium (Li) | mg/kg | - | - | 5.3 | 0.77 | 4.4 | 6.5 | 7.7 | 1.0 | 6.6 | 8.6 | 11 | 1.5 | 9.4 | 14 | 11 | 0.96 | 9.2 | 12 |
| | Magnesium (Mg) | mg/kg | - | - | 3,384 | 515 | 2,760 | 4,190 | 6,356 | 521 | 5,660 | 6,880 | 9,674 | 825 | 8,760 | 11,000 | 7,118 | 413 | 6,600 | 7,610 |
| | Manganese (Mn) | mg/kg | - | - | 519 | 312 | 245 | 1,050 | 2,085 | 1,506 | 491 | 3,690 | 410 | 174 | 204 | 549 | 975 | 140 | 813 | 1,120 |
| | Mercury (Hg) | mg/kg | 0.17 | 0.49 | 0.039 | 0.020 | 0.017 | 0.060 | 0.022 | 0.0064 | 0.012 | 0.028 | 0.044 | 0.0026 | 0.041 | 0.047 | 0.035 | 0.0058 | 0.028 | 0.041 |
| | Molybdenum (Mo) | mg/kg | - | - | 0.44 | 0.12 | 0.32 | 0.65 | 1.5 | 0.73 | 0.76 | 2.4 | 0.59 | 0.058 | 0.54 | 0.68 | 0.68 | 0.071 | 0.59 | 0.76 |
| | Nickel (Ni) | mg/kg | - | - | 13 | 2.0 | 11 | 16 | 26 | 2.3 | 24 | 29 | 38 | 2.5 | 35 | 42 | 28 | 1.3 | 28 | 30 |
| | Phosphorus (P) | mg/kg | - | - | 771 | 79 | 687 | 882 | 892 | 30 | 861 | 933 | 1,050 | 36 | 988 | 1,080 | 870 | 43 | 832 | 937 |
| | Potassium (K) | mg/kg | - | - | 548 | 97 | 440 | 690 | 1,298 | 147 | 1,140 | 1,510 | 1,134 | 110 | 1,020 | 1,300 | 1,196 | 86 | 1,100 | 1,330 |
| | Selenium (Se) | mg/kg | - | - | 0.35 | 0.078 | 0.24 | 0.45 | 0.51 | 0.24 | <0.20 | 0.78 | 0.39 | 0.044 | 0.34 | 0.44 | 0.57 | 0.11 | 0.44 | 0.70 |
| | Silver (Ag) | mg/kg | - | - | <0.10 | - | <0.10 | <0.10 | 0.13 | 0.063 | <0.10 | 0.24 | 0.10 | 0.0057 | <0.10 | 0.11 | 0.10 | 0.0057 | <0.10 | 0.11 |
| | Sodium (Na) | mg/kg | - | - | 173 | 20 | 147 | 198 | 326 | 18 | 308 | 350 | 458 | 33 | 417 | 500 | 317 | 22 | 281 | 335 |
| | Strontium (Sr) | mg/kg | - | - | 50 | 10 | 39 | 66 | 91 | 22 | 62 | 116 | 103 | 10 | 91 | 114 | 108 | 16 | 83 | 125 |
| | Thallium (Tl) | mg/kg | - | - | 0.053 | - | <0.05 | 0.063 | 0.082 | 0.010 | 0.071 | 0.10 | 0.093 | 0.012 | 0.080 | 0.11 | 0.10 | 0.010 | 0.087 | 0.11 |
| | Tin (Sn) | mg/kg | - | - | <2.0 | - | <2.0 | <2.0 | <2.0 | - | <2.0 | <2.0 | <2.0 | - | <2.0 | <2.0 | <2.0 | - | <2.0 | <2.0 |
| | Titanium (Ti) | mg/kg | - | - | 525 | 112 | 355 | 645 | 622 | 47 | 573 | 683 | 762 | 187 | 436 | 916 | 747 | 84 | 648 | 867 |
| | Uranium (U) | mg/kg | - | - | 0.87 | 0.33 | 0.56 | 1.4 | 0.89 | 0.25 | 0.54 | 1.2 | 3.2 | 0.44 | 2.7 | 3.8 | 1.2 | 0.25 | 0.94 | 1.5 |
| | Vanadium (V) | mg/kg | - | - | 37 | 6.3 | 31 | 48 | 52 | 4.0 | 50 | 59 | 70 | 2.1 | 67 | 73 | 54 | 3.6 | 51 | 60 |
| | Zinc (Zn) | mg/kg | 123 | 315 | 34 | 6.4 | 27 | 44 | 59 | 9.5 | 48 | 68 | 63 | 6.8 | 55 | 74 | 60 | 5.2 | 55 | 68 |

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

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

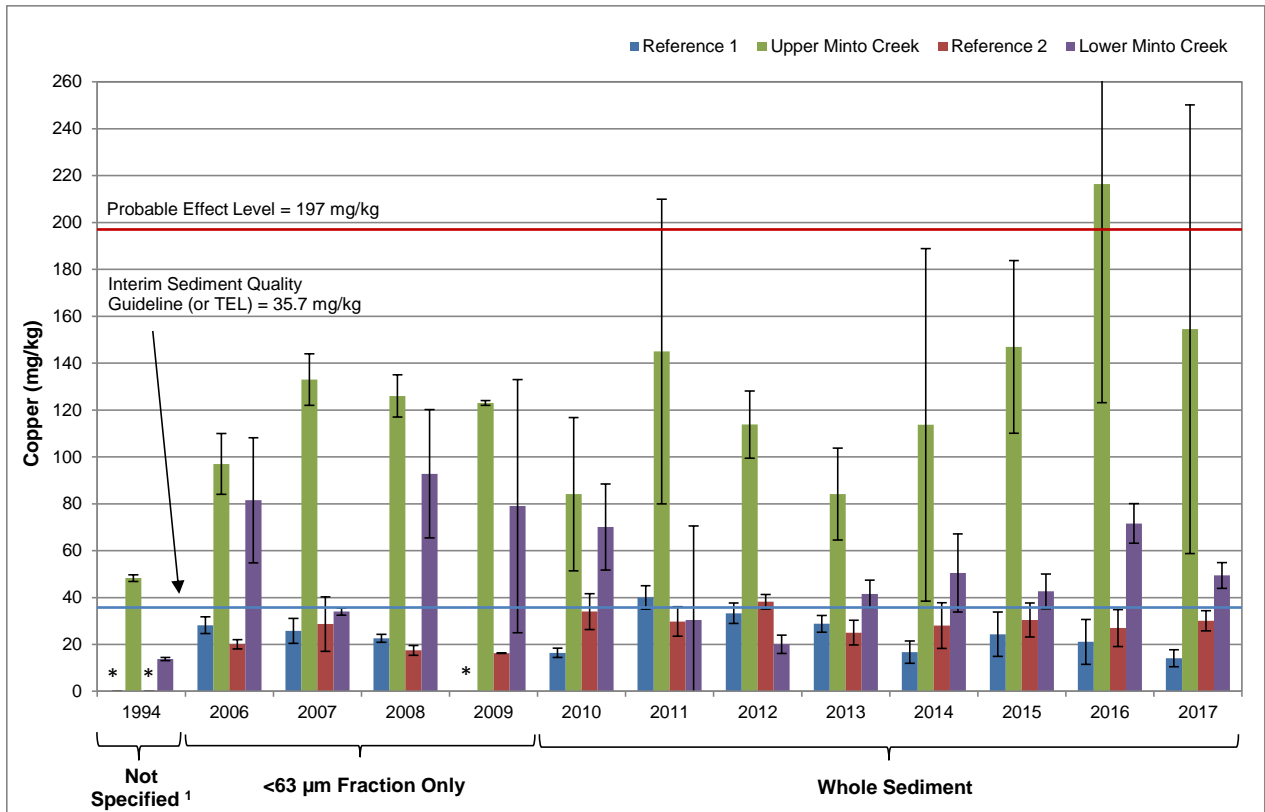


Figure 11-1: Mean Copper Concentrations in Sediment Collected in Minto Creek and Reference Locations (mean ± standard deviation) (1994-2017)

Notes:

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

² Reference 1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2017; Reference 2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2017.

* = no data.

TEL = Threshold Effect Levels.

Table 11-2: Minto Mine Sediment Toxicity Test Results Collected for Lower Wolverine and lower Minto Creeks, September 2017

| Area | <i>Hyalella azteca</i> | | <i>Chironomus dilutus</i> | |
|-----------------------------------|------------------------|-----------------|---------------------------|-----------------|
| | Survival (%) | Dry Weight (mg) | Survival (%) | Dry Weight (mg) |
| Control Sediment | 96 ± 5.5 | 0.11 ± 0.020 | 86 ± 8.9 | 1.2 ± 0.25 |
| Lower Wolverine Creek (Reference) | 94 ± 5.5 | 0.13 ± 0.030 | 90 ± 17 | 2.0 ± 0.24 |
| Lower Minto Creek (Exposed) | 92 ± 13 | 0.11 ± 0.020 | 48 ± 38 | 1.6 ± 0.32 |

- Significantly different than control sediment.
- Significantly different than reference sediment.
- Significantly different than reference and control sediment.

Note: Data presented as mean ± standard deviation.

11.2.2 Periphyton Monitoring

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

Concentration of chlorophyll-a in periphyton was significantly higher at lower Minto Creek than at lower Wolverine Creek but both areas had concentrations below the British Columbia Water Quality Guideline (BCWQG) of 100 mg/m² for the protection of aquatic life (BCMOE 1985; Figure 11-2). In most years, production of both creeks was classified as low (oligotrophic), except in 2016 when lower Minto Creek was eutrophic and lower Wolverine Creek was mesotrophic. Production was classified based on the system of Dodds et al. (1998), which sets the oligotrophic-mesotrophic boundary for benthic chlorophyll-a at 20 mg/m² and the mesotrophic-eutrophic boundary was set at 70 mg/m². In 2017, production was classified as mesotrophic at lower Minto Creek (51 mg/m²) and oligotrophic at lower Wolverine Creek (13 mg/m²). Based on only total phosphorus, both creeks would be defined as oligotrophic as was observed in previous years (Dodds et al. 1998).

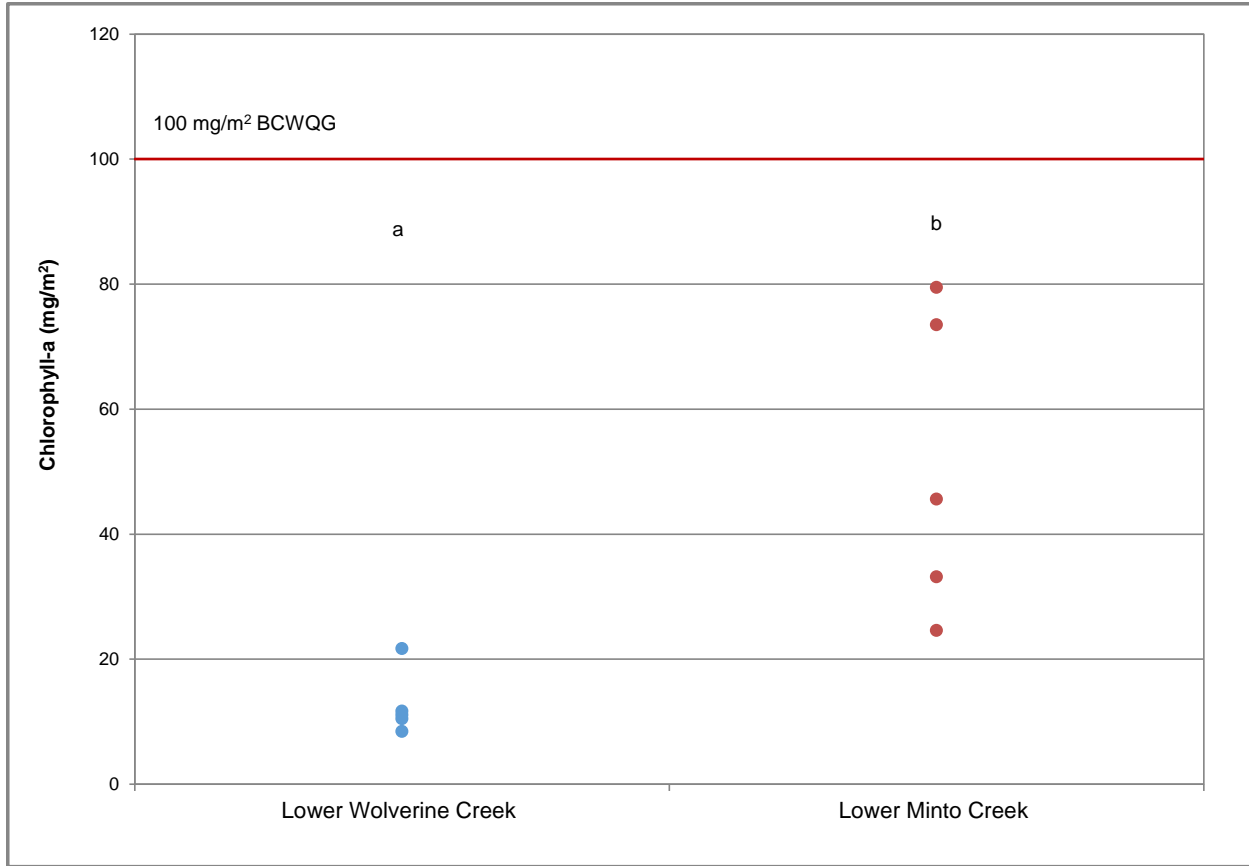
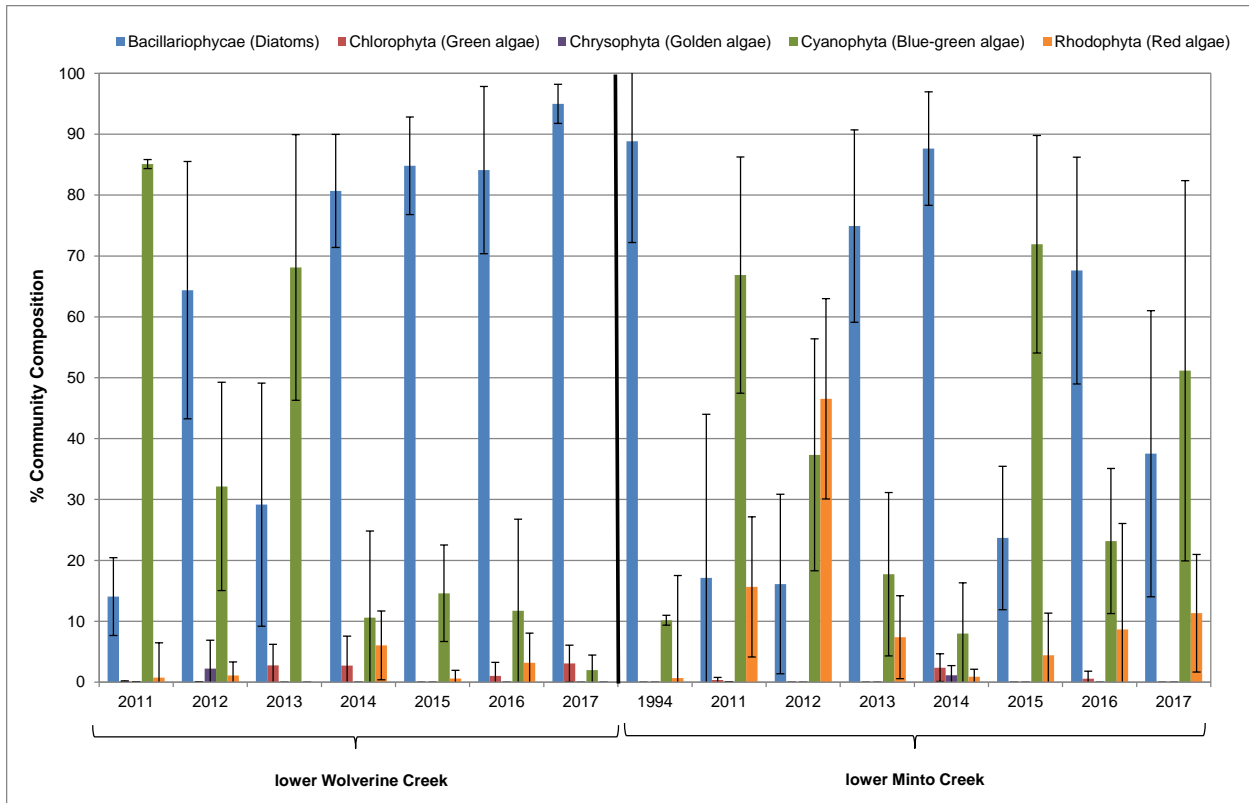


Figure 11-2: Concentration of Chlorophyll a in Periphyton Measured at Five Benthic Invertebrate Stations in Lower Wolverine and lower Minto Creeks, Minto Mine WUL, 2017

*Different letters represent significant differences between sites.

The periphyton community of lower Minto Creek was evaluated and compared to that of lower Wolverine Creek in order to evaluate any potential mine-related effects. Dominant phyla in lower Minto and Wolverine creeks were Bacillariophyceae (diatoms) and Cyanophyta (blue-green algae). Cyanophyta was dominant at lower Minto Creek (51% of community) and Bacillariophyceae was dominant at lower Wolverine Creek (95% of the community). Temporal variability in community composition has been high in both exposure and reference areas (Figure 11-3). For example, at lower Minto Creek, Bacillariophyceae were dominant in 1994, 2013, 2014, and 2016; Rhodophyta (red algae) in 2012 and Cyanophyta in 2011, 2015, and 2017 (Figure 11-3). This lack of temporal consistency was also observed at lower Wolverine Creek, with Cyanophyta dominant in 2011 and 2013 and Bacillariophyceae in 2012, 2014 to 2017 (Figure 11-3; Minnow 2013, 2014, 2015, 2016, 2017).



Note: Data presented as mean ± standard deviation

Figure 11-3: Periphyton Community Composition in Lower Minto Creek (1994, 2011 to 2017) and Lower Wolverine Creek (2011 to 2017), Minto Mine WUL, 2017

11.2.3 Benthic Invertebrate Community Monitoring

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

Benthic invertebrate community metrics of density, Simpson’s diversity, and Simpson’s evenness were not significantly different among areas (Table 11-3). Number of taxa and Bray-Curtis index showed significant differences among areas, but lower Minto Creek was intermediate between the reference areas (Table 11-3). This suggests a limited mine influence. Percent EPT did not differ significantly among areas but differences were seen with abundances of chironomids and oligochaetes (Table 11-3). The higher proportion of chironomids suggest a mine influence, but in combination with the lower proportion of oligochaetes and similar percent EPT taxa suggest limited influence of the mine on the benthic invertebrate community (Chapman et al. 1982a,b; Rosenberg and Resh 1993; Taylor and Bailey 1997). A potential decrease in number of taxa from 2012 to 2014 was not supported by the 2015 to 2017 data and appears to represent natural variability (Minnow 2015, 2016, 2017). The similarity of the benthic

community of lower Minto Creek to reference communities and the temporal stability in the benthic community of lower Minto Creek suggest limited mine influence.

Table 11-3: Statistical comparisons of Benthic Invertebrate Community Metrics, Minto Mine WUL, 2017

| Metric | Comparison | | Area Means | | Statistical Contrasts | | |
|---------------------------------------|-------------------|-----------------------|------------|------|---------------------------------------|-------------------|----------------------|
| | Exposure Site | Reference Site | | | Significant Difference between areas? | Direction | P-value ^a |
| Density (organisms/m ²) | lower Minto Creek | lower Wolverine Creek | 345 | 174 | NO | - | 0.208 |
| | | lower Big Creek | | 229 | NO | - | |
| Number of Taxa | lower Minto Creek | lower Wolverine Creek | 18 | 16 | NO | - | 0.813 |
| | | lower Big Creek | | 24 | NO | - | 0.213 |
| Simpson's Diversity ^b | lower Minto Creek | lower Wolverine Creek | 0.70 | 0.48 | NO | - | 0.105 |
| | | lower Big Creek | | 0.78 | NO | - | |
| Simpson's Evenness ^b | lower Minto Creek | lower Wolverine Creek | 0.22 | 0.18 | NO | - | 0.555 |
| | | lower Big Creek | | 0.20 | NO | - | |
| BC Index to Combined Reference Median | lower Minto Creek | lower Wolverine Creek | 0.79 | 0.82 | NO | - | 0.847 |
| | | lower Big Creek | | 0.67 | NO | - | 0.192 |
| EPT (%) ^c | lower Minto Creek | lower Wolverine Creek | 48 | 25 | NO | - | 0.161 |
| | | lower Big Creek | | 47 | NO | - | |
| Chironomids (%) | lower Minto Creek | lower Wolverine Creek | 31 | 4.7 | YES | Minto > Wolverine | 0.004 |
| | | lower Big Creek | | 27 | NO | - | 0.800 |
| Oligochaetes (%) | lower Minto Creek | lower Wolverine Creek | 6.8 | 65 | YES | Minto < Wolverine | 0.001 |
| | | lower Big Creek | | 15 | NO | - | 0.389 |
| CA Axis-1 (34.8%) | lower Minto Creek | lower Wolverine Creek | 224 | -212 | YES | Minto > Wolverine | 0.011 |
| | | lower Big Creek | | -214 | YES | Minto > Wolverine | 0.006 |
| CA Axis-2 (28.9%) | lower Minto Creek | lower Wolverine Creek | 10 | 190 | YES | Minto < Wolverine | 0.007 |
| | | lower Big Creek | | -169 | YES | Minto < Wolverine | 0.007 |

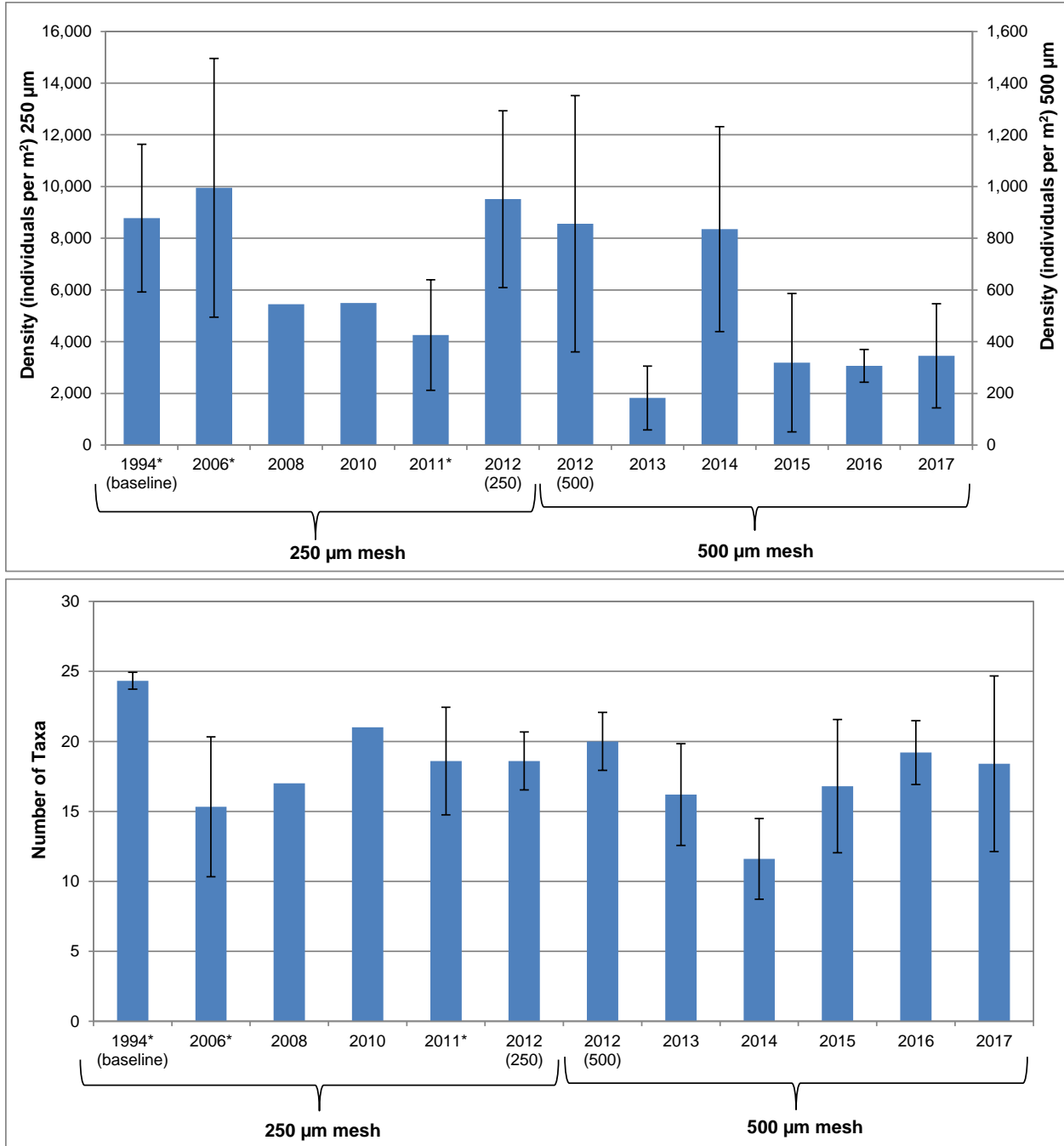
■ Indicates a statistically significant difference between exposed and reference areas, p = 0.10.

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

^b Calculated as recommended by Environment Canada 2012.

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

Comparisons of benthic invertebrate community metrics in 2017 to those documented in previous years indicated substantial temporal variability (also observed with periphyton communities) at both the receiving environment and reference areas. Benthic invertebrate density in 2017 was lower than or similar to densities in 2012 (500 µm) and 2014 to 2016 but higher than in 2013 (Figure 11-4). Number of taxa at lower Minto Creek in 2017 was lower than in 1994 and within the historical range from 2006 onwards (Figure 11-4).



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

Figure 11-4: Primary Benthic Invertebrate Community Density and Taxon Richness at Lower Minto Creek, 1994 to 2017

11.2.4 Fisheries Monitoring Program

The objectives of the 2017 Fisheries Monitoring Program were to monitor, assess and characterize fish usage in Minto Creek during open water season, and to provide data allowing interpretation of the potential role and influence of the Minto Mine on the fish community. The 2017 fisheries program was a continuation of the previous year's components, and targeted all species that have previously been encountered as well as any new species. As part of the 2017 monitoring program, assessments at Big Creek were made concurrently with sampling in Minto Creek, to compare fish use in a neighbouring system relative to Minto Creek. Fish monitoring studies were conducted as per the EMSRP.

Fish monitoring of Minto Creek and Big Creek was conducted monthly during open water season, from June to September 2017, at trapping sites consistent with the 2010 mark-recapture study and the 2011 to 2016 fish monitoring programs. Capture effort included the use of Gee-type Minnow traps with 0.635 cm wire mesh size baited with Yukon River origin Chinook salmon roe. A total of six to fourteen minnow traps were set each time in Minto Creek, depending on water levels and availability of pools and backwater areas. Three to four traps were set each time in Big Creek, near the Minto road bridge.

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

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

For details on the 2017 results of Fisheries Monitoring Program see [Appendix L](#).

11.3 Copper Toxicity Study

The copper toxicity study was initiated in 2015, due to a mild freshet and no major rainfalls, a turbid flow sampling could not be completed in 2016. The turbid flow sample was successfully collected in 2017. See [Appendix M](#) for a letter regarding the status of the program and the report on the copper toxicity for a turbid flow stream.

11.4 Aquatic Environmental Monitoring Program (AEMP) Review

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

12 Meteorological Monitoring Program

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

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

12.1 Climate Monitoring Program

The 2017 Climate Monitoring Program data are presented below in Figure 12-1 through Figure 12-7. During 2017, Minto Mine had one meteorological station located approximately 70 m northeast of the north end of the airstrip, in an area that allows ample meteorological exposure from all directions. Trees are cleared for a radius of 30 m from the meteorology station and beyond that radius is a sparse growth of 2 m tall conifers.

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

The outgoing short wave radiation sensor and evaporation pan were operational in 2017.

At some point during February 2017 the power supply to the meteorology station became disconnected. It is uncertain how this occurred. The issue was not discovered until February 17th, 2017 as an intermittent communications error was thought to be the cause of the inability to communicate with the station. When the power supply was reconnected on February 17th, 2017, all data from January 25th to February 16th was lost, and partial data was lost from January 26th and February 17th.

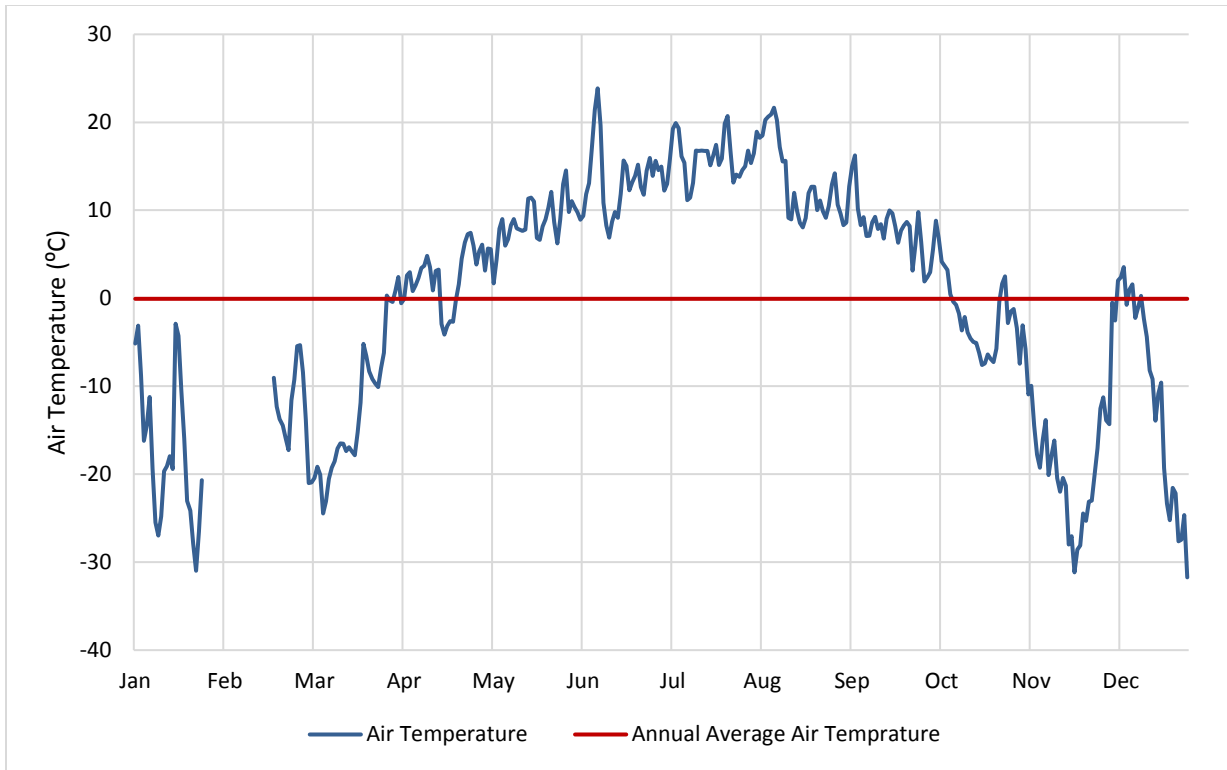


Figure 12-1: Annual Air Temperature (2017)

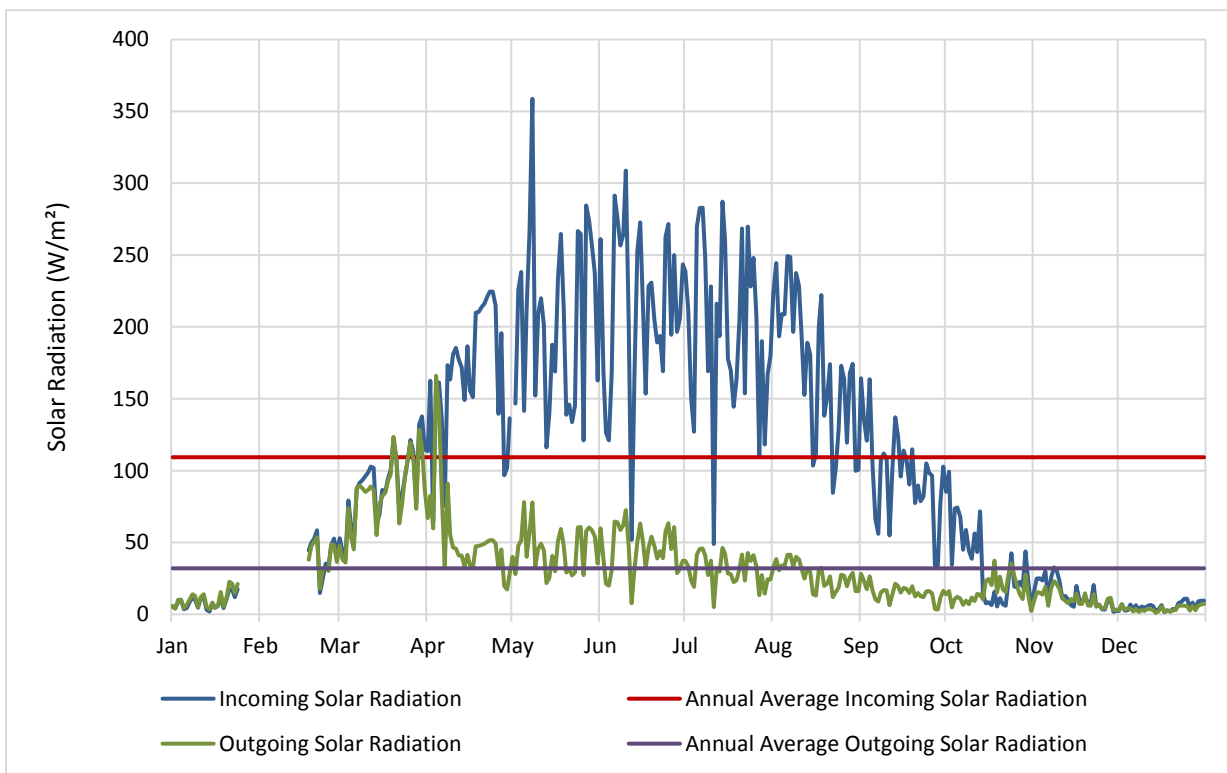


Figure 12-2: Annual Solar Radiation (2017)

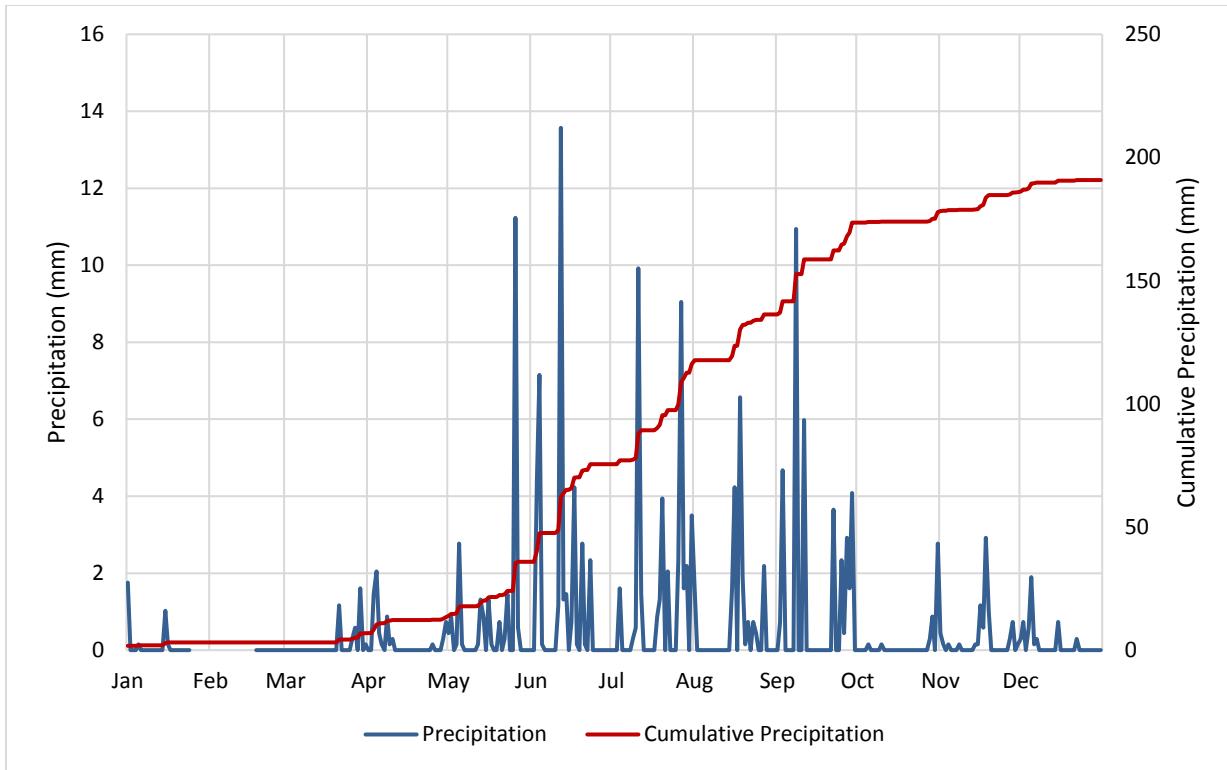


Figure 12-3: Annual Precipitation (2017)

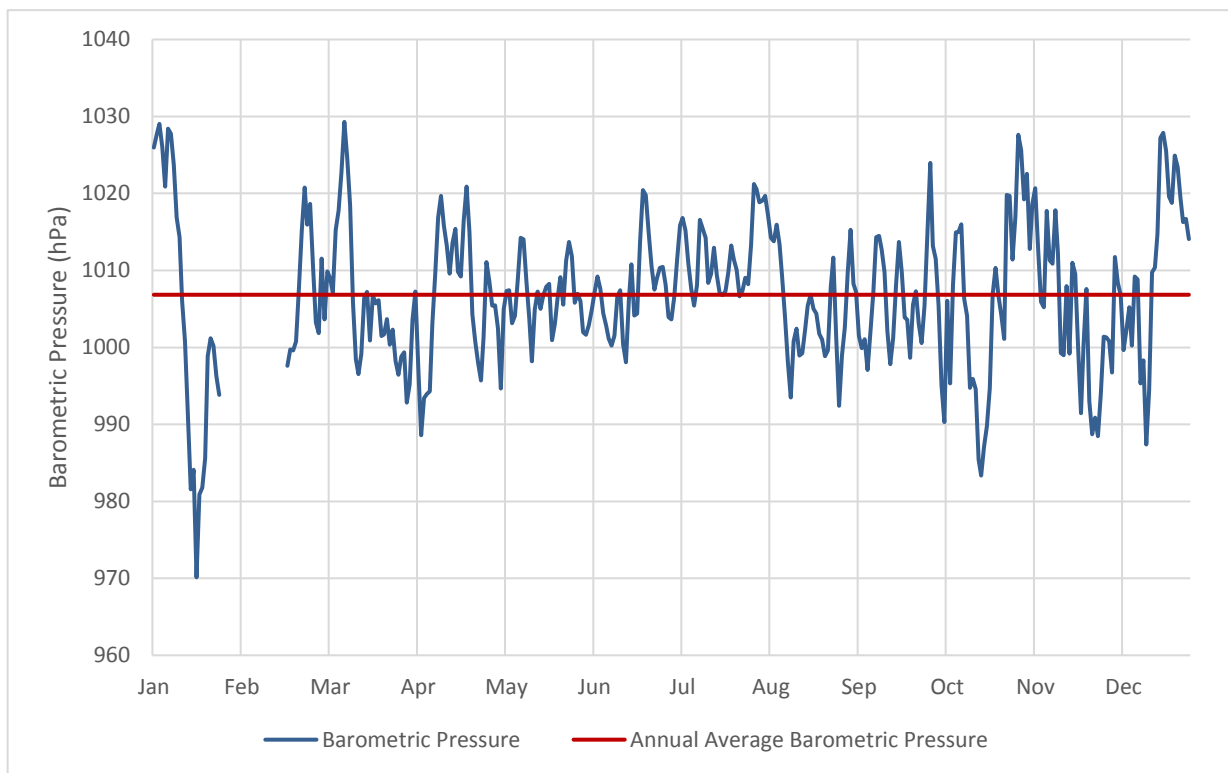


Figure 12-4: Annual Barometric Pressure (2017)

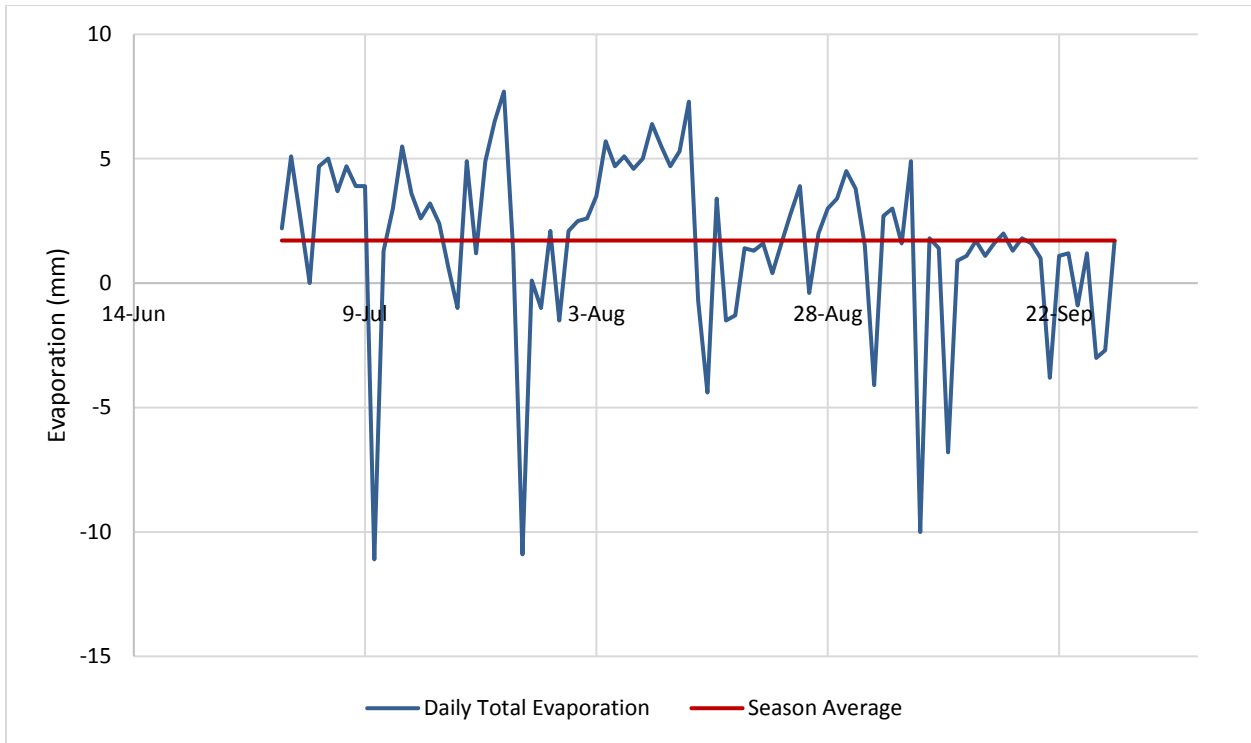


Figure 12-5: Evaporation (June 30th- September 28th 2017)

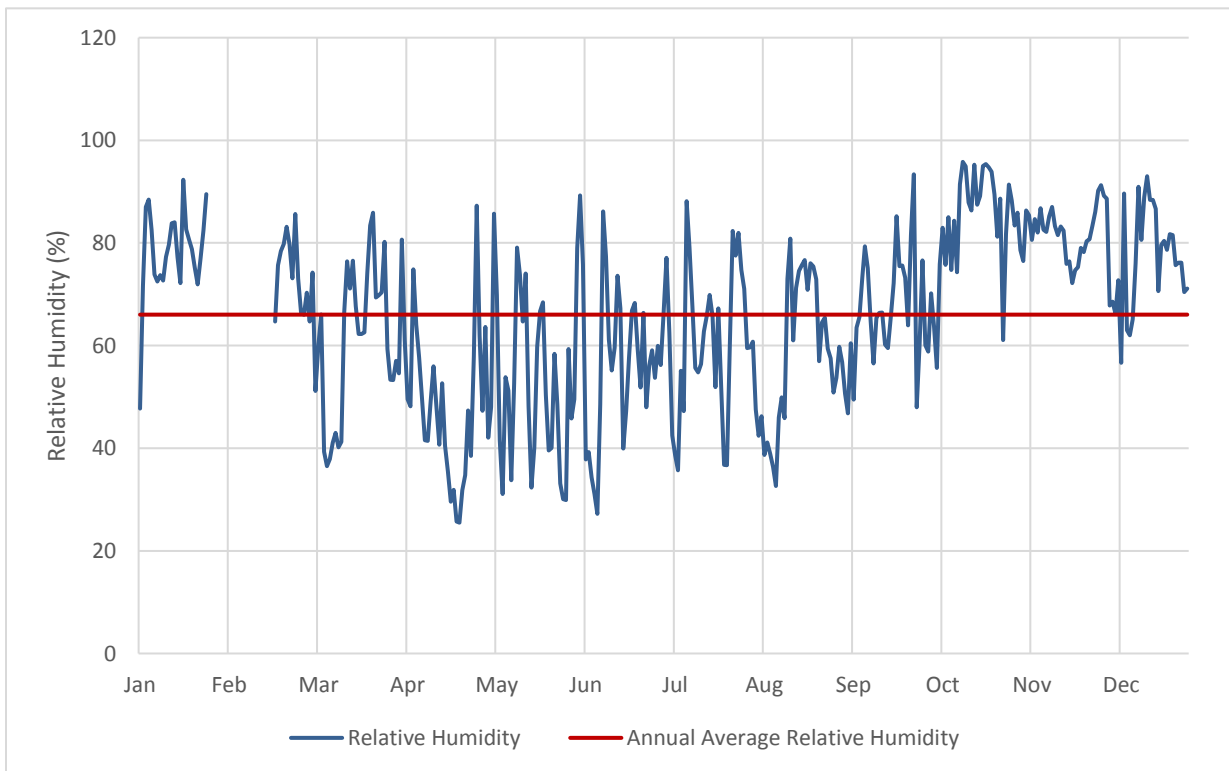


Figure 12-6: Annual Relative Humidity (2017)

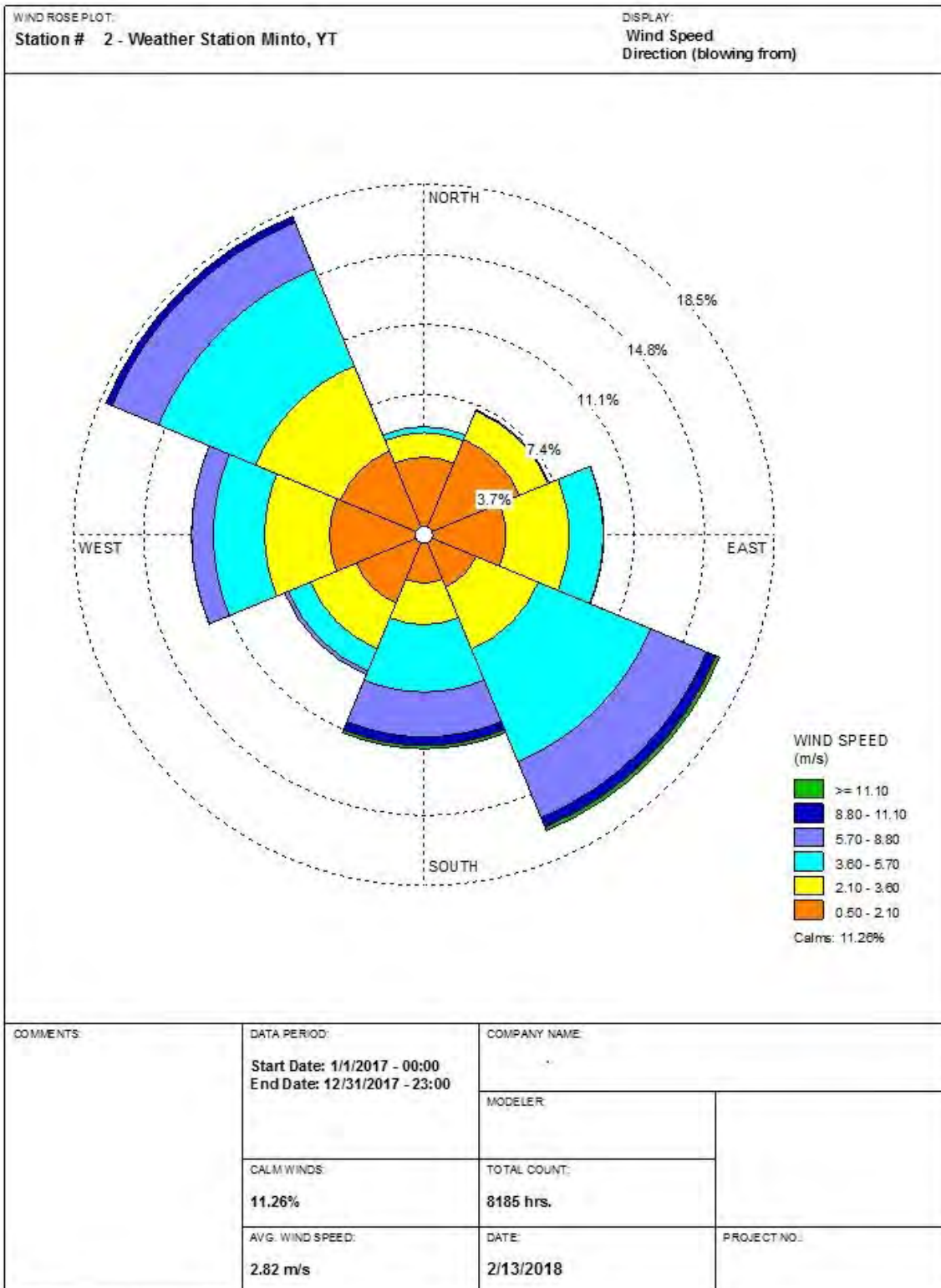


Figure 12-7: Wind Speed and Direction Events (2017) – WRPLOT View – Lake Environmental Software

12.2 Snow Survey Program

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

Table 12-1: Snow Survey Course Locations

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

12.3 Meteorology QA/QC

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

13 Geochemistry

13.1 Waste Rock Verification Program

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

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

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

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

During the year 2017, seventy-four grab samples of waste (WST) were collected from the Main Pit Waste Dump (MPD), twenty-four samples were collected from the Main Waste Dump Wrap (MWDW) and twenty-one samples from the 118-overburden dump. All the overburden and rock placed in these dumps during this period consisted of waste material from the Area 2 Stage 3 pit and the expansion.

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

Table 13-1: Waste Rock Management Verification Program Summary (2017)

| Average ABA Parameter Values: Month By Location | | | | | | | | |
|---|-------|------------|-------|----------|----------|-------|------|-------|
| Location | Month | Waste Type | Cu% | C% (Tot) | S% (Tot) | NP | AP | NP/AP |
| MPD | Jan | WST | 0.010 | 0.216 | 0.011 | 17.97 | 0.34 | 52 |
| | Feb | WST | 0.119 | 0.230 | 0.014 | 19.18 | 0.44 | 44 |
| | Mar | WST | 0.204 | 0.201 | 0.039 | 16.73 | 1.23 | 14 |
| | Apr | WST | 0.018 | 0.202 | 0.008 | 16.81 | 0.25 | 67 |
| | May | WST | 0.067 | 0.458 | 0.022 | 38.13 | 0.69 | 55 |
| | Jun | WST | 0.224 | 0.218 | 0.092 | 18.19 | 2.88 | 6 |
| | Jul | WST | 0.375 | 0.478 | 0.142 | 39.83 | 4.43 | 9 |
| | Aug | WST | 0.176 | 0.403 | 0.085 | 33.61 | 2.64 | 13 |
| | Sep | WST | 0.072 | 0.215 | 0.034 | 17.87 | 1.07 | 17 |
| | Oct | WST | 0.138 | 0.253 | 0.043 | 21.07 | 1.33 | 16 |
| | Nov | WST | 0.388 | 0.124 | 0.011 | 10.36 | 0.34 | 30 |
| 118 | Apr | WST | 0.127 | 0.205 | 0.003 | 17.09 | 0.10 | 171 |
| | May | WST | 0.093 | 0.232 | 0.005 | 19.33 | 0.17 | 116 |
| | Jun | WST | 0.110 | 0.078 | 0.007 | 6.52 | 0.21 | 31 |
| MWDW | Nov | WST | 0.368 | 0.102 | 0.019 | 8.48 | 0.60 | 14 |
| | Dec | WST | 0.114 | 0.503 | 0.070 | 41.91 | 2.19 | 19 |

13.2 Acid-Base Accounting Program

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

The following is a summary of results from the ABA program for the monitoring period of January to December 2017.

A total of 284 samples were collected from the Area 2 Stage 3 (A2S3), Area 2 Underground (A2 UG) and the Minto East Underground (ME UG) deposits and sent to an accredited laboratory (ALS Minerals) during the 2017 monitoring period. The samples were analyzed according to the MEND Modified NP Method as noted in the EMSRP.

The mean NP:mean AP results for waste rock samples was 15.26 for the duration of the monitoring period. 33 samples during the 2017 monitoring period were below the NPR threshold of 3 for waste rock. The mean paste pH values for all samples tested in 2017 was 8.50. The mean sulfide sulfur ($S(S^{-2})$) content for waste rock samples during the 2017 monitoring period was 0.082%. In 2017, 17 samples exceeded the $S(S^{-2})$ content threshold of 0.30% for construction grade waste rock.

15 tailings samples were analyzed in this period and had a mean NP:mean AP of 10.66. All tailings samples were well above a NPR of 4. All 15 samples of tailings were also below 0.30% $S(S^{-2})$ content and had a paste pH between 7.8 and 8.2.

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

13.3 Leach Pads

In 2017, two field scale leach pads were constructed and filled with Partially Oxidized Ore (POX – Leach Pad #1) and Low Grade Sulfide Ore (Green sulfide ore – Leach Pad #2), as per the EMSRP. The Pads were constructed in October, and the first leachate samples are expected to be collected in the spring of 2018.

14 Terrestrial Monitoring Programs

14.1 Wildlife Monitoring Program

The *Minto Mine Wildlife Protection Plan* (a component of the EMSRP) establishes guidelines for minimizing wildlife disturbance at the Minto Mine site and along the development corridor and includes a monitoring program to yield information about wildlife use in the area. The 2017 activities under the Wildlife Monitoring Program including the area and frequency of monitoring, are summarized in Table 14-1, below.

Table 14-1: Wildlife Monitoring Activities (2017)

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

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

In 2017, 209 wildlife sightings were recorded. The majority of these sightings were comprised of mammals: 106 individual bear sightings, 31 foxes, 28 deer, 5 moose, 10 wolves, 9 lynxes, and 6 porcupines. Other animals observed on site included but were not limited to, hares, ermine, grouse, ptarmigan, sheep, dunlin, eagles, ducks and geese.

The most active animal observation month was August and the most common sighting was bears. Most the animal hazing activities occurred between June and August.

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

14.2 Erosion and Sedimentation Monitoring Program

As part of the EMSRP, Minto has developed and implemented a *Sediment and Erosion Control Plan* (SECP). The objective of the SECP is to minimize local site impacts from erosion and prevent sedimentation to the receiving environment of Minto Creek. The 2017 activities associated with the Erosion and Sedimentation Monitoring Program are identified in Table 14-2, below. There were no significant issues in 2017.

Table 14-2: Erosion and Sedimentation Monitoring Activities (2017)

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

14.3 Invasive Plant Species Monitoring Program

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

The 2017 invasive species program focused primarily on the site access road. The Minto Environmental Department completed an invasive plant survey of the twenty-seven kilometer access road, focusing primarily on the high-risk species as listed by the Yukon Invasive Species Council (YISC) (Table 14-3). During the access road survey, one high-risk species (Common Tansy, *Tanacetum vulgare*) was observed growing along the access road. As per the EMSRP, the observed high-risk species was reported to the Yukon Invasive Species Council (YISC) Spotter’s Network. For a summary of the access road invasive species survey results, please refer to Table 14-4, below.

In accordance with the EMSRP, invasive plant surveys will continue through 2018, particularly along invasive species pathways such as roads with high visitor traffic, recently exposed areas, and areas that have been recently reclaimed.

Table 14-3: High Priority Invasive Species as determined by the Yukon Invasive Species Council, 2017

| Common Name | Latin Name |
|-----------------------|----------------------------------|
| Leafy Spurge | <i>Euphorbia esula</i> |
| Orange Hawkweed | <i>Hieracium aurantiacum</i> |
| Tall Hawkweed | <i>Hieracium piloselloides</i> |
| Perennial Sow Thistle | <i>Sonchus arvensis</i> |
| Scentless Chamomile | <i>Tripleurospermum inodorum</i> |
| Oxeye Daisy | <i>Leucanthemum vulgare</i> |
| Spotted Knapweed | <i>Centaurea stoebe</i> |
| Creeping Thistle | <i>Cirsium arvense</i> |
| Common Tansy | <i>Tanacetum vulgare</i> |
| Bird Vetch | <i>Vicia cracca</i> |

Table 14-4: Minto Mine Invasive Species Monitoring Program Results, 2017

| Survey Date | Location | Observed Species and Occurrence |
|-------------|--------------------------------------|---------------------------------|
| 19-Jul-17 | Access Road, Right Side, km 0.5-0.75 | Hawksbeard, Sporadic |
| 19-Jul-17 | Access Road, Right Side, km 1.5-2.5 | Hawksbeard, Sporadic |
| 19-Jul-17 | Access Road, Right Side, km 2.5 | Toadflax, Rare |
| 19-Jul-17 | Access Road, Right Side, km 3.25-3.5 | Hawksbeard, Sporadic |
| 19-Jul-17 | Access Road, Right Side, km 3.5-4.0 | Toadflax, Rare |
| 19-Jul-17 | Access Road, Right Side, km 4.25-5.0 | Hawksbeard, Continuous |
| 19-Jul-17 | Access Road, Right Side, km 5.75 | Toadflax, Rare |
| 19-Jul-17 | Access Road, Right Side, km 6.75-7.0 | Hawksbeard, Sporadic |

| Survey Date | Location | Observed Species and Occurrence |
|-------------|--|---------------------------------|
| 19-Jul-17 | Access Road, Right Side, km 6.75-7.25 | Toadflax, Rare |
| 19-Jul-17 | Access Road, Right Side, km 7.75-10.0 | Toadflax, Sporadic |
| 19-Jul-17 | Access Road, Right Side, km 10.0 | Common Tansy, Rare |
| 19-Jul-17 | Access Road, Right Side, km 10.5-10.75 | Toadflax, Sporadic |
| 19-Jul-17 | Access Road, Right Side, km 11.5 | Common Tansy, Rare |
| 19-Jul-17 | Access Road, Right Side, km 12.25-15.5 | Hawksbeard, Sporadic |
| 19-Jul-17 | Access Road, Right Side, km 12.25 | Toadflax, Rare |
| 19-Jul-17 | Access Road, Right Side, km 12.25 | Common Tansy, Rare |
| 19-Jul-17 | Access Road, Right Side, km 13.5 | Toadflax, Rare |
| 19-Jul-17 | Access Road, Right Side, km 15.0-17.25 | Sweet Clover, Continuous |
| 19-Jul-17 | Access Road, Right Side, km 15.75-16.5 | Hawksbeard, Rare |
| 19-Jul-17 | Access Road, Right Side, km 18.25-18.5 | Hawksbeard, Rare |
| 19-Jul-17 | Access Road, Right Side, km 18.25 | Toadflax, Rare |
| 19-Jul-17 | Access Road, Right Side, km 19.0-20.0 | Toadflax, Sporadic |
| 19-Jul-17 | Access Road, Right Side, km 19.5-19.75 | Hawksbeard, Sporadic |
| 19-Jul-17 | Access Road, Right Side, km 20.0 | Common Tansy, Rare |
| 19-Jul-17 | Access Road, Right Side, km 20.25-23.0 | Toadflax, Rare |
| 19-Jul-17 | Access Road, Right Side, km 23.25-23.5 | Hawksbeard, Rare |
| 19-Jul-17 | Access Road, Right Side, km 23.25-24.0 | Toadflax, Sporadic |
| 19-Jul-17 | Access Road, Right Side, km 24.25-27.0 | Toadflax, Rare |
| 19-Jul-17 | Access Road, Right Side, km 25.0 | Common Tansy, Rare |
| 19-Jul-17 | Access Road, Right Side, km 25.75 | Common Tansy, Sporadic |
| 19-Jul-17 | Access Road, Right Side, km 26.0 | Hawksbeard, Rare |
| 19-Jul-17 | Access Road, Right Side, km 27.0 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 0.5 | Common Tansy, Rare |
| 20-Jul-17 | Access Road, Left Side, km 1.25-2.0 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 1.5 | Sweet Clover, Rare |
| 20-Jul-17 | Access Road, Left Side, km 2.5-2.75 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 2.5-2.75 | Toadflax, Rare |
| 20-Jul-17 | Access Road, Left Side, km 3.25-3.75 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 4.75-5.75 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 5.0 | Toadflax, Rare |
| 20-Jul-17 | Access Road, Left Side, km 6.25-6.75 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 6.25 | Toadflax, Rare |
| 20-Jul-17 | Access Road, Left Side, km 7.0-8.75 | Toadflax, Rare |
| 20-Jul-17 | Access Road, Left Side, km 8.0 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 8.5 | Hawksbeard, Sporadic |
| 20-Jul-17 | Access Road, Left Side, km 9.0 | Common Tansy, Rare |
| 20-Jul-17 | Access Road, Left Side, km 9.25-10.0 | Common Tansy, Rare |
| 20-Jul-17 | Access Road, Left Side, km 9.25-9.5 | Toadflax, Rare |

| Survey Date | Location | Observed Species and Occurrence |
|-------------|--|---------------------------------|
| 20-Jul-17 | Access Road, Left Side, km 9.75-10.25 | Toadflax, Sporadic |
| 20-Jul-17 | Access Road, Left Side, km 10.5-11.5 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 12.0 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 11.5-12.0 | Toadflax, Rare |
| 20-Jul-17 | Access Road, Left Side, km 12.25-12.75 | Common Tansy, Rare |
| 20-Jul-17 | Access Road, Left Side, km 13.0-14.75 | Toadflax, Rare |
| 20-Jul-17 | Access Road, Left Side, km 14.0 | Common Tansy, Rare |
| 20-Jul-17 | Access Road, Left Side, km 14.0-14.75 | Sweet Clover, Sporadic |
| 20-Jul-17 | Access Road, Left Side, km 15.5-16.75 | Sweet Clover, Continuous |
| 20-Jul-17 | Access Road, Left Side, km 16.25-16.75 | Hawksbeard, Sporadic |
| 20-Jul-17 | Access Road, Left Side, km 18.25 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 18.75-19.0 | Toadflax, Sporadic |
| 20-Jul-17 | Access Road, Left Side, km 19.0-19.5 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 19.25 | Common Tansy, Rare |
| 20-Jul-17 | Access Road, Left Side, km 20.0-20.5 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 20.0 | Toadflax, Rare |
| 20-Jul-17 | Access Road, Left Side, km 21.0 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 21.25 | Toadflax, Rare |
| 20-Jul-17 | Access Road, Left Side, km 21.75-22.0 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 21.75 | Toadflax, Rare |
| 20-Jul-17 | Access Road, Left Side, km 22.5-23.0 | Toadflax, Rare |
| 20-Jul-17 | Access Road, Left Side, km 23.0-23.25 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 23.5-24.0 | Toadflax, Rare |
| 20-Jul-17 | Access Road, Left Side, km 24.0 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 24.75 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 25.25-25.5 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 25.5-27.0 | Toadflax, Sporadic |
| 20-Jul-17 | Access Road, Left Side, km 25.5 | Common Tansy, Rare |
| 20-Jul-17 | Access Road, Left Side, km 25.5 | Sweet Clover, Rare |
| 20-Jul-17 | Access Road, Left Side, km 26.25 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 27.0 | Hawksbeard, Rare |
| 20-Jul-17 | Access Road, Left Side, km 27.0 | Sweet Clover, Sporadic |

14.4 Vegetation Metal Uptake Plan

The Vegetation Metal Uptake (VMU) program was not required in 2017. The next scheduled program is in 2019.

15 Site Characterization Report

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

16 Reclamation

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

- Mill Valley Fill Stage 2 (MVFES2);
- Dry Stack Tailings Storage Facility (DSTSF);
- Main Waste Dump Expansion (MWDE); and
- Southwest Waste Dump (SWD)

Reclamation research regarding the use of constructed wetland treatment systems as a closure water treatment option continued throughout the year. Details regarding the program for 2017 can be found in Section 16.2 or [Appendix Q](#).

16.1 Recontouring and Overburden Placement

Recontouring continued from 2016 with the primary efforts for recontouring spent on the MWDE and the SWD. SRK continued to work on refining the closure designs with Minto engineers to guide the construction of the final closure landform designs for facilities that are no longer required by the operation.

The MWDE recontouring started again in April after the waste rock thawed and could be pushed to final slope angle. The upper west slopes were the primary targeted and largely completed by the end of August. The recontouring at the SWD was primarily focused on the Ice Rich Overburden Dump and the overburden area, north of the medium grade waste pile. The Ice Rich Overburden Dump was recontoured and blended into west side of the SWD and is now full integrated with the SWD. The overburden area was backfilled and recontoured to allow for positive drainage in the area.

The stripping of the Area 2 Stage 3 released a total volume of 1.14M BCM (unreconciled) of overburden that met the soil cover specification. That material was directly hauled and placed on the four facilities throughout the entire year. Figure 16-1 to 16-6 show the extent of the overburden placement on the targeted facilities. The reclamation overburden was dispatched from the pit using the soil cover material criteria outlined in the Reclamation and Closure Plan (2016-01). The overburden was visually inspected by Minto environment and mine operations personnel, who were familiar with the cover material criteria. Overburden material that did not meet the soil cover criteria was hauled to the Area 118 backfill dump

while the material that met the reclamation cover specification was directly hauled to one of the four targeted facilities.

After spring thaw the majority of the soil cover material was spread out at a targeted thickness of 0.50cm. The spreading was focused on the flat sections of the facilities as well as the slopes of the DSTSF and the MVFE. Near the end of August, after all the overburden was placed it was determined that additional overburden would be required and so additional material was hauled to the targeted facilities in October through December. The additional material will have to be spread out in the spring/summer of 2018.



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



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



Figure 16-3: Minto Mine - MVFE and DSTSF progressive reclamation, overburden cover placement (2017 overburden placement highlighted in red).



Figure 16-4: Minto Mine – Southwest dump progressive reclamation, overburden placement and stockpiling (highlighted in red).



Figure 16-5: Minto Mine – MWDE and Low Grade Waste progressive reclamation, overburden cover placement (highlighted in red).



Figure 16-6: Minto Mine – Site overview, all facilities.

16.1 2017 Reclamation Research

Reclamation research in 2017 focused primarily on carryover research of passive treatment technologies which started in 2014 and carried through 2017.

16.1.1 Passive Water Treatment

The demonstration-scale constructed wetland treatment system (CWTS) was constructed at Minto in 2014 and commissioned from 2015 through mid-2017 during which time the system matured and operational adjustments were made. Commissioning successfully established plant and microbial populations and achieved conditions conducive for treatment of constituents of concern. The demonstration-scale CWTS operational period ran for 35 days from mid-August to mid-September 2017.

Various aspects of the system were measured in 2017 and have been detailed under a separate report including operating conditions, water treatment performance, fate and distribution of treated metals, evapotranspiration, detritus decomposition rates, microbial community characterization (catalyzing treatment reactions), and pest control. The key findings of each phase of this research project are presented in table 16-2 below. A full detailed report can be found in [Appendix Q](#).

Table 16-1: Demonstration Scale Constructed Wetland 2017 Work Summary

| Item | Date | Activities | Actual |
|------------------------------|------------------|---|--|
| Construction | June 1-14 2014 | Identify potential location for demonstration scale CWTS (Contango site visit – 1 scientist) | Completed |
| | June - July 2014 | Engineering and geotechnical (Minto) | Completed |
| | July 2014 | Construction (Minto) | Completed |
| | August 2014 | Planting and bringing system online (Contango site visit – 1 scientist, 1 technologist), coordinate for local students to assist | Completed (no students available, brought 2 technologists) |
| Commissioning A | 2014 | Acclimation and maturation at constant flow rate, ~20 hr HRT | Completed |
| | | September - Contango site visit/checkup (1 technologist, 1 scientist) | Did not occur because construction was last week of August |
| | 2015 | Continued commissioning. Operation at constant flow rate, ~20 hr HRT | Completed (at shorter HRT) |
| | | Spring – Contango site visit/checkup (1 technologist, 1 scientist), includes micro sampling | Completed |
| | | Summer - Increase depth from 10 cm to 20 cm (1 technologist), includes micro sampling | Completed (scientist) |
| | | Fall – Contango site visit/checkup (1 technologist), includes micro sampling | Completed (scientist) |
| | 2016 | Minto to add sandbags prior to first site visit and begin W15 creek monitoring | Completed May/June 2016 |
| | | Spring – Contango site visit (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 2 of report. HRT tracer study completed, outlined in section 7 of report. | Completed June 2016 |
| | | Summer - Contango site visit/checkup (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 2 of report. Evapotranspiration study completed as outlined in section 5.5 of report. Organics were added to the CWTS as outlined in section 5.2.3 of report. | Completed July 2016 |
| | | Fall - Contango site visit/checkup (1 technologist), includes microbial sampling and tasks outlined in Table 2 of report | Completed September 2016 |
| Commissioning B ¹ | 2017 | Spring – Minto established low flow steady state in May. Contango site visit (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 2 of report. Continued commissioning/testing of CWTS including evapotranspiration and salt tracer studies. | Completed June 2017 |
| | | Summer – Contango site visit (1 scientist), includes microbial sampling and tasks outlined in Table 2 of the report., detritus collections | Completed July 2017 |
| Operational | 2017 | Fall – Operational testing completed by Minto: Water sampling, microbial, soils, water, biomass, detritus. | Completed September 2017 |

Table 16-2: Passive Water Treatment Research Key Findings (2015-2017)

| Objective | Purpose | Key Findings or Changes for Full-scale |
|--|---|---|
| Monitor explanatory parameters and performance | Determine when commissioning is complete and the operational period has begun | <ul style="list-style-type: none"> - Dissolved oxygen (DO) decreased from an average of 8.4 mg/L during commissioning- B in 2016, to an average of 5.3 mg/L during operations in 2017. The DO in the water column is likely the result of photosynthesis of algae and mosses. - Despite this DO level in the water column being in oxidizing ranges, stable reducing conditions were achieved in the CWTS soils within the targeted soil redox range (-100 to -250 mV). |
| Assess removal of constituents from the water | Develop Removal Rate Coefficients for application to Reclamation Closure Plan and Full-Scale treatment system | <ul style="list-style-type: none"> - Copper treatment in the CWTS was masked by leaching from the soils used in construction of the CWTS into the water, but this has mostly been remedied now by the wetland treating this copper and turning it into more stable sulfide forms in the soil. - During the operational period the demonstration-scale CWTS successfully achieved an average decrease in concentrations of 0.0169 µg/L for cadmium (from 0.0261 µg/L to 0.0092 µg/L), 31.8 µg/L for copper (from 49.1 µg/L to 17.3 µg/L), 3.6 µg/L for molybdenum (from 6.3 µg/L to 2.7 µg/L), 3.5 µg/L for selenium (from 4.0 µg/L to 0.5 µg/L), and 47.3 µg/L for zinc (from 49.2 µg/L to 1.9 µg/L). - Molybdenum and selenium treatment in the operational period is notable as the removal rates were negligible within the margins of error of the testing method in the commissioning-A period. |
| Determine the hydraulic retention time (HRT) | Use tracer trial and associated correction factor to apply to the nominal (calculated) HRT | <ul style="list-style-type: none"> - The tracer study effectively demonstrated the HRT (2.25 days) and flow symmetry through the CWTS. - There was a single flow path in the CWTS (shown by a single peak in the tracer study) - Water is incorporating into the CWTS soils (shown by the long tail for depletion of the tracer). - The nominal HRT is calculated from the area of the CWTS and the depth at the in-situ measuring points. This nominal HRT does not account for depth variations, embankment slopes, vegetation (using space in the water), or substrate pore space involvement. It was found that once all of these factors are in play, the correction factor from nominal to actual is only 0.01 added to the depth of the CWTS, which is incorporated into the HRT calculation as expressed in Equation 3. |
| Evaluate CWTS performance | determine achievable concentrations of contaminants of concern (thermodynamic minimums) | <ul style="list-style-type: none"> - Constituents are being treated by mineralization and sequestered to the soils (minimal plant uptake). - The lowest concentrations consistently achievable for the treatment design (thermodynamic minimums) were reached by the end of the A cells for cadmium and copper. - RRCs for cadmium and zinc in the 2017 demonstration-scale CWTS were artificially low because low flow rates did not provide the resolution needed to determine a RRC. - Removal rate coefficients (RRCs, <i>k</i>) have been developed that can be used for fullscale sizing. - Copper leaching from soils has decreased but is still likely making the RRC artificially low in this CWTS; however, the RRC is expected to improve once copper leaching has subsided. |

| Objective | Purpose | Key Findings or Changes for Full-scale |
|--|---|--|
| Update site-specific removal rate coefficients (from commissioning period) with data from operational period | Apply information to Reclamation Closure Plan and Full-Scale treatment system | <ul style="list-style-type: none"> - In pilot-scale testing specific for the Minto CWTS, the RRC for selenium was a zero-order reaction kinetic, however, optimizations of the operation of the system through the demonstration-scale commissioning have enabled a first-order RRC to be maintained. Therefore, cadmium, copper, selenium, zinc, and nitrate are calculated as first-order kinetics, but molybdenum followed a zero-order kinetic. In other words, the reaction rate for molybdenum is a constant rate and does not depend on concentration, whereas the reaction rates for cadmium, copper, selenium, zinc, and nitrate are proportional to concentration (a half-life type of reaction). |
| Determine amount of water loss due to evapotranspiration and effect on outflow concentrations | Design considerations for Full-Scale system | <ul style="list-style-type: none"> - The evapotranspiration studies revealed a significant loss of water, which will impact calculations of loads to the receiving environment (making them lower than previously estimated). - In May and June, an average water loss of 5.3 L/day/m² was observed, which is equivalent to 18-20% of water (~700 L/day lost in the demonstration CWTS). - During the evapotranspiration trials, copper leached into the water as it was transformed from an oxide mineral to a sulfide mineral (because of the copper in the soils used for construction). This is not representative of what would occur during periods with no flow in a full-scale CWTS, where soils with minimal leachable copper are used and copper is deposited in sulfide form (fraction 4) by the biogeochemical activity of the CWTS (Section 5.6). |
| Assess stability of constituents of concern in soils | Affects overall theoretical treatment capabilities of Full-Scale system | <ul style="list-style-type: none"> - In 2017, leachable copper concentrations in soils decreased in the top 0-10cm while total copper concentrations increased. - Most constituents, including copper, have shifted primarily into stable reduced and residual minerals fractions in the soil. - Acid volatile sulfides (AVS) were non-detectable in the CWTS in 2016. In 2017 small amounts of AVS were detected in cells 1A and 2A which indicates that residual sulfides are starting to become available for metal treatment and that copper in the soils are becoming rendered inert through sulfide mineralization. |
| Determine the rate and extent of detritus decomposition (<i>C. aquatilis</i> leaves) in the CWTS over time | Design considerations for Full-Scale system | <ul style="list-style-type: none"> - The detritus study suggested that algae growth on the assay devices had reached a steady state (growth vs decomposition) by ~23 days of the study. - After 83 days submerged in the CWTS, <i>C. aquatilis</i> decomposed on average 64%. |
| Assess treatment mechanisms (including microbes) | Apply information to Reclamation Closure Plan and Full-Scale treatment system | <ul style="list-style-type: none"> - Establishment of sulfide-producing bacteria (SPB) increased throughout 2017 and was highest after commissioning was completed. - SPB were found in highest abundance in root and soil samples. - The average number of different types of sulfide-producing bacteria increased over time in all sample types tested (root, soil, detritus, and moss). - Selenium-reducing and nitrate-reducing bacteria increased over time with the highest abundances found in <i>C. aquatilis</i> roots. |

| Objective | Purpose | Key Findings or Changes for Full-scale |
|--|---|---|
| Determine an appropriate method for insect pest control (aphids) in the CWTS | Optimize Operational success of Demonstration-Scale CWTS. | <ul style="list-style-type: none"> - Aphids were again found in abundance on <i>C. aquatilis</i> in 2017. - Efforts to control the aphid population on-site were made but an ongoing spraying regiment was not maintained and, therefore, aphids remained. However, no short term detrimental effect on <i>C. aquatilis</i> viability was observed, despite the persistence of aphids. - Damage to the above water vegetation was observed however new shoots were emerging in the CWTS and treatment COCs was not impacted by damage to the above water vegetation. - Effects of aphids on <i>C. aquatilis</i> did not affect treatment. - These issues with aphids are likely owing to the isolated nature of the demonstration scale CWTS and not expected to affect the full-scale CWTS. |

16.2 Proposed Reclamation for 2018

Proposed reclamation for 2018 includes the following:

- Contouring work on soil cover on the Mill Valley Fill Stage 2 Extension;
- Contouring work on soil cover on the Dry Stack Tailings Storage Facility;
- Contouring work on soil cover on the Southwest Waste Rock Dump;
- Contouring work on soil cover on the Main Waste Dump Expansion;
- Completion of Main Waste Dump Wrap;
- Minor recontouring work as required;
- Phase 1 seeding of soil cover; and
- Continuation of the Passive Water Treatment Research.

17 Socio-Economic Monitoring Program

The Minto Mine Socio-Economic Monitoring Program defines a framework for monitoring direct and indirect socio-economic effects from the Minto Mine. In 2017, as per the framework, Minto tracked and collected administrative data and other information relating to the mine's direct employment, training and procurement; worker safety; and Minto contributions to cultural well-being and community wellness. The 2017 socio-economic data which Minto tracked is summarized in [Appendix R](#).

18 Closure

Minto trusts this document fulfills the 2017 annual reporting requirements of Minto Mine's WUL and QML.

19 References

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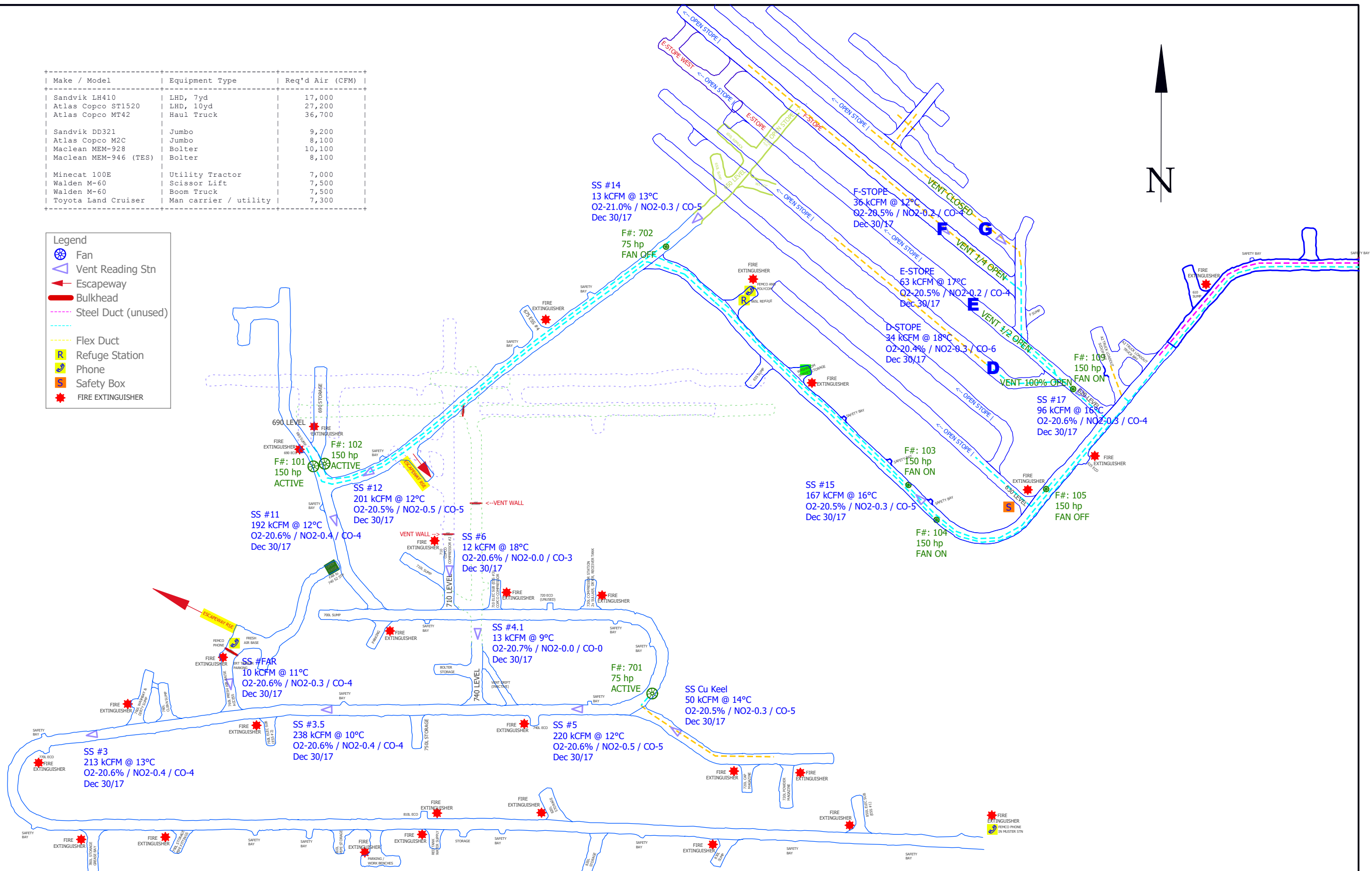
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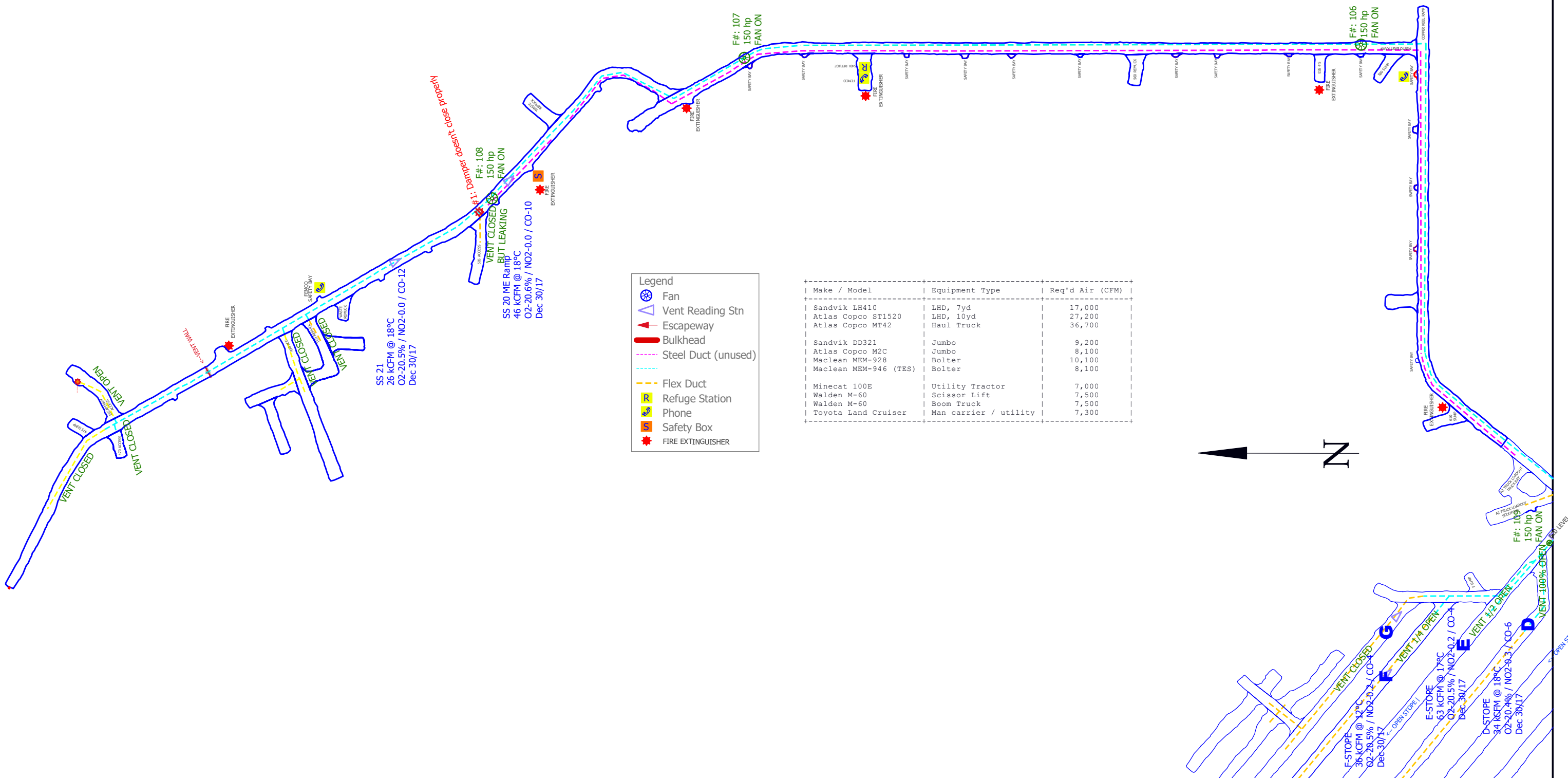
Appendix A – Minto Mine Underground Development Map

| Make / Model | Equipment Type | Req'd Air (CFM) |
|-----------------------|-----------------------|-----------------|
| Sandvik LH410 | LHD, 7yd | 17,000 |
| Atlas Copco ST1520 | LHD, 10yd | 27,200 |
| Atlas Copco MT42 | Haul Truck | 36,700 |
| Sandvik DD321 | Jumbo | 9,200 |
| Atlas Copco M2C | Jumbo | 8,100 |
| Maclean MEM-928 | Bolter | 10,100 |
| Maclean MEM-946 (TES) | Bolter | 8,100 |
| Minecat 100E | Utility Tractor | 7,000 |
| Walden M-60 | Scissor Lift | 7,500 |
| Walden M-60 | Boom Truck | 7,500 |
| Toyota Land Cruiser | Man carrier / utility | 7,300 |

| Legend | |
|--------|---------------------|
| | Fan |
| | Vent Reading Stn |
| | Escapeway |
| | Bulkhead |
| | Steel Duct (unused) |
| | Flex Duct |
| | Refuge Station |
| | Phone |
| | Safety Box |
| | FIRE EXTINGUISHER |



| | | | | |
|-----------------|------------------------------|----------------------|---|--|
| DRAWN BY: DP | SCALE: 1 : 2000 | VENT SURVEY - 171230 | Appendix A - 2017 Underground Development | |
| | DATE PLOTTED: 30-Dec-2017 | | | |



DRAWN BY:
DP

SCALE:
1 : 2000

DATE PLOTTED:
30-Dec-2017

VENT SURVEY - 171230



Appendix B – Minto Mine Spill Contingency Plan



Minto Mine
2018 Spill Contingency Plan

Prepared by:
Minto Explorations Ltd.
Minto Mine
January 2018

Summary of Revisions (2018)

| Section Revised | Description of Revision | Reason for Revision |
|-----------------|---|--|
| All | <ul style="list-style-type: none">Updated dates and references to previous years SCP. | <ul style="list-style-type: none">Annual review and update |
| 4.2 | <ul style="list-style-type: none">Updated internal and external contact information | <ul style="list-style-type: none">Contact info changes |
| 7.0 | <ul style="list-style-type: none">Changes to training (“Big 6” updated to “Big 7”) | <ul style="list-style-type: none">Annual Review and update |
| App. C | <ul style="list-style-type: none">Updated format – searchable. Included updated information | <ul style="list-style-type: none">Annual Review and update |

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Appendix A: Spill Report and Environmental Incident Report Forms

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1 Introduction

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

This Spill Contingency Plan (SCP) is an update to the previous SCP, drafted in February 2017. The content of this SCP is derived from the *Plan Requirement Guidance for Quartz Mining Projects* (Yukon Government, 2013). The SCP has been updated annually and submitted as part of Minto's Water Use Licence and Quartz Mining Licence annual reports.

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

1.1 Project Description

Minto Explorations Ltd. (Minto), a wholly owned subsidiary of Capstone Mining Corporation (Capstone), owns and operates the Minto Project located 240 km (150 miles) northwest of Whitehorse, Yukon. The Minto Mine is a high-grade copper and gold mine with ongoing operations since October 2007. The Project area encompasses the Minto Creek Valley which collects and drains in to the Yukon River (Figure 1-1). The Minto Mine is currently in Phase V/VI of surface operations. An overview of major infrastructure at the Minto Mine and the expansion of Phase V/VI is shown on Figure 1-2.

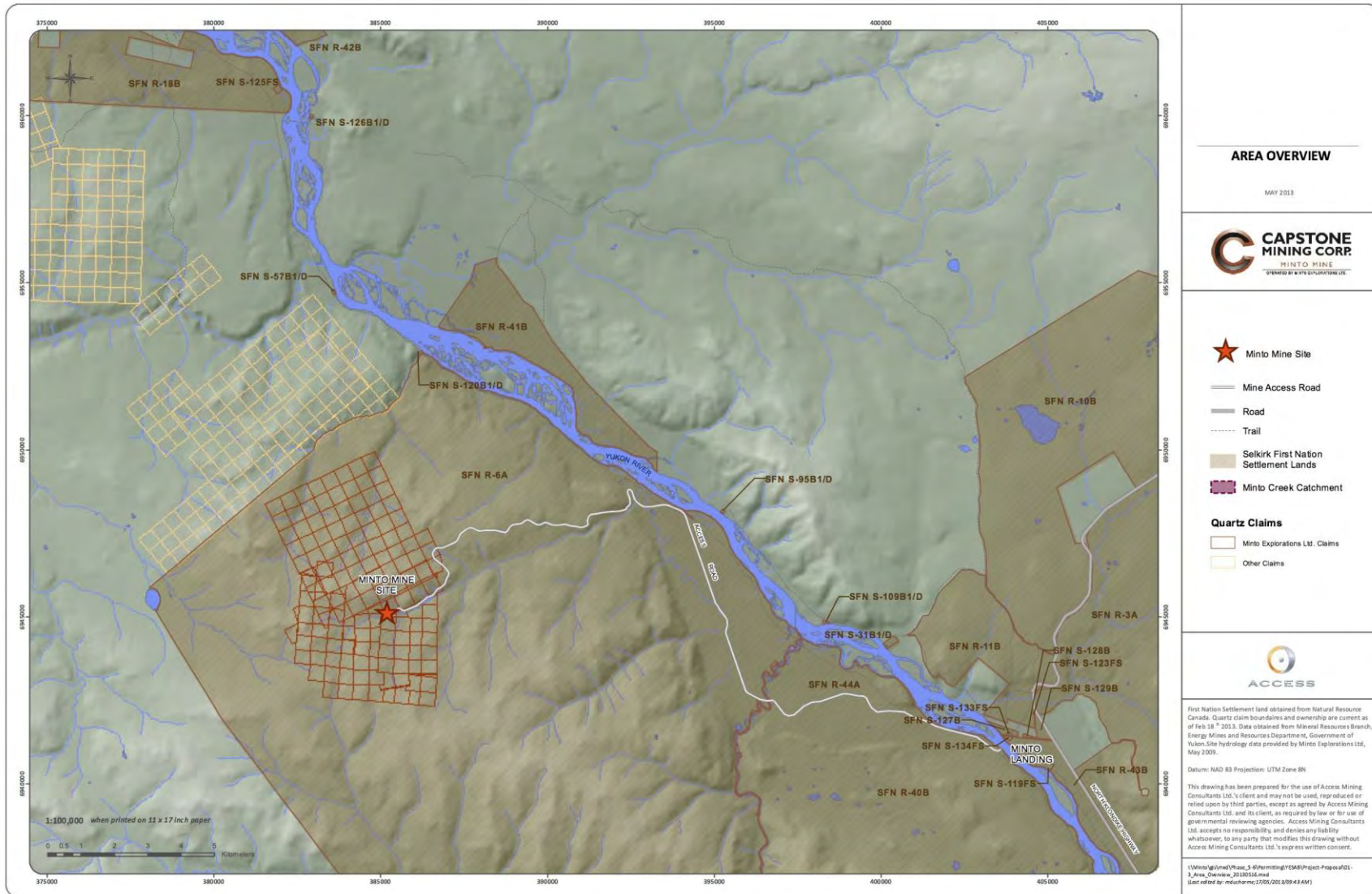


Figure 1-1: Minto Mine Area Overview

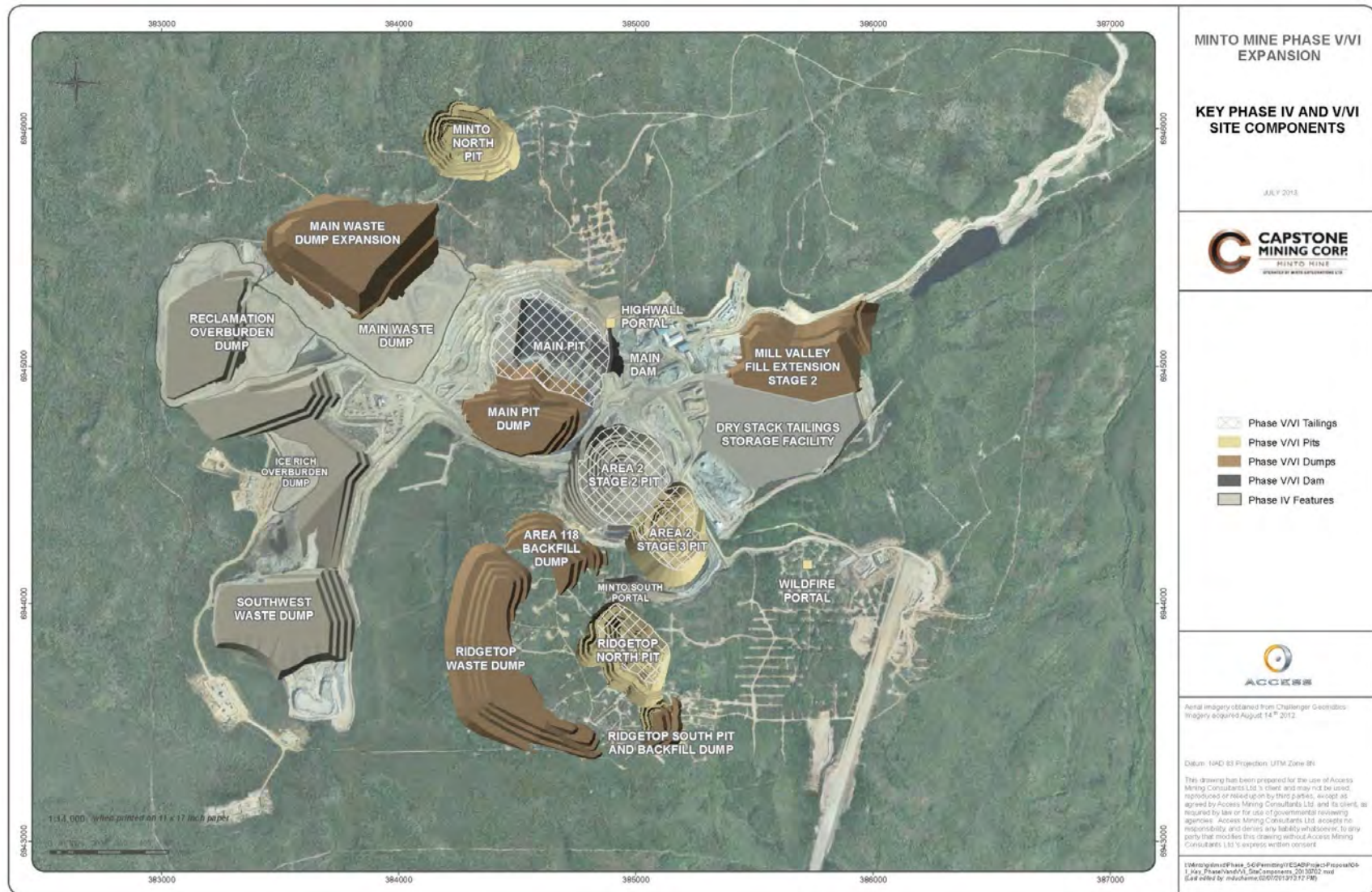


Figure 1-2: Minto Mine Area Overview – Existing and Phase V/VI Proposed Infrastructure

2 Definitions

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

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

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

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

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

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

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

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

3 Purpose and Scope

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

This SCP is prepared in support of:

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

“The Licensee shall apply the relevant procedures in the Spill Contingency Plan. The Licensee shall review the spill contingency plan annually and shall provide a summary of that review, including any revisions to the plan, as a component of the annual report.”

- *Part 3 – Deposits Out of the Normal Course of Events, Section 30 of the Metal Mining Effluent Regulations (MMER), which indicates that:*

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

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

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

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

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

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

3.1 Purpose

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

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

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

3.2 Scope

The objectives of the SCP are to:

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

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

The *Minto Mine Emergency Response Plan* (Minto, 2017) contains other information that relates to Emergency spill procedures. The Emergency Response Team (ERT) and members of the Environmental Department have been trained on responding to Hazmat Spills. It is beyond the scope of this document to define the specific Spill Response Procedures and decision loops involved in an ERT response. Any details pertaining to a response from ERT to assess, prevent, contain and clean-up a spill at a spill incident is the responsibility of the Site Safety Department. General procedures for spill response procedures to emergency spills will be detailed herein.

3.2.1 Hardcopy Locations

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

Table 4-2.

4 Communication and Spill Reporting

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

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

Table 4-1: Reportable Spill Thresholds

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

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

4.1 Internal Reporting (All Spills)

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

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

4.2 External Reporting (Reportable Spills Only)

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

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

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

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

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

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

Table 4-2.

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

| Resource | Email | Contact Number |
|---|---------------------------------|------------------------|
| Minto Internal Communications Contact Info | | |
| Health and Safety Department | safety@mintomine.com | 604 759-0860 ext. 4644 |
| Environmental Department | minto_environment@mintomine.com | 604 759-0860 ext. 4660 |
| Yves Brouillette, General Manager | yvesb@mintomine.com | 604 759-0860 ext. 4639 |
| Ryan Herbert, Environmental Manager | ryanh@mintomine.com | 604 759-0860 ext. 4634 |

| Resource | Email | Contact Number |
|--|-----------------------------|-------------------------------|
| Emergency Phone Contacts | | |
| Yukon 24- Hour Spill Line | | 867 667-7244 |
| CANUTEC-Dangerous Goods Help (Transport Canada) | | 1-888-CANUTEC or 613 996-6666 |
| Fire Department – Pelly Crossing (Emergency) | | 867 537-3000 |
| Police – Pelly Crossing | | 867 537-5555 |
| Health Centre - Carmacks | | 867 863-4444 |
| Hospital – Whitehorse | | 867 667-8700 |
| Fire Department – Whitehorse | | 867 668-8699 or 867 668-2462 |
| Police – Whitehorse | | 867 667-5555 |
| YG Department of Environment, Water Resources Branch | | 867 667-3227 |
| YG Environmental Protection Branch | | 867 667-3436 |
| Selkirk First Nation, Betty Baptiste, Lands Manager | | 867 537-3331 |
| YG EMR, Client Services and Inspections | | 867 667-3199 |
| External Reporting and Contacts for Submission of Spill Reports | | |
| YG EMR, Matthew Jenner, Natural Resources Officer - Mining | Matthew.Jenner@gov.yk.ca | 867 863-5271 |
| Selkirk First Nation, Betty Baptiste, SFN Lands Manager | landsmgr@selkirkfn.com | 867 537-3331 ext. 603 |
| YG Environmental Health Services, Craig Van Lankveld, Environmental Health Officer | craig.vanlankveld@gov.yk.ca | 867 667-8316 |
| Environment Canada, Travis Teel, Enforcement Officer | Travis.Teel@ec.gc.ca | 867-393-6705 |

5 Spill Action Plan

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

5.1 Spill Response Procedures: Non-Emergency

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

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

5.2 Spill Response Procedures: Emergency

An “emergency spill” is a release of a hazardous product where there is potential for that product to enter a waterway or cause significant danger to life, health or environment. When a spill is discovered, the first step is to assess the scene for safety and **if safe to do so** immediately control and contain the spill by any means necessary. If the discoverer or other personnel within close proximity of the incident do not have the required training, resources or equipment to deal with the incident then the individual must report a “Code 1” callout. This protocol will initiate response of the Safety Department, Environmental Lead and the Emergency Response Team. The Emergency Spill Response Command Structure and General Spill Procedure are detailed in Figure 5-1 and Figure 5-2, respectively. If the scene is safe and the discoverer and the immediate supervisor have the means necessary to control, contain and recover the spill then they should proceed as such.

Once called via a “Code 1” the Safety Coordinator/Medic will respond to the scene and conduct an initial assessment and assume command of the scene. If the Safety Coordinator/Medic is required to treat patients, command is transferred to the Health and Safety Superintendent/Officer or Emergency

Response Team Captain. Unified Command Structure will be initiated once the General Manager, Area Manager, or Environmental Lead is on scene. The Unified Command Structure is a cooperative effort command between the General Manager, Health and Safety Superintendent/Officer, Area Manager of involved Department and the Environmental Lead. Transfer of command includes a detailed verbal report of the incident and activities conducted and underway.

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

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

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

5.2.1 CANUTEC Transport Canada

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

5.2.2 Surrounding and Downstream Communities

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

5.2.3 Public Relations

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

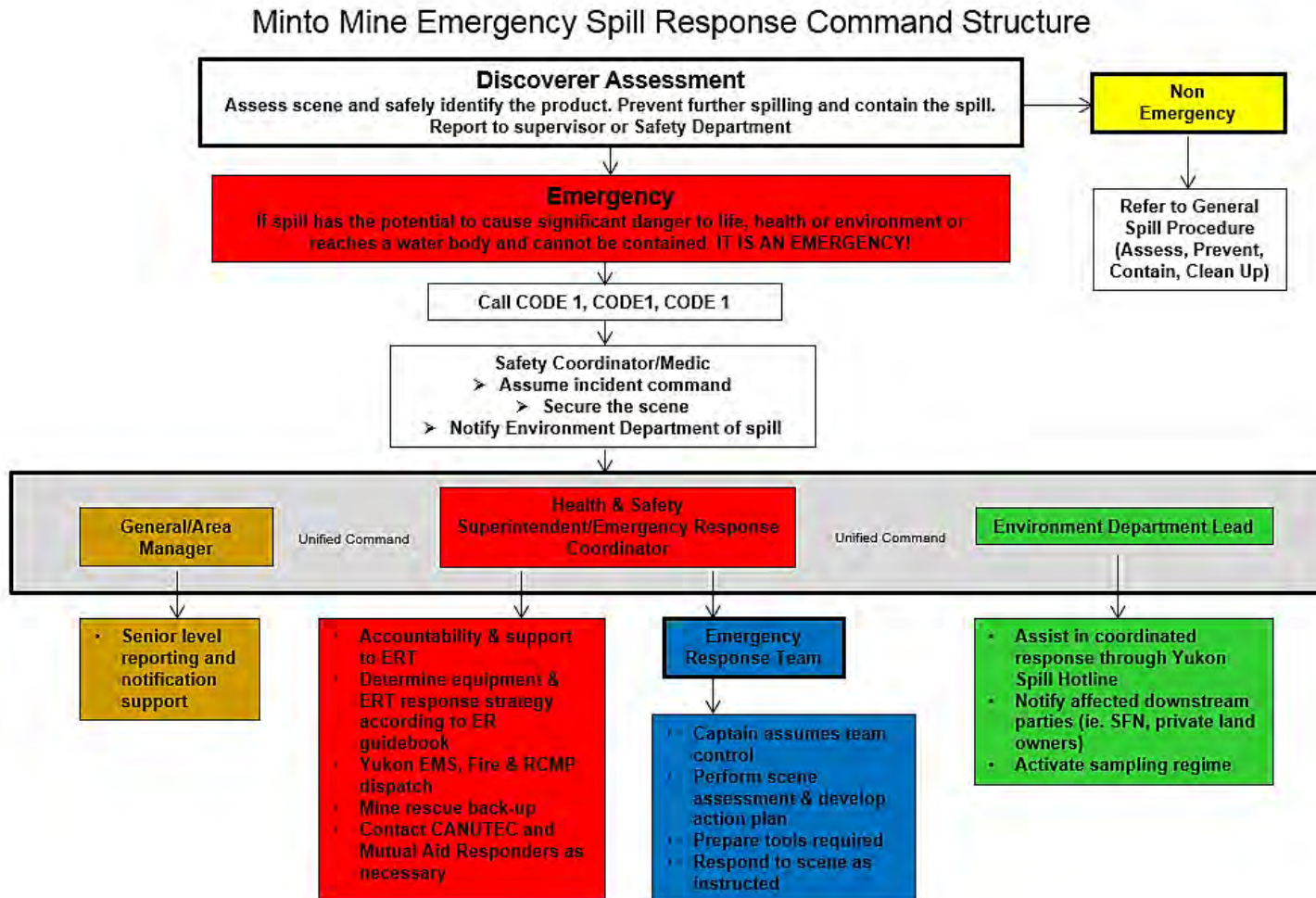


Figure 5-1: Minto Mine Emergency Spill Response Command Structure

Minto Mine General Spill Procedure (Assessment Prevention Containment Clean-up)

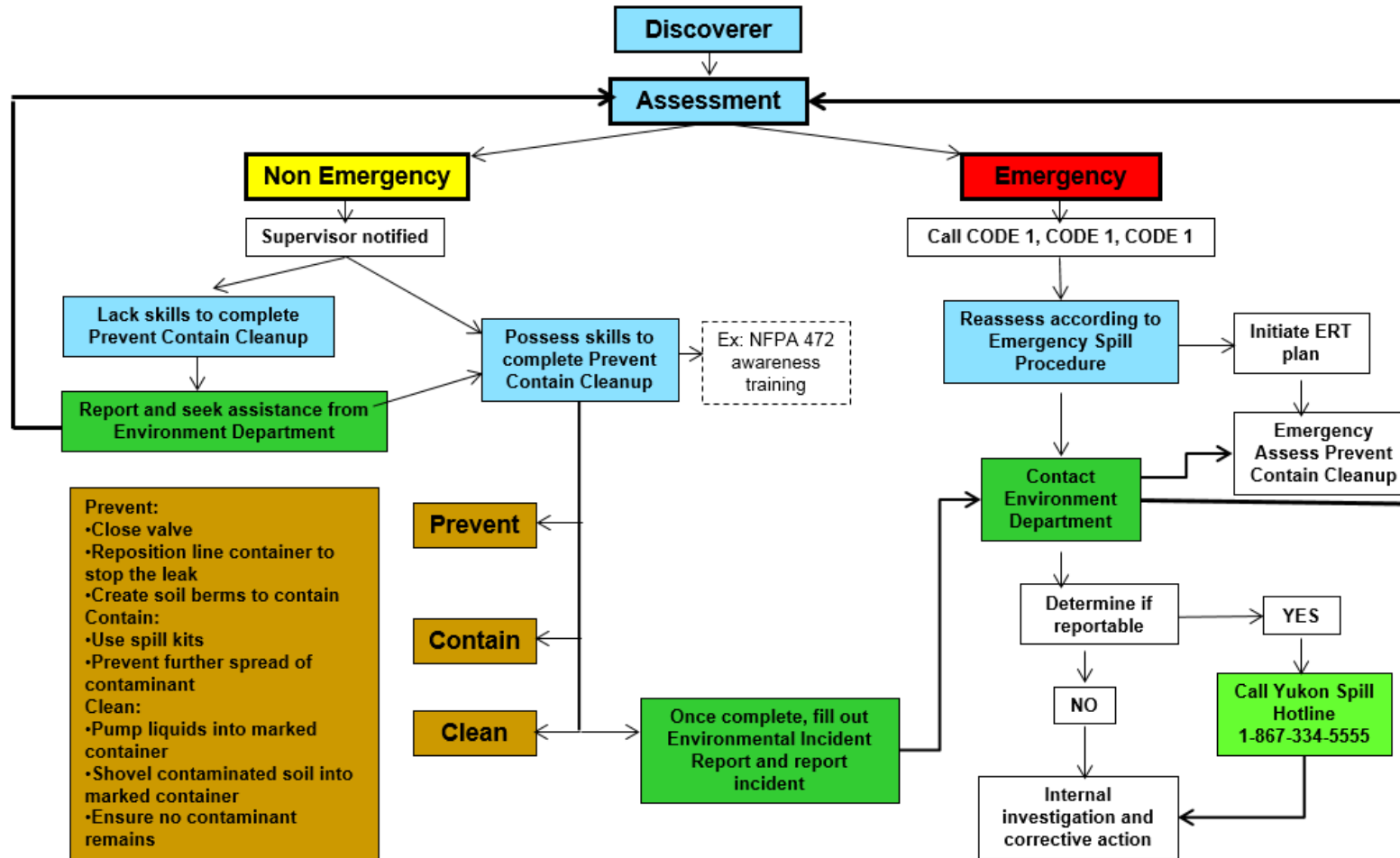


Figure 5-2: Minto Mine General Spill Procedure

5.3 Disposal and clean-up

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

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

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

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

6 Spill Response Supplies

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

Table 6-1: Spill Kit Contents

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

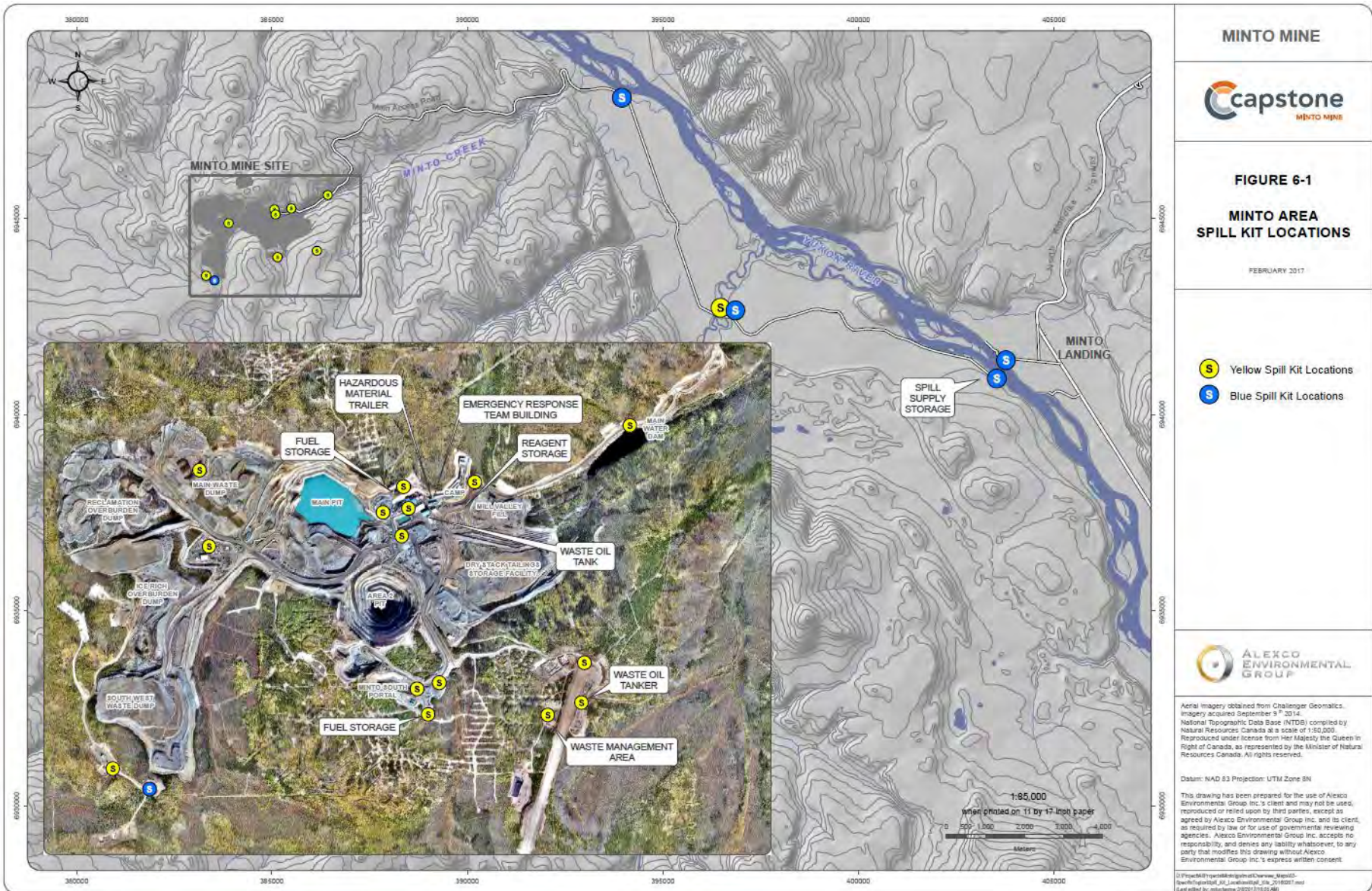


Figure 6-1: Minto Mine Area Overview – Hazmat Storage and Spill Supplies

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

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

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

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



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

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

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

| Quantity of Units | Equipment | Quantity of Units | Equipment |
|-------------------|-----------------------------------|-------------------|---|
| 1 | 416 Backhoe | 1 | Assorted Wooden Plugs |
| 1 | 3800 Litre Vacuum Truck | 4 | 773DTruck |
| Various | Dozers, Excavator, Loaders | 9 | 777 Truck |
| 1 | In-Viro Drum Portable Vacuum unit | 1 | Hazmat trailer 20' |
| 2 | 9500 Litre bladders | 1 | Top Kick fire truck |
| 1 | 24' Packman Response Vessel | 500' | Sorbent Boom (various sizes) |
| 2 | 10,000 Litre Fuel Trucks | 1 | Storage Sea Can at Landing |
| 1 | Roll Over Kit | 3 | Trash pumps |
| 1 | Pipe Plug kit | 1 | S.S. Alpha Adjustable Folding Weir Skimmer Pump |

7 Spill Prevention and Response Training

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

7.1 Existing Spill Prevention and Response Training

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

7.1.1 Orientation

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

7.1.2 “Big 7” Training

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

7.1.3 Targeted Practical Training

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

7.1.4 Training for Fuel Handling Employees

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

7.1.5 ERT Training

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

7.1.6 Emergency Spill Response Drills

Table top exercises and/or field drills will help to prepare the ERT and other mine staff to respond to a major spill safely by identifying any deficiencies in the equipment or processes in place. On October 26th, 2014, a combined field and table top exercise took place with the following objectives:

- Help individuals become more knowledgeable with the ERP and SCP;
- Identify gaps in the plan;
- Improve communication between stakeholders and departments; and
- Learn new ways and better ways to execute the plan.

The announced exercise was initiated to test part of the Emergency Response Plan as it applies to Spills and the SCP. It focused on the crisis, interaction and escalation of problems within:

- Administrative;
- Operational;
- Managerial; and
- Facilities.

The scenario was as follows:

- A tanker truck with pup and trailer of diesel overturns on Oct 26th on icy roads at 3:20pm at south end of Big Creek. It is still dark and it is a Sunday and roads are icy and snowing lightly.

The exercise lasted approximately 2 hours and involved management staff onsite and offsite, the ERT, major contractors, The Yukon Spill Hotline, CANUTEC, Transnorth Helicopters, WCB, Parkland Fuel, and

Quantum Murray. A post-incident debrief revealed both opportunities and successes at the field operations and management level.

7.1.7 Training KPI's

Individuals who receive training are tracked, and training numbers are used as a key performance indicator (KPI) with annual targets. In addition, tracking is used to ensure annual retraining is delivered and statistics measured against key performance indicators.

8 Routine Maintenance and Monitoring

The Fuel Farm is inspected twice monthly for any leakages and, through the Human Machine Interface (HMI) readout, regular inventory is tracked daily to identify any incidental losses. An overfill protection system is installed on the two main diesel tanks using a visual indicator and a relay to the control room that will alarm on the HMI to alert maintenance personnel. The area also receives inspections by a qualified engineer and recommendations are recorded and deficiencies corrected as per the *CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products* (Canadian Council of Ministers of the Environment, 2003).

The tug and barge receive frequent inventory inspections for spill equipment and have had major overhauls in the last few years to ensure that the operation is continually improving. Maintenance activities are also carried out regularly and systems are inspected as per Transport Canada Regulations. The daily start-up procedure includes checking for leaks and ensuring all systems are performing to specifications. Annual maintenance activities have included the following: propeller repairs, controls work, system checks and repairs. Substantive refits have included: cylinder heads, exhaust manifold seals, motor mounts, transmission mounts and replacement of water pumps. A new transmission, propulsion seals and propellers have been installed and aligned. Other improvements have included welding reinforcements on the bow of the barge for landings, electrical upgrades, and the installation of an anchor with hawser.

The open pit mining equipment is outfitted with Wiggins Fast Fuel Systems on newer contractor open pit equipment that is a fail-safe system for overflow protection. All fuel trucks receive a daily walk-around inspection to ensure emergency shutoffs and hatches and tank valves are operating properly and are free of leaks. These are recorded daily.

The Waste Management Area (WMA) is restricted to access between 10-3 pm every Sunday by an attendant familiar with the protocols for waste segregation, incineration, special waste handling and landfilling. The attendant will inspect all loads that come into the WMA to ensure that waste has been properly sorted before any material is off loaded. The Environmental Department is directly responsible for the administration, compliance and procedures associated with the management of waste. They are also responsible for providing support and manpower to prepare shipments for backhauling and to ensure the WMA is maintained in accordance with the Commercial Dump Permit (# 81-005). The Environmental Monitors are responsible for conducting weekly inspections to ensure that the WMA is in compliance.

9 References

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Appendix A: Spill Report and Environmental Incident Report Forms

Spill Report Form



| | |
|--------------------|--|
| Spill Name: | |
|--------------------|--|

General Report Information: (To be completed by the supervisor of responsible department or company)

| | | | |
|---|--|---------------------------------|--|
| EIR #: | | Location of Incident: | |
| Date of Incident: | | Time of Incident: | |
| Contaminant Type: | | Volume of Spill (L): | |
| Equipment (Type): | | Equipment (#): | |
| Company or Department: | | Supervisor | |
| Hours since last PM: | | Proximity to nearest waterbody: | |
| Previous indication of leak (i.e. Prior Drip) (Yes/No): | | Estimated cost of spill: | |

Failure of Mechanism: (Check one box below)

| | | | | | |
|------------|--|------------------------|--|-------------|--|
| Blown Hose | | Failed Hose Connection | | Human Error | |
| Unforseen | | Blown or Leaking Seal | | Unknown | |
| Other | | | | | |

Brief Description of Cause: (conditions at time of spill, what was happening at the time, specific direct cause of spill, etc.)

Clean Up Actions Undertaken:

Land Treatment Facility Information: (To be filled out by Environment Department)

| | | | | | |
|---------------------------------|--|----------------------------|--|-----------------------------|--|
| Material Moved to LTF (Yes/No): | | Material Sampled (Yes/No): | | Quantity (m ³): | |
|---------------------------------|--|----------------------------|--|-----------------------------|--|

| | |
|--------|--|
| Notes: | |
|--------|--|

Corrective Actions: (Must fill out for all reportable and preventable spills)

| Action Item # | Responsible Department | Corrective Action | Due Date |
|---------------|------------------------|-------------------|----------|
| | | | |
| | | | |
| | | | |
| | | | |

Reporting Sequence:

First Observer:

Name

Company

Date/Time

Reported To:

Name

Company

Date/Time

Reported To Environmental:

Name

Company

Date/Time

Reported To General Manager:

Name

Company

Date/Time

Regulatory Tracking: (To be completed by Environment Department)

24 Hour Spill Hotline (867) 667-7244:

Reported By:

Reported To:

Date/Time:

Selkirk First Nation Lands Director (867)-537-3331

Reported By:

Reported To:

Date/Time:

EMR - Client services and Inspections (867) 456-3882: (or site inspectors)

Reported By:

Reported To:

Date/Time:

Environment Canada in the event of a discharge to a waterway (867)-667-3400

Reported By:

Reported To:

Date/Time:

Detailed written report and MSDS to YWB, EMR, EC and SFN (Required within 10 days of spill):

Submitted By:

Date of Submission:

Photos:

| | |
|--|--|
| | |
| | |

Appendix B: Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

| Common Name (Synonyms) | Chemical Name | Manufacture / Supplier | Phase | TDG Class | WHMIS Class | NFPA Rating | Reporting Threshold | Use | Special Precautions | PPE Required | Special Cleanup and Disposal Info |
|-------------------------------|---|------------------------|---------------------------|---------------|------------------------------|-------------|------------------------------------|-------------------------|---|--|---|
| Acetone | 2-Propanone | Anachemia | Liquid | 3 | B-2, D-2B | 1, 3, 0 | 200 L | Solvent | Extremely Flammable | Goggles, gloves. SCBA if in confined space | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant foam. Do not allow into waterway or drains. Contain spread of spill and soak up with absorbent pads. Clear up using non-sparking tools. Place liquid and absorbents into tightly sealed container, label clearly and dispose of as hazardous waste offsite. |
| Acetylene | C ₂ H ₂ | AIRGAS INC | Pressurized gas dissolved | 2.1 | A, B-1, F | 1, 4, 3 | any if container larger than 100 L | Welding/cutting gas | Extremely flammable, pressurized gas dissolved in an extremely flammable liquid (Acetone) | Goggles, gloves. Respirator or SCBA if in confined space | Eliminate all sources of ignition, if possible without risk, shut off bottles. If bottle is ruptured after the gas has been expelled, the bottle will release the Acetone. At that point treat as an Acetone spill. |
| AERO 6493 Promoter | Alkyl hydroxamate | Cytec Canada | Liquid above 15C | 9 | | 2, 1, 2 | 5 L | Metal flotation in mill | | | Soak up with absorbent (do NOT use sawdust. Use PLASTIC tools). In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Place recovered spill liquid in labelled drums for disposal as Special waste. Incinerate used absorbent pads. |
| AERO MX-5149 | Modified Thionocarbamate 15-40% Xanthate ester 40-70% | Cytec Canada | Liquid | 3 | B3, D-1B, D-2B | 3,2,0 | 200 L | Metal flotation in mill | Flammable | Closed system, safety glasses, gloves | Remove sources of ignition. Cover spills with some inert absorbent material; sweep up and place in a waste disposal container. Flush spill area with water. |
| Aerodri 100 Dewatering Agent | | Cytec Canada | Liquid | 3 | B3, B-2, D-2A | 2, 3, 0 | 200 L | | Avoid contact with strong oxidizers or acids. | Safety Glasses, Gloves | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste. Soak up with absorbent materials and dispose of offsite in clearly labeled containers |
| Alconox | | Anachemia | solid | not regulated | D-2B | 1, 0, 0 | 50 kg | | | Safety Glasses, Gloves | Clean up uncontaminated material for reuse. Incinerate waste. |
| ALIQUAT 336 | Methytriocetyl-ammonium Chloride | Sigma-Aldrich Canada | Liquid | 6 | D-2B | 2, 1, 1 | 5 kg | | Toxic if swallowed. Very corrosive. Will burn skin and eyes. Avoid contact with strong oxidizers. Hygroscopic; avoid contact with moist air. | Safety Glasses, Gloves | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste. |
| AlphaSolve II | >50% Sodium Hydroxide <50% Silicate | Alpha Resources | Solid | | | | | | Avoid contact with strong oxidizers. | Safety Glasses, Impervious Gloves. | Highly caustic. Will produce heat and steam on contact with water. May boil and spatter. May generate hydrogen gas on contact with metals. Sweep or vacuum and, if not re-useable, send offsite as hazardous waste, in tightly closed, well labeled containers. |
| Aluminex 5 | Aluminum Chloride Hydroxide Sulphate 15% | NALCO | Liquid | 8 | E | | 5 L | Coagulant | | Safety Glasses, Gloves | Soak up with absorbent materials. These can be incinerated. Any remaining spill liquid should be stored in closed container, labelled and disposed of off-site as Special Waste. |
| Aluminum Standard - AA | | Anachemia | Liquid | 8 | E | 4, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| AM28 Flotation Reagent | Mixture of Potassium Hydroxide Alkyl hydroxamate | Axis House (Pty) Ltd. | Liquid | not regulated | D-2B | 2,1,0 | | Flotation Reagent | corrosive solid. | Safety Glasses, Gloves | Soak up with absorbent (do NOT use sawdust. Use PLASTIC tools). In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Place recovered spill liquid in labelled drums for disposal as Special waste. Incinerate used absorbent pads. |
| Amco Clear Turbidity Standard | | GFS Chemicals | Liquid | not regulated | not regulated | | | | | Safety Glasses, Gloves | Contain spill. Incinerate waste or place in landfill |
| Ammonia, Refrigerant | Ammonia, Anhydrous | GT&S, INC | Liquefied Gas | 2.3, 8 | does not appear classified?? | 3, 0, 0 | any amount | | Liquefied gas, will produce extreme cold when released. Death has occurred at 5000ppm exposure for 5 minutes. Evacuate release area upwind and avoid low areas. | Goggles, gloves. SCBA. | Toxic gas and will react with a large number of substances, many in a violent manner, Gas will dissipate quickly in air. Small spills can be dissolved in water at ratio of 1:10 Not very flammable. Do not attempt to neutralise. |

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

| Common Name (Synonyms) | Chemical Name | Manufacture / Supplier | Phase | TDG Class | WHMIS Class | NFPA Rating | Reporting Threshold | Use | Special Precautions | PPE Required | Special Cleanup and Disposal Info |
|--|--|------------------------------|-----------------|------------------|---------------------------------|-------------|------------------------------------|--------------------|---|--|--|
| Ammonium Nitrate prill | Ammonium Nitrate | Agrium | solid | 5.1 | C, D-2B | 1.0.3 | 50 kg | | Oxidizing material, does not burn but may contribute to combustion of materials that can burn | Safety Glasses, Gloves | In case of fire, cool containing vessels with water jet in order to prevent pressure build-up/explosion. Use flooding quantities of water. Evacuate surrounding area. If fumes or gases present, fire fighters should wear self-contained breathing apparatus. In event of spill, prevent from entering waterways. Will dissolve and disperse in water. |
| Ammonium Nitrate Emulsion | Ammonium Nitrate Emulsion | on-site | Liquid | 5.1 | | 2,0,3 | 50 kg | Explosive | Oxidizing material, does not burn but may contribute to combustion of materials that can burn | Safety Glasses, Gloves, chemical suits, SCBA may be required | In case of fire, cool containing vessels with water jet in order to prevent pressure build-up/explosion. Use flooding quantities of water. Evacuate surrounding area. If fumes or gases present, fire fighters should wear self-contained breathing apparatus. In event of spill, prevent from entering waterways. Use non-combustible material to soak up. |
| Arsenic Standard - AA | | Anachemia | Liquid | 8 | D-2A, E | 4, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Ascorbic Acid | L-Ascorbic Acid (Vitamin C) | Anachemia | solid | not regulated | not regulated | 1, 1, 1 | 5 kg | | also known as Vitamin C | Safety Glasses, Gloves | Contain spill. Incinerate waste or place in landfill |
| Brake & Electrical Parts Kleen | CO ₂ aerosol of Heptane and Isopropyl alcohol | Kleen-Flo Tumbler Industries | aerosol | Limited quantity | Consumer commodity; A, B5, D2-B | 1, 3, 0 | | | Highly flammable | Safety Glasses, Gloves | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Incinerate waste. |
| Buffer Solution pH 10 | | Anachemia | Liquid | not regulated | D-2A | 1, 0, 0 | | Analytical Lab use | Dilute Sodium Hydroxide | Safety Glasses, Gloves | Contain spill. Absorb with sand, vermiculite or sorbal. Incinerate waste. |
| Buffer Solution pH 4 | | Anachemia | Liquid | not regulated | not regulated | 1, 0, 0 | | Analytical Lab use | | Safety Glasses, Gloves | Contain spill. Absorb with sand, vermiculite or sorbal. Incinerate waste. |
| Buffer Solution pH 7 | | Anachemia | Liquid | not regulated | not regulated | 1, 0, 0 | | Analytical Lab use | | Safety Glasses, Gloves | Contain spill. Absorb with sand, vermiculite or sorbal. Incinerate waste. |
| Cadmium Standard - AA | | Anachemia | Liquid | 8 | D-2A, E | 4, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use flooding quantities of water. Contributes to combustion of other materials. Neutralize with soda ash or lime. Contain spill, keep from entering ground water. Neutralized spill can be pumped to the pit or tailings system. |
| Calcium Chloride | | J.T. Baker | solid | not regulated | D-2B | 1, 0, 2, 3 | any amount | | Road Salt, will corrode metals | Safety Glasses, Gloves | Sweep up spilled material and it may be deposited in dilute form to the pit or tailings system. In case of fire use appropriate measures for surrounding fire. |
| Carbon Dioxide in Argon | | Mittler Supply Inc. | Pressurized gas | 2.2 | A, D-2B | 1, 0, 0 | any if container larger than 100 L | | Non-Flammable but will replace the O ₂ in confined space | Goggles, gloves, SCBA if in confined space | close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers. |
| Caustic Soda (solid) | Sodium Hydroxide | Fisher Scientific | solid | 8 | E | 3, 0, 1 | 5 kg | | very corrosive solid | Safety Glasses, Gloves | Sweep up spilled material for reuse. In case of fire use appropriate measures for the surrounding fire. Minimise direct water spray on material. This material melts and 318°C and when molten reacts violently with water. Neutralize the residue with a dilute solution of acetic acid. Neutralized solution can be disposed of in the pit or tailings system. |
| Caustic Soda (solution) | | DOW | Liquid | 8 | E | 3, 0, 1 | 5 L | | very corrosive liquid | Safety Glasses, Gloves | Contain spill and pump to plastic barrel for re-use. In case of fire use appropriate measures for the surrounding fire. Neutralize the residue with a dilute solution of acetic acid. Neutralized solution can be disposed of in the pit or tailings system. |
| Caustic Potash | Potassium Hydroxide | Brenntag Canada | Solid | 8 | D-1B, E | 3,0,1 | 5 kg | | water reactive, contact with metals may evolve flammable hydrogen gas. | Safety Glasses, Gloves, fume hood | Sweep up or vacuum spillage, collect in suitable container for disposal. Avoid dust formation. |
| Chevron 2-Cycle Oil | | Chevron Lubricants Canada | Liquid | not regulated | B-3 | 1, 2, 0 | 100 L | | flammable oil for 2-stroke fuel | Safety Glasses, Gloves | contain spill and use absorbent and incinerate waste |
| Chevron ATF+3 Automatic Transmission Fluid | | Chevron Lubricants Canada | Liquid | not regulated | not regulated | 1, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| Chevron Automatic Transmission Fluid MD-3 | | Chevron Lubricants Canada | Liquid | not regulated | not regulated | 1, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| Chevron Clarity Synthetic Machine Oil | | Chevron Lubricants Canada | Liquid | not regulated | not regulated | 1, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

| Common Name (Synonyms) | Chemical Name | Manufacture / Supplier | Phase | TDG Class | WHMIS Class | NFPA Rating | Reporting Threshold | Use | Special Precautions | PPE Required | Special Cleanup and Disposal Info |
|--|------------------------------|---------------------------|------------|------------------------------|-----------------|-------------|---------------------|--------------|---|--|---|
| Chevron Compressor Oil 260 | | Chevron Lubricants Canada | Liquid | not regulated | not regulated | 1, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| Chevron Coupling Grease | Grease | Chevron Lubricants Canada | Semi-Solid | not regulated | not regulated | 1, 1, 0 | 100 L or 100 kg | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal. |
| Chevron Delo 300 Motor Oil | | Chevron Lubricants Canada | Liquid | not regulated | not regulated | 1, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| Chevron Delo Grease EP | Grease | Chevron Lubricants Canada | Semi-Solid | not regulated | not regulated | 1, 1, 0 | 100 L or 100 kg | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal. |
| Chevron Diesel Engine Oil Delo 6170 CFO | | Chevron Lubricants Canada | Liquid | not regulated | not regulated | 1, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| Chevron Drive Train Fluid HD | | Chevron Lubricants Canada | Liquid | not regulated | not regulated | 1, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| Chevron ECO Hydraulic Oil AW | | Chevron Lubricants Canada | Liquid | not regulated | not regulated | 0, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| Chevron Gas Engine Oil 930 and 940 | | Chevron Lubricants Canada | Liquid | not regulated | not regulated | 0, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| Chevron Mid-grade unleaded gasoline | | Chevron Products | Liquid | 3 | B-2, D-2A, D-2B | 2, 3, 0 | 200 L | | Extremely Flammable, Vapours are harmful and they may be explosive. Non-sparking tools required. Vapours will collect in low areas and travel along the ground to an ignition source. | Goggles, gloves. Respirator or SCBA if in confined space | Eliminate all sources of ignition. Ventilate area if required. Dike the spill and pump to containers for recycling. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Allow waste absorbent to evaporate and then incinerate waste. |
| Chevron NWS Manual Transmission Fluid 6044GR | | Chevron Lubricants Canada | Liquid | not regulated | not regulated | 1, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| Chevron RPM Universal Gear Lubricant | | Chevron Lubricants Canada | Liquid | not regulated | not regulated | 1, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| Chevron Supreme Antifreeze/Coolant | Ethylene Glycol | Chevron Lubricants Canada | Liquid | not regulated under 5000 lb. | D-2A | 1, 1, 0 | 25 L | | may be fatal by ingestion | Safety Glasses, Gloves | contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal. |
| Chevron Ulti-Plex® Grease EP | | Chevron Lubricants Canada | Semi-Solid | not regulated | not regulated | 1, 1, 0 | 100 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal. |
| Chloramine T | Chloramine-T trihydrate | Fisher | solid | 8 | D-2A, E | 3, 1, 1 | 5 kg | | Container may explode under fire conditions. Will release toxic fumes with fire or when mixed with strong oxidizers or acids | Goggles, gloves. SCBA if in confined space | Eliminate all sources of ignition. Ventilate area if required. In case of fire, Material by itself is non-flammable, may decompose violently >100°C, use dry chemical, CO2 foam or water spray. DISPOSAL mix with flammable solvent and incinerate. |
| Chromium Standard - AA | | Anachemia | Liquid | 8 | D-2A, E | 3, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Citric Acid | Citric Acid, Monohydrate | Anachemia | solid | not regulated | E | 2, 1, 0 | 5 L | | Will cause severe eye damage. Avoid oxidizers, acids, bases and bleach. | Safety Glasses, Gloves | Eliminate all sources of ignition. Ventilate area if required. In case of fire, use flooding quantities of water. Will decompose at high temperatures and emit acrid smoke and fumes. |
| Copper Standard - AA | | Anachemia | Liquid | 8 | E | 4, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Crystal 78 | Sodium Silicate | Quadra Chemicals | Liquid | not regulated | D-2B | | 25 L | | Caustic solution. Avoid mixing with strong acids. Contact with metals such as aluminum, tin, lead and zinc generates hydrogen gas. | Goggles, gloves. Respirator | solution can be pumped into plastic drum and possibly recycled in mill circuit, or shipped off site. In case of fire use appropriate measures for surrounding fire. |
| Cyquest DP-6 | Sodium polyacrylate in water | Cytec Canada | Liquid | not regulated | not regulated | 1,1,0 | | Mill reagent | Slippery | Goggles, Impervious gloves | Soak up with absorbent materials. These can be incinerated. Any remaining spill liquid should be stored in closed container, labelled and disposed of off-site as Special Waste. |

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

| Common Name (Synonyms) | Chemical Name | Manufacture / Supplier | Phase | TDG Class | WHMIS Class | NFPA Rating | Reporting Threshold | Use | Special Precautions | PPE Required | Special Cleanup and Disposal Info |
|---|---|---------------------------|--------|---------------|-----------------------|-------------|---------------------|------------------|---|--|---|
| Delo Diesel Fuel System Cleaner | | Chevron Lubricants Canada | Liquid | 3 | B-3, D-2A, D-2B | | 200 L | | | Safety Glasses, Gloves | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste. |
| Diesel Fuel No. 2 | | Chevron Products Company | Liquid | 3 | B-3, D-2A, D-2B | 0, 2, 0 | 200 L | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| DIISOBUTYL KETONE | 2,6-Dimethyl-4-heptanone | J.T. Baker | Liquid | 3 | B-2, D-2A | 2, 2, 0 | 200 L | | Avoid contact with strong oxidizers or acids. | Safety Glasses, Gloves | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste. |
| Drierite, indicating | | Anachemia | solid | not regulated | D-2A | 1, 0, 1 | | | | Safety Glasses, Gloves | Eliminate all sources of ignition. In case of fire use measures dictated by surrounding fire. Will decompose at 1450°C liberating Cl ₂ and SO ₂ . This product can be dried and reused, recycled. |
| Envirobind KFZ | | Power Chemicals Ltd. | Liquid | not regulated | not regulated | 1, 0, 0 | | Dust Suppression | Avoid contact with oxidizing agents or strong acids. | Goggles, Gloves | Do not use absorbents. Contain spill using noncombustible materials such as vermiculite, earth or sand. |
| Envirobind KTF | | Power Chemicals Ltd. | Liquid | not regulated | not regulated | 1, 0, 0 | | Dust Suppression | Avoid contact with oxidizing agents or strong acids. | Goggles/Glasses, Gloves | Do not use absorbents. Contain spill using noncombustible materials such as vermiculite, earth or sand. |
| Envirobind PCW | | Power Chemicals Ltd. | Liquid | not regulated | not regulated | 1, 0, 0 | | Dust Suppression | Avoid contact with strong oxidizing materials. | Goggles/Glasses, Gloves | Dike or contain. Absorb irrecoverable material onto inert oil absorbent medium, package, and label for legal disposal. Wash hard surfaces with water. Contaminated absorbent material may be disposed of in an approved landfill |
| FLEET CHARGE 50/50 Antifreeze | Ethylene Glycol | OLD WORLD INDUSTRIES | Liquid | 9 | D-2A | 1, 1, 0 | 25 L | | may be fatal by ingestion | Safety Glasses, Gloves | contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal. |
| Fleet Charge PG Antifreeze/Coolant | Propylene Glycol | OLD WORLD INDUSTRIES | Liquid | not regulated | not regulated | 0, 1, 0 | 25 L | | | Safety Glasses, Gloves | contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal. |
| Flomin C 3505 Collector | Potassium amyl xanthate (PAX) | Flomin Inc. | solid | 4 | not regulated | 2, 2, 1 | 25 kg | | Product is spontaneously combustible. Avoid contact with heat, moist air, and water. | Safety Glasses, Gloves | Sweep up spilled material and place in closed container for reuse. Solutions of product may be disposed of on the pit or tailings system. In case of fire use appropriate measures for surrounding fire. |
| Flomin F 500 Frother | 4-METHYL-2-PENTANOL (Methyl isobutyl carbinol - MIBC) | Flomin Inc. | Liquid | 3 | B-2, D-2B | 2, 2, 0 | 200 L | | Acids, acid chlorides, alkalis, oxidizing agents. Will attack some forms of plastics, rubber and coatings | Goggles, gloves. Respirator or SCBA if in confined space | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste. |
| Floran Catalyst | Proprietary Inorganic Peroxide Blend | Floran Technologies | Liquid | 5 | C, D-2B | 2, 0, 1, OX | 50 L | | Non-Flammable but will aid combustion of other materials | Safety Glasses, Gloves | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use flooding quantities of water. Contributes to combustion of other materials. Contain spill, keep from entering ground water. Absorbed pill can be disposed in the pit or tailings system. |
| Frost Killer (Tannergas) | Methyl alcohol | TANNER SYSTEMS, INC. | Liquid | 3, 6.1 | B-2, D-1B, D-2A, D-2B | 1, 3, 0 | 200 L | | Extremely Flammable, Vapours are harmful and solution is poisonous | Goggles, gloves. Respirator or SCBA if in confined space | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste. |
| FUEL INJECTOR CLEANER | | Radiator Specialty Co | Liquid | 3 | B-3, D-2A, D-2B | | 200 L | | | Safety Glasses, Gloves | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste. |
| Gasoline, Unleaded | | Petro-Canada | Liquid | 3 | B-2, D-2A, D-2B | 2, 3, 0 | 200 L | | Extremely Flammable, Vapours are harmful and they may be explosive. Non-sparking tools required. Vapours will collect in low areas and travel along the ground to an ignition source. | Goggles, gloves. Respirator or SCBA if in confined space | Eliminate all sources of ignition. Ventilate area if required. Dike the spill and pump to containers for recycling. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Allow waste absorbent to evaporate and then incinerate waste. |
| Glycerin | IPAC | Power Chemicals Ltd. | Liquid | Not regulated | Not regulated | | | | Avoid contact with reducing agents and oxidizing agents. | Goggles, gloves. | Dike spilled product to prevent runoff |
| Havoline DEX-COOL Extended Life 50/50 Anti-Freeze/Coolant | Ethylene Glycol | Chevron Lubricants Canada | Liquid | not regulated | D-1b, D-2A | 2, 0, 0 | 25 L | | may be fatal by ingestion | Safety Glasses, Gloves | contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal. |

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

| Common Name (Synonyms) | Chemical Name | Manufacture / Supplier | Phase | TDG Class | WHMIS Class | NFPA Rating | Reporting Threshold | Use | Special Precautions | PPE Required | Special Cleanup and Disposal Info |
|---|--|--------------------------------------|--------|---------------|-----------------------|-------------|---------------------|-----------------------|--|---|---|
| HAVOLINE DEX-COOL extended life anti-freeze/coolant-B | Ethylene Glycol | Chevron Lubricants Canada | Liquid | not regulated | D-1b, D-2A | 2, 1, 0 | 25 L | | may be fatal by ingestion | Safety Glasses, Gloves | contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal. |
| Havoline Power Steering Fluid | | Chevron Products | Liquid | not regulated | not regulated | 0, 1, 0 | | | | Safety Glasses, Gloves | contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system. |
| Hot 4-in-1 Heating Oil Treatment | Proprietary Blend | FPPF Chemical Company, Inc. | Liquid | 3 | B-3, D-1A, D-2A, D-2B | 3, 2, 0 | 200 L | | Fuel Additive, fumes will collect in low area's. | Safety Glasses, Gloves | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste. |
| Hydrated Lime | Ca(OH) ₂ | Chemical Lime Company of Canada Inc. | Solid | not regulated | D-2A, E | | | | Will cause severe caustic burns. Avoid strong acids, and aluminum | Safety Glasses, Gloves | sweep up uncontaminated material for reuse. Neutralize with dilute acid and may be disposed of in pit or tailings system. |
| Hydraulic Oil SAE 10W | | EXXON MOBIL | Liquid | not regulated | not regulated | 0, 1, 0 | 200 L | | | Safety Glasses, Gloves | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste. |
| Hydrex 3223 | | Veolia | Liquid | 8 | E | 1, 0, 0 | 5kg or 5L | Coagulant in the WTP | | Safety glasses with side shields or goggles, face shield, chemical resistant gloves. Suitable respiratory equipment in poorly ventilated areas. | Contain spill. Ventilate area if required. Use absorbent. Place contaminated materials in sealed container for disposal and dispose of via a licensed waste disposal contractor. |
| Hydrex 6186 | | Veolia | Solid | not regulated | not regulated | 0, 1, 0 | | Flocculant in the WTP | | Safety glasses with side shields or goggles. | Sweep or vacuum spilled material. Do not get water on spilled material. Flush area with water after product recovery. Place recovered material in sealed container and dispose of via a licensed waste disposal contractor. |
| Hydrochloric Acid | | Anachemia | Liquid | 8 | D-1A, E | 3, 0, 1 | 5 L | | Concentrated acid, Extremely corrosive. Ventilate or stay upwind | Goggles, gloves. Respirator or SCBA if in confined space | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Hydrofluoric acid, 47 - 51% | | Fisher | Liquid | 8, 6.1 | D-1A, D-2A, E | 4, 0, 1 | 5 L | | Extremely corrosive and Toxic acid. Causes very severe acid burns with symptoms being delayed. Skin contact of <10% can be fatal from cardiopulmonary problems. IMMEDIATE medical attention is required for all exposures. | Goggles, gloves. Respirator or SCBA if in confined space (Actually SCBA should be used anywhere unless spill is in a fumehood) | Neutralize with soda ash. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to a plastic barrel and then disposed of in the pit or tailings system. |
| IPAC 6832 | | Quadra Chemicals | Liquid | not regulated | not regulated | | | | water soluble | Safety Glasses, Gloves | No special clean up procedures, |
| Iron Standard - AA | | Anachemia | Liquid | 8 | E | 1, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Isopropylxanthic acid sodium salt (SIPX) | | Quadra Chemicals Ltd. | Solid | 4.2 | B-6, D-1B, D-2B | | 25 kg | Collector in Mill | Keep away from water - contact with water liberates extremely flammable gases. Keep away from heat, sparks and flame - fine dust clouds may form explosive mixtures with air. Use only with adequate ventilation. | Goggles, Gloves, Respirator (air-purifying or air-fed) | Move containers from spill area. Avoid allowing the spilled material to get wet or using water to clean up spillages or residues, unless the quantity remaining is very small. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. |
| Javex Liquid Bleach | NaOCl | Colgate Palmolive | Liquid | not regulated | E, D-2B, C | | | | Self heating and may catch fire. | Safety Glasses, Gloves, SCBA | Ventilate area and allow qualified personnel to stop/control spill. Small spills: flush area with plenty of water and mop up. Large spills: dike the ingredient and transfer to appropriate containers. Consult Federal, Provincial and Municipal regulations for disposal. May be neutralized with sodium bisulphite or dilute hydrogen peroxide. |
| KAX 51 | Proprietary Blend (mix of isoamyl alcohol, potassium amyl xanthate, and potassium hydroxide) | Prospec Chemicals | Solid | 4.2 | B-6, D-1B, E | | 25 kg | Collector in Mill | | Safety Glasses, Face Shield, Gloves, SCBA | If in the liquid state: Stop spill at source. Contain any spilled material to prevent discharge into the environment. Eliminate all sources of ignition. Persons not wearing protective equipment should be excluded from the area. Absorb with inert dry material. Put into an approved metal salvage drum for disposal. If in the solid state: Eliminate all sources of ignition. Restrict access to area until completion of clean-up. Ensure clean-up is conducted by trained personnel only. Do not touch spilled material. Do not use water on spilled material as heat will be generated. Put spilled material into approved salvage drums for disposal. Flush cleaned area with water, making sure no water enters xanthate containers. |

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

| Common Name (Synonyms) | Chemical Name | Manufacture / Supplier | Phase | TDG Class | WHMIS Class | NFPA Rating | Reporting Threshold | Use | Special Precautions | PPE Required | Special Cleanup and Disposal Info |
|---|---|--------------------------------------|---------------|-----------------------|-----------------------|-------------|------------------------------------|-----------------|--|---|--|
| KOPR-KOTE | Graphite, Cu & MoS ₂ mixture | Jet-Lube of Canada | paste | not regulated | not regulated | 1,1,1 | | | | Safety Glasses, Gloves | Wipe up spill with rags and incinerate waste. |
| Lead Standard - AA | | Anachemia | Liquid | 8 | D-2A, E | 4, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Lime | | Chemical Lime Company of Canada Inc. | powder | not regulated | E | 3, 0, 1 | | | Will cause severe caustic burns. Avoid strong acids, and aluminum | Safety Glasses, Gloves | sweep up uncontaminated material for reuse. Neutralize with dilute acid and may be disposed of in pit or tailings system. |
| Liquid Nitrogen | Nitrogen | Praxair Canada Inc. | Liquefied Gas | 2.2 Non-flammable gas | A | 3, 0, 2 | any if container larger then 100 L | | Use air supplied respirator when working in confined space, Loose-fitting cryogenic gloves, Metatarsal shoes for cylinder handling. Protective clothing where needed. Cuff less trousers should be worn outside of shoes | Extremely cold liquefied gas, Will cause severe frost bite Use SCBA when working in confined space, | Evacuate all personnel from danger area. Allow spilled liquid to evaporate. Use self contained breathing apparatus where needed. Shut off flow if you can do so without risk. Ventilate area or move cylinder to a well-ventilated area. Test for sufficient oxygen, especially in confined spaces, before allowing re-entry |
| LIQUID WRENCH SUPER LUBRICANT (AEROSOL) | Proprietary Blend | Radiator Specialty Co | aerosol | 2.1 | A, B5, D-1A, D2-B | | any if container larger then 100 L | | containers may rupture if exposed to high temperatures. | Safety Glasses, Gloves | Allow container to completely discharge while eliminating ignitions sources. Wipe up spill with rags and incinerate waste. |
| Loctite Belt Dressing | Proprietary Blend | Henkel Canada, Inc. | aerosol | 2.2 | A, D-2A, D-2B | | any if container larger then 100 L | | containers may rupture if exposed to high temperatures. | Safety Glasses, Gloves | Allow container to completely discharge Wipe up spill with rags and incinerate waste. |
| LPS 2 Spray Lubricant | Proprietary Blend | LPS Laboratories | aerosol | 2.2 | A, D-2A, D-2B | | any if container larger then 100 L | | containers may rupture if exposed to high temperatures. | Safety Glasses, Gloves | Allow container to completely discharge Wipe up spill with rags and incinerate waste. |
| Magnesium Nitrate Matrix Modifier | | Spex CertiPrep | Liquid | 8 | D-2A, E | 3, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| MAXGOLD™ 900 Promoter | Proprietary Blend | Cytec Canada | Liquid | 3 | B-3, D-2A | 3, 2, 0 | 200 L | | slightly yellow liquid that has a slight sulphur smell. In confined space use respirator with organic vapour cartridges | Goggles, gloves. Respirator or SCBA if in confined space | eliminate ignition sources, use absorbent on small spills, for large spill pump to plastic drum for shipment off site. In case of fire use dry chemical extinguisher, CO ₂ or foam. Water likely not effective. |
| MERCSORB Mercury Amalgamation Powder | | NPS Corporation | solid | 4 | | 0, 1, 1 | 25 kg | | Dry zinc dust will not ignite spontaneously, but once ignited, it may burn readily in air | Safety Glasses, Gloves | Sweep up spilled material and place in closed container for reuse. In case of fire use appropriate measures for surrounding fire. |
| Mercury Indicator Powder | Proprietary Blend | NPS Corporation | solid | not regulated | | 2, 1, 0 | | | Odorless, yellowish-tan to gray powder. Dust may form a flammable or explosive mixture in air. When heated to decomposition, toxic fumes of sulfur oxides are produced | Safety Glasses, Gloves | Sweep up spilled material and place in closed container for reuse. In case of fire use appropriate measures for surrounding fire. This product in itself is considered to be non-hazardous. |
| Mercury Standard - AA | | Anachemia | Liquid | 8 | D-2A, E | 3, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Mercury Vapor Suppressor | Proprietary Blend | NPS Corporation | solid | not regulated | | 2, 1, 0 | | | Odorless, black, irregular, dry granular solid. Wet activated carbon removes oxygen from the air causing a severe hazard to workers in confined space. | Safety Glasses, Gloves | Sweep up spilled material and place in closed container for reuse. Contaminated waste can be incinerated. In case of fire use appropriate measures for surrounding fire. This product in itself is considered to be non-hazardous. |
| Methanol | | Anachemia | Liquid | 3, 6.1 | B-2, D-1B, D-2A, D-2B | 1, 3, 0 | 200 L | | Extremely Flammable, Vapours are harmful and solution is poisonous | Goggles, gloves. Respirator or SCBA if in confined space | Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO ₂ , Alcohol-resistant Foam or water spray. Incinerate waste. |
| MIBC | Methyl Isobutyl Carbinol | Flomin Inc. | Liquid | 3 | | 2, 2, 0 | 200 L | Frother in Mill | Product liquid and vapor are flammable. Keep away from heat and sources of ignition. Product vapors or mist may be irritating to eyes and respiratory system. Product liquid may cause eye and skin burns. Harmful if swallowed. | Goggles or Face Shield, Gloves, Respirator (NIOSH/MSA) | Dike spill and collect for disposal or reuse. Use adsorbents on residual material. Flush spill area with water. Keep flush material out of waterways. Dispose of cleanup material in an approved manner. |
| MIBK | 4-Methyl-2-pentanone | Fisher Scientific | Liquid | 3 | B-2 | 2, 3, 0 | 200 L | | clear liquid that has a slightly sweet smell. In confined space use respirator with organic vapour cartridges | Safety Glasses, Gloves | Clear liquid that is immiscible with water. Use absorbent for small spills and incinerate waste. Large spills, eliminate ignitions sources and pump to plastic drum for shipment off site. |
| Molybdenum Standard - AA | | Anachemia | Liquid | not regulated | not regulated | 0, 0, 0 | | | | Safety Glasses, Gloves | Contain spill. Incinerate waste or place in landfill |
| Mucosal universal detergent | | Sigma-Aldrich Canada | Liquid | not regulated | D-2B | 2, 0, 0 | | | | Safety Glasses, Gloves | |

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

| Common Name (Synonyms) | Chemical Name | Manufacture / Supplier | Phase | TDG Class | WHMIS Class | NFPA Rating | Reporting Threshold | Use | Special Precautions | PPE Required | Special Cleanup and Disposal Info |
|-----------------------------------|-------------------------|----------------------------|-----------------|---------------|---------------|-------------|------------------------------------|-------------------------------|---|---|--|
| Nickel Standard - AA | | Anachemia | Liquid | 8 | D-2A, E | 1, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Nitric Acid | | Anachemia | Liquid | 8 | C, D-1A, E | 4, 0, 0, OX | 5 L | | Concentrated acid, Extremely corrosive. Ventilate or stay upwind. Strong Oxidizer | Goggles, gloves. Respirator or SCBA if in confined space | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Nitric Acid 40% | | Quadra Chemicals | Liquid | 8 | C, D-1A, E | 4, 0, 0, OX | 5 L | | Concentrated acid, Extremely corrosive. Ventilate or stay upwind. Strong Oxidizer | Goggles, gloves. Respirator or SCBA if in confined space | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Oxygen | | BOC Canada Limited (Linde) | Pressurized gas | 2.2 | A, C | 0, 3, 0, OX | any if container larger than 100 L | | Strong Oxidizer will Contribute to combustion of other materials. | Safety Glasses, Gloves | close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers. |
| Oxygen Refrigerant | | Air Liquide Canada | Liquefied Gas | 2.2 | A, C | 0, 3, 0, OX | any if container larger than 100 L | | Strong Oxidizer will Contribute to combustion of other materials. Liquefied gas, will produce extreme cold when released. | Safety Glasses, Gloves | close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers. |
| Palladium Nitrate Matrix Modifier | | Spex CertiPrep | Liquid | 8 | D-2A, E | 3, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Phosphoric acid | | Sigma-Aldrich Canada | Liquid | 8 | D-1A, D-2B, E | | 5 L | | Concentrated acid, Extremely corrosive. Ventilate or stay upwind. | Goggles, gloves. Respirator | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |
| Pine Oil (Terpene SW Blend) | | Quadra Chemicals Ltd. | Liquid | not regulated | B-3, D-2B | | | Frother in Mill | Combustible liquid and vapor. Causes respiratory tract, eye and skin irritation. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling. Avoid oxidizing materials. | Goggles, Gloves, Respirator (air-purifying or air-fed) | Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. |
| PAX | Potassium Amyl Xanthate | Quadra Chemicals Ltd. | Solid | 4.2 | B-6, D-2B | | 25 kg | Collector in Mill | Keep away from water - contact with water liberates extremely flammable gases. Keep away from heat, sparks and flame - fine dust clouds may form explosive mixtures with air. Use only with adequate ventilation. | Goggles, Gloves, Respirator (air-purifying or air-fed) | Move containers from spill area. Avoid allowing the spilled material to get wet or using water to clean up spillages or residues, unless the quantity remaining is very small. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. |
| Polyclear A2501 | | Quadra Chemicals Ltd. | Solid | not regulated | not regulated | | | Tailings thickener flocculant | Keep away from heat, sparks and flame- fine dust clouds may form explosive mixtures with air. Take precautionary measures against electrostatic discharges. Use only with adequate ventilation. Avoid oxidizing materials. | Safety Glasses, Gloves | Move containers from spill area. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. In case of fire use appropriate measures for surrounding fire. Place in sealed container and dispose of via a licensed waste disposal contractor. |
| Polyclear 2528 | Polyclear Floc | Quadra Chemicals Ltd. | solid | not regulated | not regulated | | | | concentrated solution is extremely slippery, use caution | Safety Glasses, Gloves, respiratory equipment if risk assesment deems necessary | Sweep up spilled material and it may be deposited of in dilute form to the pit or tailings system. In case of fire use appropriate measures for surrounding fire. |
| Polyclear 31080C | | Quadra Chemicals Ltd. | Liquid | 9 | D-2B | | | Dewatering Aid in Mill | Use only with adequate ventilation. Avoid contact with strong oxidizers or halogens | Goggles, Gloves, Respirator (air-purifying or air-fed) | Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor. |
| Polyfroth W31 | | Quadra Chemicals Ltd. | Liquid | not regulated | not regulated | | | Frother in Mill | Harmful or fatal if swallowed. Can enter lungs and cause damage. May cause target organ damage | Goggles, Gloves, Respirator (air-purifying or air-fed) | Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor. |
| Potassium hydroxide | KOH | Science lab | Solid | 8 | D-1B | 3, 0, 1 | 5 kg | | very corrosive solid | Safety Glasses, Gloves | Use appropriate tools to put the spilled solid in a convenient waste disposal container. If necessary; Neutralize the residue with a dilute solution of acetic acid. |
| Potassium Iodide | | Anachemia | solid | not regulated | D-2A | 1, 1, 1 | | | light and water exposure will cause breakdown | Safety Glasses, Gloves | Eliminate all sources of ignition. In case of fire use measures dictated by surrounding fire. Will decompose at high temperatures and emit toxic I ₂ fumes. Use appropriate SCBA. |
| Potassium permanganate | | CAIROX | Solid | 5.1 | C, E | 1, 0, 0, OX | 50 kg | | corrosive solid. Oxidizing solid | Safety Glasses, Gloves | Sweep up solid spill for possible reuse. If necessary reduce material in aqueous solution with sodium thiosulfate (hypo). In case of fire use flooding quantities of water, material will contribute to combustion. |
| Propane | | Superior Propane | Liquefied Gas | 2.1 | A, B-1 | | any if container larger than 100 L | | Extremely flammable. Liquefied gas, will produce extreme cold when released. | Goggles, gloves. SCBA if in confined space | close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers. |
| Selenium Standard - AA | | Anachemia | Liquid | 8 | E | 1, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

| Common Name (Synonyms) | Chemical Name | Manufacture / Supplier | Phase | TDG Class | WHMIS Class | NFPA Rating | Reporting Threshold | Use | Special Precautions | PPE Required | Special Cleanup and Disposal Info |
|--|--|------------------------|--------|--|-------------------|-------------|---------------------|--------------------|--|--|--|
| Sodium Borohydride | | Anachemia | solid | 4.3 | B-6, B-4, D-1B, E | 3, 1, 2 | 25 kg | | Flammable solid. Reacts violently with water and acids to produce flammable H ₂ gas. Strong reducing agent. | Safety Glasses, Gloves | Eliminate ignition sources, sweep up dry material. In case of fire use only dry chemical extinguisher, DO NOT USE WATER OR CO ₂ |
| Sodium Hydroxide Solutions (various strengths) | NaOH (The Anachemia MSDS is current, treat all solutions in the same manner regardless of strength.) | Various Suppliers | Liquid | 8 | E | 3, 0, 1 | 5 L | | Caustic solution. Avoid mixing with strong acids. Contact with metals such as aluminum, tin, lead and zinc generates hydrogen gas. | Safety Glasses, Gloves | Neutralize the residue with a dilute solution of acetic acid. Neutralized solution can be disposed of in the pit or tailings system. |
| Sodium Nitrite | | Anachemia | solid | 5.1, 6.1 | C, D-1B, D-2A | 3, 0, 2, OX | 50 kg | | Strong Oxidizer will contribute to combustion of other materials. | Safety Glasses, Gloves | Eliminate all sources of ignition. In case of fire, use flooding quantities of water. Will decompose at high temperatures and emit acrid smoke. Strong oxidizer, may form compound that are sensitive to shock, friction. Sweep up solid spill for disposal. Dispose of contaminated solution in the pit or tailings system. |
| sodium sulphide Flakes | Sodium sulphide Hydrated | Quadra Chemicals | solid | 8 | D-1B, E | | 5 kg | | caustic, very corrosive solid | Goggles, gloves. And a respirator, avoid creating dust and avoid any acids. Contact with acids liberate toxic H ₂ S | Sweep up spilled material in place in plastic sealed container for shipment off site. |
| TMT 15% | trisodium salt | Quadra Chemicals | Liquid | not regulated (treated as Cl. 9 Miscellaneous) | D-2B | | 25 L | | water soluble | Safety Glasses, Gloves | No special clean up procedures, treated as Class 9 Miscellaneous as product does not meet Class 6 Toxicity standards but is an environmental hazard. |
| Urea | Carbamide | Anachemia | solid | not regulated | not regulated | 1, 0, 0 | | | Avoid contact with strong oxidizers. In fire conditions it can produce oxides of nitrogen. Also ammonia, and HCN | Safety Glasses, Gloves | Sweep up spilled material and it may be deposited in dilute form to the pit or tailings system. In case of fire use appropriate measures for surrounding fire. |
| Vitec 7000 | | Avista Technologies | Liquid | not regulated | 2A | 1, 0, 0 | | Antiscalant in WTP | Avoid mixing with strong bases, strong oxidizers, very strong acids, water reactive materials | SCBA or SABA in confined space, Safety goggles/glasses, Chemical impervious gloves | Soak up or wet vacuum spilled liquid. Neutralize residue with sodium bicarbonate or other neutralizing agent for very dilute acids. Decontaminate the area thoroughly. Place all spill residues in suitable container and dispose of via a licensed waste disposal contractor. |
| VAR SOL 3139 SOLVENT | Petroleum Hydrocarbons | Imperial Oil Chemicals | Liquid | 3 | B-3, D-2B | 1, 2, 0 | 200 L | | Flammable solvent | Safety Glasses, Gloves | Clean up uncontaminated material for reuse. Incinerate waste. |
| VoltEsso 35 | | Imperial Oil Chemicals | Liquid | not regulated | not regulated | 1, 1, 0 | | | electrical insulating oil | Safety Glasses, Gloves | Clean up uncontaminated material for reuse. Incinerate waste. |
| Zinc Standard - AA | | Anachemia | Liquid | 8 | E | 1, 0, 0 | 5 L | | Dilute Nitric Acid <5% | Safety Glasses, Gloves | Neutralize with soda ash or lime. Contain spill, do not allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system. |

Appendix C: ERT Response to HazMat Spills

ERT Response to Hazmat Spill

Spill Contact: Yukon Territory Spill Line 1-867-667-7244

Canutec: 1-613-996-6666 Cell: *666

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1.0 Overall HAZMAT Response Procedures

1.1 Site Management and Control

Initial responders will :

- Approach the scene from uphill and upwind.
- Establish command uphill and upwind of spill at an appropriate distance.
- Establish 2 isolation perimeters: one that separates the hot zone from the warm zone and another that separates the warm zone from the cold zone. Emergency Response Guide or Canutec shall be referenced for perimeter size.
- Evacuate affected area or 'protect in place', as req'd. Emergency Response Guide or Canutec shall be referenced for evacuation zone.
- Identify contaminated persons and ensure they remain isolated until they can be decontaminated.
- Establish a staging area.
- Designate an information officer.
- Possible unification of command.

1.2 Identification of the problem

I/C will identify the:

- Spilled product, as per witness testimony, placards, labels, bill of lading, type of container, etc. If product cannot be identified from command position, then a recon team will be tasked with identification.
- Size of container.
- Size and nature of release.
- Conditions and # of victims at accident site.
- Topography of area, and exposures threatened.

1.3 Hazard & Risk Evaluation

A risk evaluation will be conducted, taking into consideration:

- Product hazards
- Access & Egress
- Size of Spill
- Condition of container
- Proximity of exposures
- Personnel available to perform operations, and their level of training/experience
- Information from MSDS, ERG, Canutec, etc., minimum 3 sources

1.4 Personal Protective Equipment

PPE will be selected for Ops, RIT, and Decon teams, considering:

- Flammability/explosiveness of product
- Toxicity of product
- Route of entry of product
- Permeation rate of PPE
- Breakthrough time of PPE
- Availability of PPE
- Visibility and workability while wearing PPE

1.5 Information Management and Resource Coordination

The information officer will begin to gather information about the product once it has been identified. The information officer can use the MSDS, ERG, Canutec, or many other resources to gather information, such as:

- Properties of the product
- Hazards of the product
- Expected travel of product released
- Populations/ environment in jeopardy
- PPE req'd by responders
- Decontamination requirements

Command will prioritize the information and ensure that the correct people receive the correct information.

1.6 Implementing Response Objectives

Command will develop an overall strategy, which may be offensive (entry of hot zone to gain quick control), defensive (contain from the cold zone to prevent spread), or passive (isolate only, and wait for incident to run its course), considering:

- Life safety
- Incident stabilization
- Environmental protection
- Property salvage

Command will delegate tactics to operations teams, such as:

- Reconnaissance for unknown product
- Evacuation for toxic gas leak, fire, or explosive hazard
- Fire control for flammable gas, flammable liquid, or oxidizer
- Search and rescue
- Leak control
- Neutralization of corrosives
- Deployment of boom, drain covers, etc.
- Building of dams, dykes, etc.

To follow: specific tactic options will be discussed in more detail, pertaining to hazardous materials that are commonly found in large quantities at the Minto Mine.

Entry teams will enter with a clear objective, but must assess for the next team's objective. For example, the 1st entry team may be tasked with rescuing the driver of a fuel truck that rolled down a bank and is spilling fuel. Although their objective is to rescue, while they are on scene they should observe where the leak is, consider what could be used to stop it, where the fuel is going, and what is needed to contain it. They should bring a camera, so that pictures can be brought back to command. This will give command crucial information and better prepare the next team for their task.

1.7 Decontamination

Considerations for decontamination should begin at the outset of the incident. A decontamination construct will exist in the warm zone prior to any team entering the hot zone. It will typically consist of a large berm fashioned out of a large chemical resistant tarp, wrapped over a charged 2 ½" hose-line. There will be a charged 1 ½" hose-line nearby for emergency decontamination. Within the berm, there will be a series of smaller berms, in which, personnel will stand while being decontaminated. Personnel conducting the decontamination will be wearing the appropriate PPE (typically 1 class below ops) and will use detergent and water to gently scrub and rinse ops personnel and rescuees as they exit the hot zone. Tools and anything else exiting the hot zone will be decontaminated as well.

Once decontamination is complete, all product collected by the berms, will be handled as per the MSDS.

1.8 Termination

Once emergency operations are complete, the scene will be handed over to clean-up & recovery operations. Command will ensure that the hand-off includes all pertinent information about the spilled product:

- Properties
- Hazards
- Location
- Safe-handling
- Exposure signs and symptoms
- Req'd PPE
- Disposal procedures

Command will conduct an on-site debrief. As well, a more formal debrief will be conducted, with all parties involved, at a later time. The incident will be documented, including exposure records for all personnel that entered the warm and/or hot zones.

2.0 Specific Chemical Responses

2.1 Ammonium Nitrate

Site management and control

- Set up perimeter with at least 25m radius.
- Command, staging, & decon shall be positioned upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept, Dyno Nobel, product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1942.
- Solid state. Prills or granules.
- White.
- Odorless.
- Is there threat to a stream?

Hazard & risk evaluation

- Oxidizer .
- Exposure to high heat may evolve toxic, flammable gases.
- Explosive when confined and exposed to high heat.
- Ingestion and inhalation hazard.
- Toxic to aquatic life.

PPE

- If there is a fire situation, PPE will consist of full turn-out gear with SCBA.
Otherwise
- Class C suit with long sleeves.
- Dust mask.
- Oil resistant gloves & boots

Information management and resource coordination

- See MSDS for product information.

- Work closely with Dyno.
- Standard decon set-up will be constructed.
- Have tools cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured personnel.
- Fire-fighting: If flame impingement on tank, use unmanned ground monitor to supply flooding quantities of water via straight-stream, to cool tank. Then, evacuate area 800m in all directions. If signs of imminent explosion are present prior to setting up ground monitor, do not attempt to set it up, just evacuate for 800m in all directions.
- Prevent from entering streams.
- Once in stream, may be unrecoverable. Underflow dams should be constructed, and surface can be skimmed.
- If possible, stop anymore product from being spilled.
- Follow Dyno's recommendations for recovery and clean-up of product.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, vac-truck can be utilized to clean up solution contained with the decon berms.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief.

2.2 Emulsion

Site management and control

- Consider initial perimeter of 800m.
- Command, staging, & decon shall be positioned upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept, Dyno Nobel, product carrier (if spill occurs during delivery to mine).

Identification



- UN# 0332.
- Viscous liquid.
- Pink, opaque.
- Slight fuel oil odour.
- Shipped in bulk by tanker truck.

Hazard & risk evaluation

- Emulsion explosives.
- Stable under normal conditions.
- May explode under fire conditions.
- Eye & skin irritant.
- Slight ingestion & inhalation hazard.
- Avoid contact with corrosives.
- Is there threat to a stream?

PPE

- Class C suit with long sleeves.
- Standard PPE

Information management and resource coordination

- See MSDS for product information.
- Work closely with Dyno.
- Standard decon set-up will be constructed.
- Have tools cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.

- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured personnel.
- Fire-fighting: If fire reaches cargo, DO NOT ATTEMPT TO FIGHT FIRE. Cargo may explode. Evacuate in all directions for 1600m.
- Prevent from entering streams.
- If possible, stop anymore product from being spilled.
- Follow Dyno's recommendations for recovery and clean-up of product.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, clean out berms under direction of Dyno.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief.

2.3 Diesel, Kerosene, CFE 150

Note: LEL sensor will not detect presence of long-chain hydrocarbon vapour. Photo-ionization detector (PID) should be used, if available.

Site management and control

- Set up perimeter with at least 50m radius.
- Command, staging, & decon shall be positioned uphill and upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept, Dyno Nobel (if spilled product is CFE 150), product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1202.
- Liquid state.
- Colour varies.
- Petroleum odour.
- Transported by B-train, tidy-tanks.
- Stored in 5 large tanks at fuel farm (total volume of 3,282,000 L), one 70,000 l Tank by UG portal, and one tank at Dyno (45,000 L).
- What is downhill from spill??
- Is there threat to life??
- Is there threat to a stream?

Hazard & risk evaluation

- Combustible liquid.
- Vapour could be ignited by any source of ignition.
- Extraction methods could create static if not bonded/grounded, and serve as an ignition source.
- Ambient temperature relevant.
- Irritant to eyes and skin
- Ingestion and inhalation hazard
- Toxic to aquatic life.

PPE

- If there is a fire situation, PPE will consist of full turn-out gear with SCBA.
Otherwise
- For offensive strategies, such as rescue or plugging, full turn-out gear with SCBA
- For defensive strategies, such as diverting, damming, booming, diking, class B suit.

- Respirator with OV cartridges.
- Oil resistant gloves & boots

Information management and resource coordination

- See MSDS for product information.
- Know the product's route of travel.
- Standard decon set-up will be constructed.
- Ensure tools are cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd.
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured personnel.
- Consider using fog stream to protect rescuers.
- Fire-fighting: Use dry chemical, CO2, Class B foam, or water with fog pattern.
- If using fog, considering increased run-off hazard
- Prevent from entering streams.
- If possible, stop the leak: close valves, use plugs, plug n' dyke, gaskets, straps, jacks, cribbing, etc.
- Containment berm at source, 'Surrey Condom'.
- If possible, contain by covering drains/culverts, diking, diverting to a berm, absorbing, etc.
- If product has entered a stream, use booms, hydrocarbon-only absorbent socks and pads, under-flow dams, diversion-booms, skimmers to contain and extract, as per instructions found later in this document.
- If transfer of product req'd, ensure entire system is bonded/grounded.
- Use non-sparking tools, such as pneumatics.
- Site Services Vac-truck is an option for cleaning up product.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, vac-truck can be utilized to clean up solution contained with the decon berms.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief

2.4 Gasoline

Note: Minto gas detectors are calibrated to pentane and are suitable for use during gasoline spill mitigation

Site management and control

- Set up perimeter. Consider radius up to 800m depending on amount of product and level of explosion hazard.
- Command, staging, & decon shall be positioned uphill and upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1203.
- Liquid state.
- Colourless to slightly yellow.
- Recognizable odour.
- Transported by B-train, tidy-tanks.
- Stored in 2 tank at fuel farm (34,150 L combined).
- What is downhill from spill??
- Is there threat to life?
- Is there threat to a stream?

Hazard & risk evaluation

- Flammable liquid. Extremely flammable in presence of ignition source, at nearly any temperature.
- Vapour could be ignited by any source of ignition.
- Vapour is heavier than air and may travel considerable distance to an ignition source, and flash back.
- Product extraction methods could create static if not bonded/grounded, and serve as an ignition source.
- Explosion hazard where flame impingement on tank.
- Irritant to eyes.
- Ingestion and inhalation hazard
- Toxic to aquatic life.

PPE

- If there is a fire situation, PPE will consist of full turn-out gear with SCBA.
Otherwise
- For offensive strategies, such as rescue or plugging, full turn-out gear with SCBA
- For defensive strategies, such as diverting, damming, booming, diking, fire resistant class B suit.
- Respirator with OV cartridges, only if LEL's are being monitored, otherwise, do not dampen sense of smell. Rather, move upwind of product vapour.

Information management and resource coordination

- See MSDS for product information.
- Know the product's route of travel.
- Standard decon set-up will be constructed.
- Ensure tools are cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Offensive tactics for rescue of injured personnel only.
- Consider blanketing affected area with class B foam, prior to rescuers entering hot zone.
- Use fog stream to suppress vapours and protect rescuers.
- Rescuers will carry intrinsically-safe radios and gas-detector.
- Prevent from entering streams
- If possible, stop the leak.
- If possible, contain by covering drains/culverts, diking, diverting to a berm, absorbing, etc.
- If product can or has entered a stream, use booms, hydrocarbon-only absorbent socks and pads, under-flow dams, diversion-booms, as per instructions found later in this document.
- Safe handling and disposal of all waste product.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, safe disposal of decon berm contents
- Safe and proper disposal of all spent PPE
- Hand-over command of operation to Environmental Dept.
- Debrief

2.5 LPG (Propane)

Note: Minto gas detectors are calibrated to pentane, and require no correction prior to use during propane leak mitigation.

Site management and control

- Set up initial perimeter of at least 100m. For large tank where there is fire, set up perimeter of at least 1600m.
- Command, staging, & decon shall be positioned uphill and upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1075
- Colourless liquid and vapour while stored under pressure.
- Colourless and odourless gas in natural state at any concentration.
- Commercial propane has an odorant added which is commonly ethyl.
- Transported by tanker truck.
- Stored in 6 113,000L tanks West of the Main Pit, One 12,000L tank at the refill station near the airport, twin 3,000L tanks at Pelly, and twin 18,000L tanks at Km 0 of the access road.
- What is downhill from spill?
- Is there threat to life?
- Is there threat to a stream?

Hazard & risk evaluation

- Extremely flammable gas.
- Vapour could be ignited by any source of ignition.
- Vapour is heavier than air and may travel considerable distance to an ignition source, and flash back.
- Stored under pressure, as a liquid.
- Product extraction methods could create static if not bonded/grounded, and serve as an ignition source.
- Massive explosion hazard where flame impingement on tank.

PPE

- Full turn-out gear with SCBA.

Information management and resource coordination

- See SDS for product information.
- Consider contacting Canutec.
- Know the product's route of travel.
- Ensure tools are cribbed for entry teams.
- Have fire truck at scene and ambulance in staging area, as req'd

Implementing Response Objectives Leak in an enclosed space

- Evacuate structure.
- Close supply valve remotely if possible.
- Eliminate any source of ignition.
- Use positive pressure to ventilate space, ensure that it is exhausting to safe location.

If no remote isolation valve:

- Entry team (2 ERT members) & RIT team (2 ERT members) will don full turn-out gear & SCBA.
- Any electronic equipment being carried, such as radio or gas detector, must be intrinsically safe.
- Entry team will enter with charged 1 ½" hose-line and gas detector equipped with LEL sensor, while RIT stages in the cold zone .
- Once entry team is at 'reach of stream' distance from the leak, the nozzleman (Entry member 1) will set-up, with nozzle fixed on Entry member 2. Entry member 2 will continue toward valve, with gas detector.

If LEL sensor rises above 20%, entry team will retreat until ventilation can be made adequate.

- Once Entry member 2 reaches the valve, he will close the valve, then back away until he reaches entry member 1.
- Entry team will exit the structure, until it has been adequately ventilated.
- Once adequately ventilated, ERT members, wearing appropriate PPE, will sweep the structure with gas detector(s), to ensure there are no pockets of gas, before deeming the structure 'safe to enter'.

****** If no remote shut-off is available or accessible, the main propane lines can be shut off by cutting the Underground Power feed in the Tailings Building.***

2.5.1 LPG line on fire, with no impingement

Note: a propane leak that is burning is safer than one that is not burning, as long as there is no impingement on a tank or structure. Therefore, in this scenario, gas will be allowed to burn until the valve can be shut off.

- Evacuate immediate area.
- If possible, close isolation valve from remote location.

If no remote isolation valve:

- Eliminate any further source of ignition.
- 2 or more ERT members in full turn-out gear & SCBA will be on 1 ½" hose-line.
- Nozzle will be turned to full fog, which will create a water-curtain between the fire and the fire fighters.
- The fire team will approach the isolation valve, keeping the water-curtain between themselves and the fire at all times, being careful not to put the fire out with the stream
- When the valve is reached by the team, the 2nd member on the line will let go of the hose and approach the valve, while the nozzleman maintains the water-curtain between the fire and the valve/fire team.
- The 2nd member will close the valve then back away from the fire until he regains his position on the hose.
- The team will maintain the water-curtain while they back away from the damaged gas-line.
- Once the team is at a safe distance, a 45 degree pattern can be fixed on the broken gas-line to cool it, and disperse any residual gases.

2.5.2 LPG leak, not enclosed, not on fire

Note: LPG has a very high vapour pressure (1013 kPa) so it wants to be a gas, a high vapour density (1.52) so it's heavier than air, and a low flash point (-103.4 C). This combination means that it can form an explosive gas cloud that will stay close to the ground, may linger in incident area, or migrate downwind and/or downhill, possibly settling in low lying areas.

- Evacuate immediate area as well as areas downwind/downhill as per ERG recommendations.
- If possible, close isolation valve from remote location.
- From 'reach of stream', set up ground monitor and fix a 45 degree fog pattern on area of concern. This will push gas cloud away from area and disperse it. Be sure to push it to a safe location.

If no remote isolation valve:

- Entry team (2 ERT members) & RIT team (2 ERT members) will don full turn-out gear & SCBA.
- Any electronic equipment being carried, such as radio or gas detector, must be intrinsically safe.
- Entry team will enter with charged 1 ½" hose-line and gas detector equipped with LEL sensor, while RIT stages in the cold zone.
- While ground monitor continues to 'make it rain' in the hot zone, nozzleman (entry member 1) will fix nozzle on entry member 2, as entry member 2 approaches the isolation valve, with gas detector.

If LEL sensor rises above 20%, entry team will retreat until water stream can be made more effective

- Once Entry member 2 reaches the valve, he will close the valve, then back away until he reaches entry member 1.
- Entry team will retreat to the cold zone until gases are adequately dispersed
- Once the gas is adequately dispersed, ERT members, wearing appropriate PPE, will sweep the area with gas detector(s), including low-lying areas where gas may have migrated to, before deeming the area 'safe to enter'.

2.5.3 Fire where there is flame impingement on LPG tank

- Evacuate all non-ERT members for at least 1,800 m where there is flame impingement on either the 12,000 L tank or the tandem 18,000 L tanks.
- Command will know and understand the signs of imminent BLEVE.
- If Command witnesses signs of imminent BLEVE from an upright tank, there shall be no attempt made to cool tanks, rather, all focus shall be on a rapid evacuation of all personnel, at least 1,800m.
- If tank has been knocked over, there may be little or no warning signs of BLEVE, therefore no attempt shall be made to cool, rather, all focus shall be on a rapid evacuation of all personnel, at least 1,800m.
- If a BLEVE is not imminent, an attempt will be made to connect a ground monitor to the stand-pipe at the Tailings bldg.
- A narrow fog stream will be fixed on the tank at the area of flame impingement.
- The monitor will be left unmanned and the remaining ERT will evacuate at least 1,800m.

Where a tanker truck carrying propane has over-turned on the access road, causing damage to the tank trailer and subsequent rapid release of propane, the strategy for the hazmat portion of the incident response, will be passive and conducted from an upwind/uphill location, at a safe distance, as per the ERG. Transfer of residual product for the scenario, will be conducted by outside resource.

Decontamination

- 1 ½" charged hose-line, as emergency decon

Termination

- Debrief

BW GasAlert Micro 5 is intrinsically safe, as per: http://directories.csa-international.org/xml_transform.asp?xml=certxml%5C080259_0_000-4828-82.xml&xsl=xsl/certrec.xsl

- GasAlert Micro 5 Portable Gas Detector, Model M5-xwt1t2-r-p-d-a-b-cc & M5PID-xwt1t2-r-p-d-a-b-cc; utilizing electrochemical, catalytic bead and photo-ionization sensors; Intrinsically Safe when powered by one of the following AA Size Batteries / Battery Pack
 - Duracell MN1500; T-Code T4; Ambient -20 to +40°C; T-Code 139.8°C (T3C); Ambient -20 to +50°C
 - Energizer E91; T-Code 153°C(T3C); Ambient -20 to +40°C; T-Code 163°C (T3B); Ambient -20 to +50°C
 - NiMH Rechargeable Battery Pack "M5-BAT01"; T-code T4; Ambient -20 to +50°C
 - Lithium Polymer Rechargeable Battery pack "M5-BAT07B"; T-Code T4; Ambient -20 to +50°C

2.6 Nitric Acid 40%

Note: when it comes to corrosives such as Nitric Acid, the solution to pollution is NOT dilution. For a spill of 1 45 gal drum, it would take over 450,000 gal of pure water to make the solution habitable for fish. It would take over 45,000,000 gal of pure water to neutralize it.

Site management and control

- Set up perimeter with at least 50m radius.
- Command, staging, & decon shall be positioned uphill.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product Carrier (if spill occurs during delivery to mine).

Identification



- UN# 2031
- Liquid state
- Colourless to yellow
- Transported in 45 gallon drums
- # of 45 gal drums possibly damaged will help estimate size of spill.
- What is downhill from spill? Could acid reach a stream?

Hazard & risk evaluation

- Strong acid, very corrosive.
- Severely hazardous to eyes and skin
- Ingestion could cause death
- Inhalation hazard, although low vapour pressure 1.3kPa (wants to be a liquid).
- Could be devastating to stream life.
- Strong oxidizer, could have explosive reaction with organic or combustible materials

PPE

- If there is a fire situation, PPE will consist of full turn-out gear and SCBA.
Otherwise
- Know and heed permeability rate and breakthrough times of all PPE.
- Acid resistant, class B suit with hood.
- Full-face respirator with appropriate chemical cartridges.
- Chemical resistant gloves & boots
- Chemical resistant tape used to seal between boots/suit, gloves/suit, and mask/hood.

Information management and resource coordination

- See MSDS for product information.
- Know the product's route of travel.
- Was anyone exposed?
- Will non-human life be exposed?
- Standard decon set-up will be constructed.
- Have tools cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is enough neutralizing agent at the site to complete the task. *See below for chart*
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured/exposed personnel.
- Prevent from entering streams
- Prevent from contacting combustibles and organics.
- If possible, stop the leak.
- If possible, contain by covering drains/culverts, damming, diverting to a berm, etc.
- Use over-pack to contain leaking drums that still contain product.
- Neutralize spilled product with weak caustic – primary neutralizing agent is Ansul Spill X-A, alternatively hydrated lime or baking soda (if available). Be cautious of chemical reaction.
- Use Litmus paper to test for pH when neutralizing with lime or baking soda.
- Site Services Vac-truck is an option for cleaning up product before or after neutralized, as necessary.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, vac-truck can be utilized to clean up solution contained with the decon berms.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief

2.6.1 Chart for Estimating Caustic Req'd to Neutralize 40% Nitric Acid

For **Spill X-A**, use 1:1 ratio by volume, or 10lbs Spill X-A per 1 gal Nitric Acid.

| Amount of Nitric Acid Spilled (in Gal.) | Amount of Baking Soda Req'd (in Lbs.) |
|---|---------------------------------------|
| 1 | 5.6 |
| 2 | 11 |
| 5 | 28 |
| 10 | 56 |
| 20 | 110 |
| 45 | 252 |
| 90 | 504 |
| 135 | 756 |
| 180 | 1,008 |

| Amount of Nitric Acid Spilled (in Gal.) | Amount of Lime Req'd (in Lbs.) |
|---|--------------------------------|
| 1 | 2.4 |
| 2 | 4.8 |
| 5 | 12 |
| 10 | 24 |
| 20 | 48 |
| 45 | 108 |
| 90 | 216 |
| 135 | 324 |
| 180 | 432 |

Charts derived from formulas below

Specific Gravity Nitric Acid: 1.2455

Concentration: 40%

1 gal HNO₃ x 1.24 x 8.34 lbs/gal x 0.40 = 4.14 lbs HNO₃

HNO₃ + NaHCO₃ → NaNO₃ + H₂O + CO₂ Therefore 1 mol Nitric Acid per 1 mol Sodium Bicarb (Baking Soda)

$2\text{HNO}_3 + \text{Ca}(\text{OH})_2 \rightarrow \text{Ca}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$ Therefore 2 mol Nitric Acid per 1 mol Calcium Hydroxide (Lime)

$\text{HNO}_3 = 63 \text{ amu}$

$\text{NaHCO}_3 = 85 \text{ amu}$

$\text{Ca}(\text{NO}_3)_2 = 74 \text{ amu}$

$(4.14 \text{ lbs HNO}_3 / 63 \text{ amu-HNO}_3) \times 85 \text{ amu-NaHCO}_3 = 5.6 \text{ lbs NaHCO}_3$

Therefore 1 gallon of Nitric Acid req's 5.6 lbs of baking soda

$(4.14 \text{ lbs HNO}_3 / (2(63) \text{ amu-HNO}_3)) \times 74 \text{ amu-Ca}(\text{OH})_2 = 2.4 \text{ lbs Ca}(\text{NO}_3)_2$

Neutralization Formulas and Quick Access Charts Formulas

The key to effective and efficient neutralization, is knowing how to use the following formulas.

1. The first formula indicates how much acid is spilled in weight.

Step #1- Determine the quantity of acid spilled, usually in gallons.

Step #2- Determine the specific gravity of the acid usually provided in MSDS.

Step #3- Determine the concentration of the acid spilled usually in %.

Step #4- The weight of water is 8.34 pounds per gallon.

After the above figures are known plug them into the following formula:

$\text{Quantity of spill} \times \text{specific gravity} \times \text{weight of water} \times \text{concentration}$
 $= \text{weight of the spill}$

Example:

One gallon of sulfuric X 1.84 X 8.34 X 98% = 15.04 pounds of sulfuric

2. The second formula will determine the quantity of the neutralizer needed. The type of neutralizer needs to be selected based on costs and availability. Plug numbers into the following formula:

$\text{Weight of the acid spilled} \times \text{number in the chart for the selected neutralizer.}$

Example :

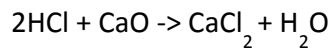
15.04 pounds of sulfuric X 1.06 for Soda Ash = 15.94 pounds of Soda Ash

Determination through Chemistry

To calculate the amount of neutralization agent needed the balanced chemical reaction must be written and the equivalent weights of acid and base determined.

Example: 1,000 gallons of 38% hydrochloric acid will be neutralized with lime.

Step #1 – Write the complete balanced neutralization reaction:



This equation shows that 2 moles of HCl are required in the reaction with one mole of calcium oxide (lime).

Step #2 – Calculate the molecular weight of each compound:

HCl – H = 1, Cl = 35.5, Total = 36.5 amu

CaO – Ca = 40, O = 16, Total = 56

Step #3 – Calculate the weight of the HCl spill:

1,000 gallons X 1.20 X 8.34 X 0.38 = 3,803.04 pounds of HCl

Step #4 – Calculate the amount of neutralizer needed:

From Step #1 it was found that 2 moles of HCl are needed to react with 1 mole of CaO. From Step #2 it was found that 1 mole of HCl weighs 36.5 amu's so 2 moles weigh 73.0 amu's. The formula is;
weight of acid/formula weight of acid X formula weight of base = pounds of the neutralizer needed.

$3,803.04/73 \times 56 = 2,917.4$ pounds of lime

Finer Points

The final amount is an approximation and in actual practice more neutralizing agent should be obtained. The neutralization process needs to be checked at several spots to assure pH levels are acceptable and uniform.

Neutralization Precautions

Remember, the neutralization process is exothermic and it may involve splashing of product. Safety is paramount and proper protective equipment is very important. Also, the neutralizer is hazardous in its own right and needs to be handled with care. Consider expense and availability in selecting neutralizer. Other weak bases that may be used and their molecular weights are; sodium bicarbonate (NaHCO_3)- 85, and magnesium hydroxide (Mg(OH)_2)-58.

Neutralization Chart Information

Acids

Hydrochloric Acid, HCl, MW = 36.5, density/specific gravity is 1.19, weight of a gallon is 3.77 pounds at 38% concentration. Synonyms are chlorohydric acid and muriatic acid.

Nitric Acid, HNO_3 , MW = 63, density/specific gravity is 1.41, weight of a gallon is 8.23 pounds at 70% concentration. Synonyms are Aqua Fortis and Azotic Acid. (Aqua Regia is a mixture of nitric and hydrochloric acids).

Phosphoric Acid, H_3PO_4 , MW = 98, density/specific gravity is 1.69, weight of a gallon is 11.98 pounds at 85% concentration. Synonyms are orthophosphoric acid.

Sulfuric Acid, H_2SO_4 , MW = 98, density/specific gravity is 1.84, weight of a gallon is 15.04 pounds at 98% concentration. Synonyms are Oil of vitriol and "oleum" is fuming sulfuric acid.

Bases

Ammonium hydroxide, NH_4OH , MW = 35, clear solution, synonyms are ammonia solution and aqua ammonia.

Strong ammonia odor evolves from liquid. High vapor pressure.

Calcium carbonate, CaCO_3 , MW = 100, white powder, synonyms are crushed limestone and dolomite. Low heat of reaction that gives off carbon dioxide gas.

Calcium hydroxide, Ca(OH)_2 , MW = 74, white powder, synonyms are slaked lime, hydrated lime, and calcium hydrate.

Calcium oxide, CaO , MW = 56, white powder, synonyms are quicklime, lime, and unslaked lime. Most economical, lowest cost, neutralizer. **Best choice!** Maximum pH is 12.45 at 25C.

Magnesium carbonate, MgCO_3 , MW = 84, synonyms are magnesia alba and carbonate magnesium.

Magnesium hydroxide, Mg(OH)_2 , MW = 58, white powder, synonyms are milk of magnesia and magnesia hydrate.

Good neutralization agent. Maximum pH is 10.6 at 25C.

Potassium hydroxide, KOH , MW = 56, white flakes, synonyms are caustic potash. High heat of reaction with toxic fumes. Maximum pH is 14 at 25C.

Sodium bicarbonate, NaHCO_3 , MW = 85, white powder, synonyms are baking soda and sodium acid carbonate.

Low heat of reaction with carbon dioxide gas evolution.

Sodium Carbonate, Na_2CO_3 , MW = 106, white powder, synonyms are soda ash. **Second most economical neutralization agent next to lime.** Maximum pH is approximately 11 at 25C.

Sodium hydroxide, NaOH , MW = 40, white powder, synonyms are caustic soda, soda lye, caustic, and lye. High heat of reaction with toxic fumes. Maximum pH is 14 at 25C.

2.6.2 Quick Access Charts for Neutralizing Various Acids with Baking Soda

2.6.2.1 *Sulfuric Acid neutralization using Baking Soda (Sodium Bicarbonate)*

| Amount of Sulfuric Acid spilled | Amount of Baking Soda needed in pounds |
|---------------------------------|--|
| 1 gallon | 25.6 |
| 2 gallons | 51.2 |
| 3 gallons | 76.8 |
| 4 gallons | 102.4 |
| 5 gallons | 128.0 |
| 10 gallons | 256.0 |
| 50 gallons | 1280.0 |
| 55 gallons | 1408.0 |
| 100 gallons | 2560.0 |

2.6.2.2 *Hydrochloric Acid neutralization using Baking Soda*

| Amount of Hydrochloric Acid spilled | Amount of Baking Soda needed in pounds |
|--|---|
| 1 gallon | 5.5 |
| 2 gallons | 11.0 |
| 3 gallons | 16.5 |
| 4 gallons | 22.0 |
| 5 gallons | 27.5 |
| 10 gallons | 55.0 |
| 50 gallons | 275.0 |
| 55 gallons | 302.5 |
| 100 gallons | 550.0 |

2.6.2.3 *Nitric Acid neutralization using Baking Soda*

| Amount of Nitric Acid spilled | Amount of Baking Soda needed in pounds |
|--------------------------------------|---|
| 1 gallon | 7.4 |
| 2 gallons | 14.8 |
| 3 gallons | 22.2 |
| 4 gallons | 29.6 |
| 5 gallons | 37.0 |
| 10 gallons | 74.0 |
| 50 gallons | 370.0 |
| 55 gallons | 407.0 |
| 100 gallons | 740.0 |

2.7 Sodium Sulphide

Site management and control

- Set up perimeter with at least 50m radius if water introduced, or 25m if solid.
- Command, staging, & decon shall be position upwind and uphill.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1849
- Solid state
- Yellow
- Smell sulfurous or like rotten eggs with introduction of moisture.
- Transported in 1000 Kg 'Super-Sacks'.
- # of super-sacks possibly damaged, will help estimate size of spill.
- Is water being introduced to the spill? If so, what is downhill from the spill? Could run-off reach a stream?
- Are corrosives being introduced to spill? If so, what is downwind?

Hazard & risk evaluation

- Strong caustic.
- Severely corrosive to digestive tract, respiratory system, eyes, and skin.
- Dust is powerful systemic poison. Inhalation could cause headache, dizziness, unconsciousness, pulmonary edema, asphyxiation, death.
- Contact with acid releases toxic and flammable Hydrogen Sulfide.
- Routes of entry include absorption, inhalation, and ingestion.
- Keep spilled product dry
- If water introduced, avoid run-off, contact with soil, waterways.

PPE

- If there is a fire situation, PPE will consist of full turn-out gear and SCBA.
Otherwise
- Know and heed permeability rate and breakthrough times of all PPE.
- SCBA if significant H₂S release, otherwise, full-face respirator & OV cartridges with pre-filter.
- Corrosive resistant, class B suit with hood.
- Chemical resistant gloves & boots
- Chemical resistant tape used to seal between boots/suit, gloves/suit, and mask/suit.

Information management and resource coordination

- See MSDS for product information.
- Was anyone exposed?
- Will non-human life be exposed?
- Standard decon set-up will be constructed.
- Have tools cribbed for entry team.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured/exposed personnel.
- Keep product dry.
- Monitor atmosphere for H₂S and SO₂.
- If water introduced, contain run-off by covering drains/culverts, damming, diverting to a berm, etc. Solution collected can be mixed with oxidizing agent, such as hydrogen peroxide or sodium hypochlorite to prevent evolution of H₂S.
- If product has entered a stream, consider using over-flow dams to contain product, for extraction.
- Vacuum or sweep up dry product
- Disposal as per Environmental Dept. recommendations

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, solution in decon berms to be disposed of, as per Environmental recommendations.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief

Appendix D: Tug and Barge Emergency Contingency Plan



Minto Mine
Tug and Barge Emergency Contingency Plan
2017-01

Prepared by:
Minto Explorations Ltd.
Minto Mine
February 2017

First Issue: January 15, 2013

Revision History

| Revision Number | Issue Date | Description and Revisions Made |
|------------------------|-------------------|--|
| 2013-01 | January 2013 | First Issue |
| 2017-01 | February 2017 | Review, revision of document and update of information: <ul style="list-style-type: none">• Revised format of document (added revision history and table of contents);• Section 2.0 and 3.1 - Removed references to JDS and mutual aid agreement (not in place);• Section 4.0 - updated level of NFPA training for ERT (472 HazMat awareness level);• Section 4.0 - updated reference to 2014 field and table top exercise. |

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List of Appendices

Appendix A: Man Boat Specifications

Appendix B: Safe Job Procedure for Loading and Unloading the Barge.

1 Introduction

Minto Mine (Minto) a subsidiary of Capstone Mining Corporation is pleased to submit the following contingency plan (plan) as per requirements of the Selkirk First Nation Access and Land Use Permit “Minto Landing Ice Bridge and Marshalling Area and West Side Barge Landing and Marshalling Area” (the permit). It is Minto’s intention that this plan will fulfill the requirement as stated in Schedule 2, Section 9.0 Contingency Plan of the permit. It is not Minto’s objective for this plan to mitigate all possible accidents or malfunction in regards to the in stream operation of the Copper Queen tug and barge.

The plan as prepared is adaptive and will be amended as is practicable. This plan is intended to deliver the best possible means of mitigating an accident or malfunction of the loading/unloading or in-stream operation of the tug and barge with the resources available at Minto. Preventing such an occurrence requires a combination of: procedural and engineering controls, based on an awareness of at risk conditions. These documents exist in the form of the Spill Contingency Plan, Emergency Response Plan, and any procedures or plans on the tug or barge from Site Services. This document serves as a contingency plan in the event that an accident or malfunction occurs when loading, unloading, and in-stream operations of the Copper Queen tug and barge (CQTB).

2 General Procedures

Any Response to an Emergency condition will be based on a priority sequence of Life, Environment and Property. Therefore every event will be regarded with these priorities in mind. Initial on scene assessment of the accident or malfunction will be called out on channel one as a “Code 1”. The Emergency Response Team will be dispatched, communication established and the barge operator and deckhand will respond to control the scene.

Deckhands will mitigate all emergencies on the barge to the best of their ability given the resources available. General procedure in the event of an emergency would have the barge move to the west landing if possible or practical unless otherwise communicated to the barge captain. To mitigate an emergency in offloading or loading vehicles onto the barge the deckhand will utilize the anchor points on both landings. Slack will be left in the rope to ensure the barge captain is able to maneuver when docked at the landing. Tying off to the anchor points will mitigate complete catastrophe if the barge loses power during loading and offloading and will be discussed further under the specific procedures section of this plan.

To mitigate the risk of losing control of the barge downstream Minto will be installing an anchor on the barge. In the event of an emergency the deckhand would be able to deploy the anchor allowing the barge a safety contingency if control was lost.

3 Specific Procedures

Below is a list of the current on site procedures for dealing with various emergencies in regards to the CQTB at Minto Mine.

1. Emergency Response to Sinking
2. Emergency Response to Loss of Power or Control
3. Emergency Response to Fire Onboard
4. Emergency Response to Man Overboard
5. Emergency Response to Freight or Vehicle Overboard
6. Emergency Response to Medical Emergency on Board of the Barge
7. Emergency Response to Spill Response

3.1 Emergency Response to Sinking of CQTB

1. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
2. Captain and deckhand will deploy Canadian Coast Guard approved life rafts.
3. As per Emergency Response Plan, Incident command (IC) will communicate with Deckhand by radio to determine any further details of events, number of injured or trapped people, risks to property and environment.
4. IC will respond to scene in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs based on initial assessment and

evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.

5. Incident Accountability will be established and adhered to throughout the operation.
6. IC will determine the need for rescue of people downstream. Option to deploy rescue ropes via launcher considered for KM 12.
7. Alternate access to river to be determined by nature of incident, KM 20 provides a second potential access. All other access would require trail cutting which is possible but would take more time.
8. IC, ERT Captain, and Environmental Lead (Unified Incident Command Support) will assess ongoing situation and need for additional or fewer resources.
9. Alternate man boat (see Appendix A for details on man boat) will be deployed from landing as needed to support rescue and/or to gain more information regarding location of sunken vessel and determine possible plan for retrieval/securing. Man boat operator will work under the direction of IC.
10. Once rescued, all patients will be treated as per OFA3/EMR protocols transported as per Yukon EMS dispatch confirmation aligned with Minto Emergency Response Plan.

3.2 Emergency Response to Loss of Power or Control of CQTB

The tug operates on two engines so total loss of power is not likely; however, is still possible and below is the emergency procedure that would be activated in the event that total loss or control of the CQTB was to occur.

11. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response. Captain will also communicate freight details and passenger numbers on board.
12. Passengers and crew will follow instructions from Captain and remaining on board if deemed safe. The Captain and deckhand will follow MED protocol in decision making in regards to passenger safety.
13. Captain and deckhand will deploy Canadian Coast Guard approved life rafts if deemed unsafe to stay on board by Captain.

14. IC will respond to scene or as close to it, in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs and downstream communication and reporting requirements based on initial assessment and evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.
15. Incident Accountability will be established and adhered to throughout the operation.
16. Captain will navigate to the best of his ability to the safest downstream location possible. Under the direction of the Captain the deckhand may deploy the anchor to assist in stopping the barge and tug.
17. Captain will communicate to IC location and details of condition of vessel and people and assist in determining plans for action.
18. Once vessel is secured to shore or where landed in river, Man boat will be deployed to assist with additional securing and remove non-essential people to location where they can be transferred back to site or alternate safe location.
19. If available and a benefit, Minto would exercise the use of the mutual aid agreement with JDS.
20. Plan for retrieval will be based appropriate to the conditions and location of vessel. Plan to be developed cooperatively through Barge Captain, Minto ECC and Mutual Aid resources. Equipment and additional resources will be sourced through ECC as per Minto Emergency Response Plan.

3.3 Emergency Response to Fire on the CQTB

21. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
22. If safe to do so, deckhand will attempt to suppress fire using equipment on board following Marine Emergency Duty (MED) protocol.

23. Captain and deckhand will deploy Canadian Coast Guard approved life rafts if vessel in immediate danger. If possible and practical the Captain will position barge so that wind is blowing port to starboard, to keep smoke/flames away from life raft.
24. If able to do so Barge will cross to West Bank of crossing and continue to use barge supplied fire suppression equipment. All passengers will disembark under direction of deckhand.
25. IC will respond to scene in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs based on initial assessment and evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.
26. Incident Accountability will be established and adhered to throughout the operation.
27. Once IC on scene and vessel safely secured, fire suppression will be conducted under the direction of the IC following NFPA 1081 standards. Industrial Fire Brigade.
28. Consideration of environmental sensitivity need to be considered by IC in cooperation with the Environmental Lead (unified incident command support).
29. Defensive spill containment methods to be utilized to control run off and releases from firefighting operations. This may include tactics such as extinguishing agent selection, damming and berming on barge, boom placement around vessel, removal of burning equipment once fire controlled, etc.

3.4 Emergency Response to Man Overboard

30. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
31. Captain and deckhand will throw out provided Canadian Coast Guard approved life-rings to all personnel overboard. The response from the barge crew will conducted as per their MED training.
32. If able to successfully rescue person overboard, deckhand will treat person based on marine first aid protocols awaiting response by ERT and site Medic.

33. If unable to successfully achieve rescue, vessel will continue to West landing and man boat deployed for downstream rescue. Communication to IC on Radio Channel 1 must be available at all times. Man boat operation will be conducted under the direction of IC once in place.
34. Captain will communicate to IC of possible downstream rescue requirement.
35. IC will instruct ERT to stage at KM 12 with option to deploy rescue ropes via launcher considered for KM 12.
36. Incident Accountability will be established and adhered to throughout the operation.
37. IC to stage ambulance for patient pick up.
38. IC will communicate the need for mutual aid to ECC who will follow the Minto ERP by contacting local agencies for assistance on East side of river.
39. Once rescued, all patients will be treated as per OFA3/EMR protocols transported as per Yukon EMS dispatch confirmation aligned with Minto Emergency Response Plan.

3.5 Emergency Response to Freight or Vehicle Overboard of the CQTB

40. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response. Captain will also communicate freight details and passenger numbers on board.
41. Passengers and crew will follow instructions from Captain (Captain will respond as per MED training) remaining on board if deemed safe.
42. Captain and deckhand will deploy Canadian Coast Guard approved life rafts if deemed unsafe to stay on board by Captain. If at landing passengers will be offloaded to safe location on shore.
43. IC will respond to scene or as close to it, in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs and downstream communication and reporting requirements based on initial assessment and evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.

44. Incident Accountability will be established and adhered to throughout the operation.
45. Captain will navigate to the best of his ability to the landing, preferably west landing.
46. Once vessel is secured to shore, man boat will be deployed by deckhand or ERT members to assist with additional securing of vessel and freight, and deployment of containment booms located at landing and on vessel. Man boat operation under the direction of IC once in place.
47. Plan for retrieval of freight will be determined appropriate to the condition and location of freight. Plan developed cooperatively through Barge Captain, Minto ECC and Mutual Aid resources.
48. Equipment and additional resources will be sourced through ECC as per Minto Emergency Response Plan including manpower, expertise, heavy equipment, etc.
49. Special considerations for support in the event of incident occurring on East side of river to include Yukon Emergency Measures Organization, local first responders and alternate equipment operations contractor.

3.6 Emergency Response to Medical Emergency on board CQTB

50. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
51. For serious injury as defined in the ERP, Yukon EMS will be notified immediately.
52. Deckhand will treat patient per Marine Emergency First Aid protocols.
53. Captain will navigate barge to west bank of Yukon River and all vehicles will offload on west bank, giving clear passage for Ambulance.
54. ERT response will include medic, ambulance, fire truck and compliment of team members to assist with patient transfer and packaging.
55. Incident Accountability will be established and adhered to throughout the operation.
56. Yukon EMS dispatch will be updated of situation once history and assessment confirmed.
57. Upon arrival, Minto Medic will take control of scene and advise ERT Captain of resources needed on scene.

58. Upon history and assessment, patient will be treated, packaged and transferred as per OFA3/ERM protocols transported as per Yukon EMS dispatch confirmation aligned with Minto Emergency Response Plan.

3.7 Emergency Response to a Spill

59. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
60. Deckhand will attempt to contain spill using on board spill kit, to prevent spill into Yukon River.
61. IC will respond to scene in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs, downstream communication, communication with CANUTEC and reporting requirements based on initial assessment and evaluation by IC will be communicated to the ECC as per Emergency Response Plan and Spill Contingency Plan.
62. Incident Accountability will be established and adhered to throughout the operation.
63. If practical the barge captain will navigate the barge to west landing.
64. All passengers will disembark vessel.
65. All vehicles and machinery that is not in the spill zone will disembark.
66. Deckhand and ERT members under the direction of IC will use the man boat to deploy containment booms around the barge.
67. IC with advice from the Environment Lead will develop and implement the SCP for stopping the spill if possible.
68. If the spill cannot be stopped a plan to mitigate the quantity of contaminant spilt to environment will be developed and implemented.
69. If safe and practical to do so Environment Lead will deploy environment staff to sample downstream of spill to measure contamination concentration.

70. IC with advice from the Environment Lead will oversee cleanup of the spill.

71. Special considerations for support in the event of incident occurring on East side of river to access the barge with ERT by man boat.

4 Minto Mine Training

The barge crew were trained and certified in Marine Emergency Duties (MED) A1 and A2 in 2012. The MED course meets the standards of training, certification and watch-keeping, and is run by Transport Canada. The A1 MED course covers basic safety with a focus on hazards and emergencies awareness, firefighting, emergency response, lifesaving appliances and abandonment, survival and rescue. The A2 MED course covers small passenger-carrying vessel safety with the same focus as A1 with the addition of maintenance and inspection of emergency equipment and passenger control. As well the barge crew is trained in Marine First Aid.

The ERT team has been trained to National Fire Protection Association (NFPA) 472 Hazardous Materials awareness level for responders. In 2014, Minto conducted a table top and field exercise in regards to Yukon River response. The table top and field exercise was held in conjunction with ERT, barge crew, environment department, management, major contractors, the Yukon Spill Hotline, CANUTEC, Transnorth Helicopters, WCB, Parkland Fuel, and Quantum Murray. A post-incident debrief revealed both opportunities and successes at the field operations and management level.

Appendix A: Man Boat Specifications



- Brand/Model: Munson Packman Landing Craft
- Hull Length: 24 feet (7.3 meters)
- Beam: 8 feet 6 inches (2.6 meters)
- Hull Type: Packman mono hull
- Power: Twin Yamaha 150hp
- Propulsion: Outboard (25" shaft)
- Outfitting: 52" bow door

Appendix B: Safe Work Procedure for Loading and Unloading the Barge.



Capstone Minto Safe Work Practice

Barge Loading and Offloading



Purpose: To ensure the safe practice of loading and offloading the barge at the Yukon River. To educate workers on the hazards of loading and offloading the barge, and working on landings.

Scope: This Safe Work Practice pertains to the Captain and the crew of the Minto Mine property who are exposed to operating the barge for transport across river.

Definitions:

Certified Flotation Device – Personal Flotation Devices marked "Approved by Department of Transport Canada" or "Approved by Canadian Coast Guard, Department of Fisheries and Oceans"

Hypothermia - A potentially fatal condition that occurs when the body core temperature falls below 95°F (35°C). This can occur quickly when immersed in cold water.

Responsibilities

Employer / Supervisor Responsibilities

- Make sure appropriate training and assistance are provided to crew.
- Make sure appropriate rescue devices such as a life hook and flotation devices are available to workers

Safety Department Responsibilities

- Ensure this SWP is in alignment with the Yukon Health and Safety Act and Regulations

Worker Responsibilities

- Read, understand, and follow this safe work practice
- If unsure then stop work and ask for assistance
- Wear appropriate PPE defined to their work area.
- Provide training for proper use of PFD to passengers

Reference to Legislative and Site Requirements

- Yukon Occupational Health and Safety Regulations – Part 1 – section 1.34 – Each worker shall be provided with and be required to use an appropriate personal flotation device with the required buoyancy where a worker is employed in a situation where there is a risk of drowning

Safe Work Practice:

The captain and crew will give direction in regards to the following.

1. Landings.

- 1.1. Assess landing and vehicles to be loaded and unloaded. The use of wooden ramps may be needed. (For more information reference safe work practice for wooden ramps.)
- 1.2. Use gauge on apron ram to determine the need for landing to be rebuilt. This gauge is located on the ram closest to deckhand shed and has a max angle marked on the gauge. If the apron should go past the marked max angle stop and fix landing. (For more information reference safe work practice for landing maintenance and apron angle.)

2. Transportation.

- 2.1. Due to landing and vehicle loads ask driver to back on or drive on. This may be determined by many factors, such as:
 - Angle and length of landing
 - Apron angle and how it contacts the landing
 - Underwater debris
 - Drivers skill
 - Extra low trailers
 - Frozen or icy landings
 - Load weights
- 2.2. Deckhand must communicate with captain any concerns about previously mention conditions. It is ultimately the captains' decision on how the barge is loaded.

3. Priority Boarding

- 3.1. Emergency vehicles on medical runs are given the top priority. Compassionate reasons or special circumstances are considered when loading vehicle traffic. The bus will also be given high priority

along with con trucks. Loading priority will be determined by the Captain or the Supervisor.

- 3.2.** Priority may change from day to day and we ask that drivers cooperate and be patient. Ultimately the captain will make the decision based on information available at the time.

4. Communication.

- 4.1.** Drivers are given a handout of standard hand signals as endorsed by WCB and a signature logbook is maintained to who has received the handout and when.
- 4.2.** The deckhand is in charge of directing and communicating with all traffic. Radios, hand signals, face to face communication are all used. An air horn is used as warning to stop the drivers quickly.

5. Hazards.

- 5.1.** Working at or near water has its inherent risks. A JHA should be conducted for any new or unusual work being conducted on or near the water. Some hazards to be aware of are:

- Exposure to the environmental elements of the season
- Slips, trips and falls on uneven ground
- Slipping on slippery rocks and surfaces
- Eroding shore line sloughing or slipping on ice along shoreline
- Falling into cold water
- Ice flows and ice jams
- Swift current
- Drowning
- Hypothermia
- Wildlife
- Slippery deck

6. Emergency Equipment.



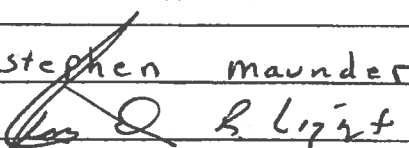
- 6.1.** Life ring with rope and pole must be available on the barge. An emergency response container complete with first aid kit, oxygen therapy unit, spare dry coveralls and several blankets is located on the tug. This container is used to reduce the effects of hypothermia until emergency response arrives.

- 6.2. As the river is 27kms from the mine site emergency response will take at least 40 minutes to arrive at the scene. Deckhands should have marine first aid training and clear knowledge of where all safety equipment is and its condition.
- 6.3. Honda pump & fire hose along with fire extinguishers are also in place. Deckhands should be well train in this area and will instruct people as needed on what to do in case of an emergency.

7. Training.

- 7.1. All workers must be trained and competent to operate or run any equipment that pertains to their job.
- 7.2. At least one worker must have a valid marine first aid ticket in the event of an emergency due to the location of this worksite and the anticipated delay on response time by ERT.

SWP Development and Approval

| | Print: <u>Developed/ Revised by:</u> | DD/MM/YYYY |
|-----------------------|---|-------------------|
| Worker: | | Date: |
| Worker: | | Date: |
| JOHSC Representative: | Siana mills | Date:24/08/2012 |
| Supervisor: | Stephen Maunder | Date:26/08/2012 |
| Supervisor: | Captain Dave Johnstone | Date: :26/08/2012 |
| Supervisor: | Jeff Billings | Date: :26/08/2012 |
| Supervisor: | | Date: |
| JOHSC Representative: | | Date: |
| Senior Supervisor: | | Date: |
| Senior Supervisor: | | Date: |
| Departmental Manager: | | Date: |
| | Print & Sign: <u>Reviewed By:</u> | |
| Safety Department: | MARK GOEBEL  | |
| Safety Department: |  | Date: Sept 19/12 |
| | Print & Sign: <u>Approved By:</u> Determined by Safety Dept. Enter NA if not applicable. | Date: |
| Departmental Manager: | stephen maunder | Date: 19/09/12 |
| General Manager: |  | Date: 9.20.2012 |

Clarification of this safe work practice can be directed to the Safety Department.

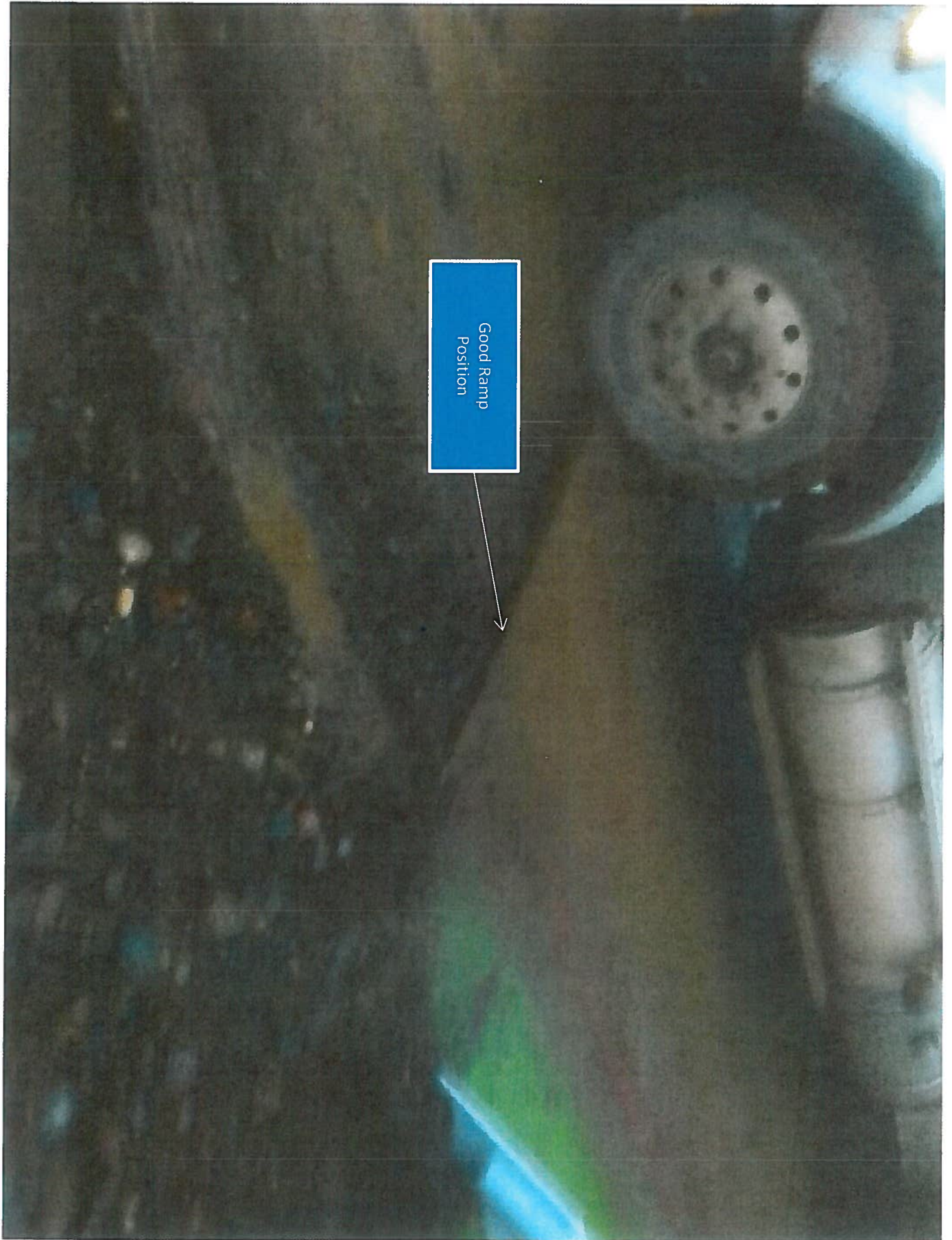
Name of SWP:

Location: X:\Health & Safety\Safety Public\Procedures and Safe Work Procedures

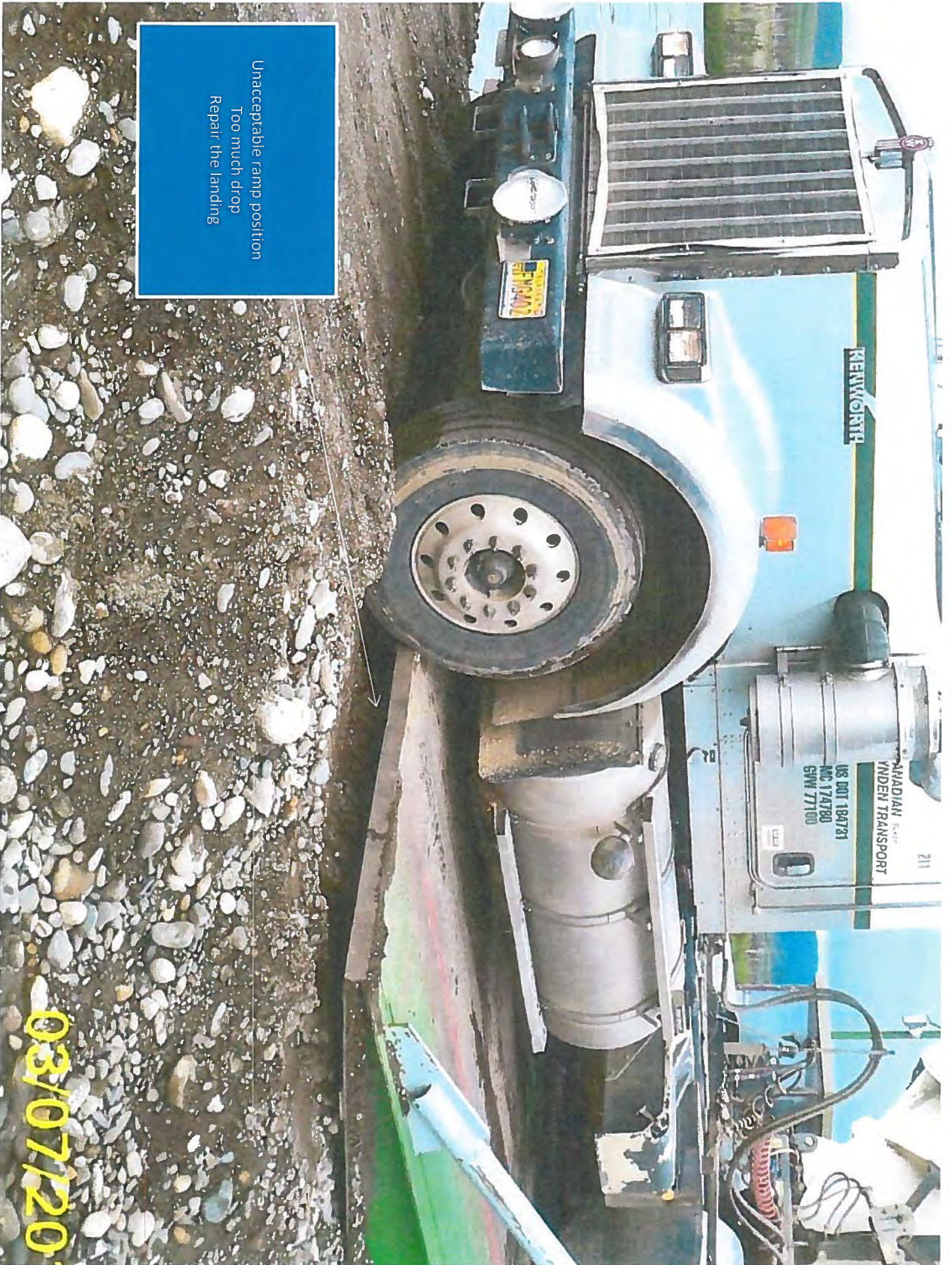
Last revision date: April 21 2012



Ideal Ramp Position for Loading



Good Ramp
Position



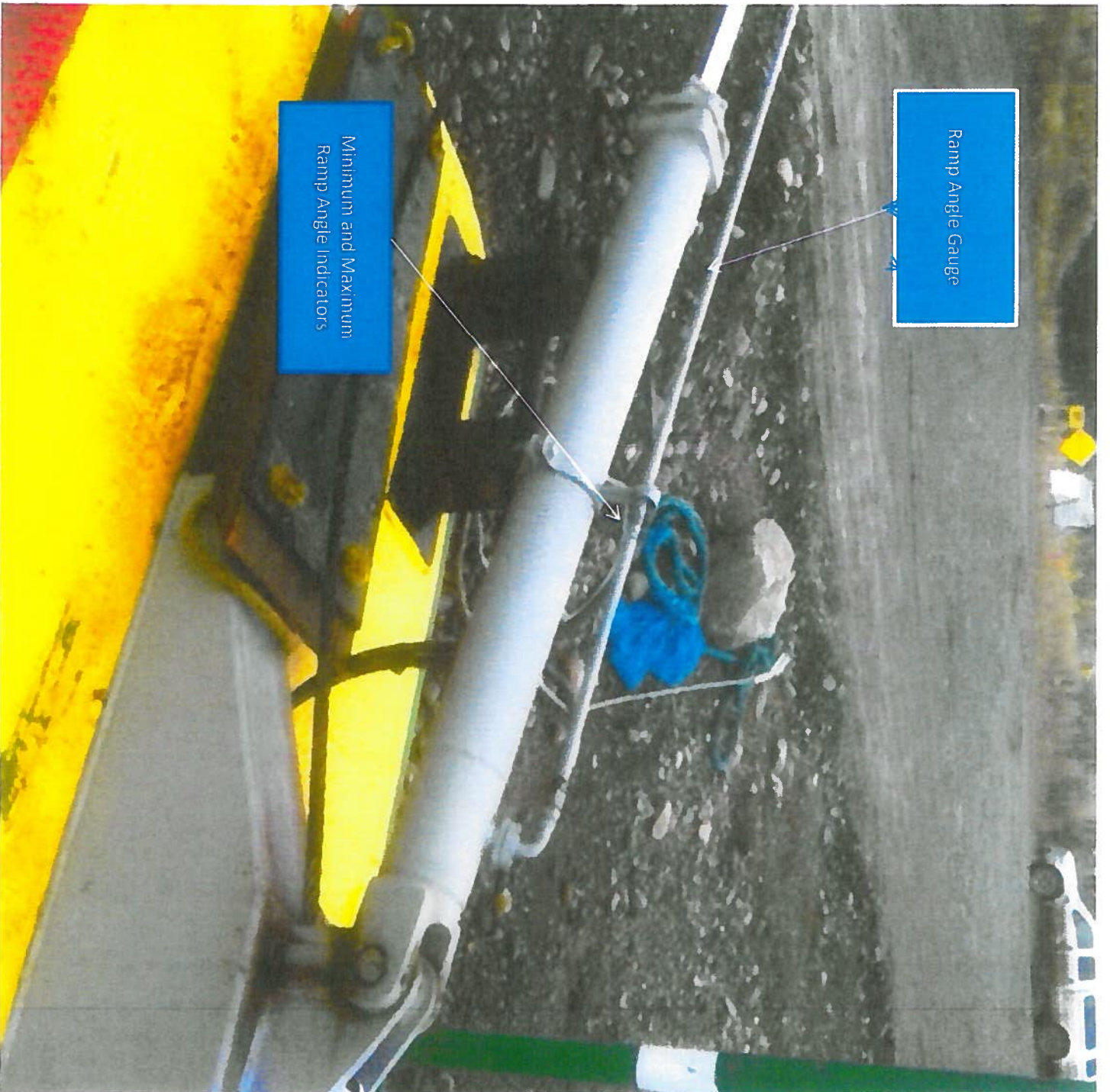
Unacceptable ramp position
Too much drop
Repair the landing

KENWORTH

211
ANADIAN
YNDEN TRANSPORT

US DOT 184731
MC 174780
SWM 77100

03107120



Ramp Angle Gauge

Minimum and Maximum Ramp Angle Indicators



Ramp Angle Gauge

Minimum and Maximum Ramp Angle Indicators

Appendix C – Groundwater Quality Monitoring Program Laboratory Results



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 04-JAN-18
Report Date: 16-JAN-18 17:50 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2041421
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2018-01-03 C
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | | | | | |
|--------------------------------------|---|---|---|---|---|------------------------|
| | L2041421-1 Water 31-DEC-17 11:15 MW12-06-01 | L2041421-2 Water 31-DEC-17 11:50 MW12-06-02 | L2041421-3 Water 31-DEC-17 13:30 MW12-06-03 | L2041421-4 Water 31-DEC-17 13:50 MW12-06-04 | L2041421-5 Water 31-DEC-17 14:15 MW12-06-05 | |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 702 | 955 | 970 | 966 | 966 |
| | Hardness (as CaCO3) (mg/L) | 290 | 518 | 533 | 530 | 529 |
| | pH (pH) | 7.81 | 7.70 | 7.90 | 7.93 | 7.92 |
| | Total Suspended Solids (mg/L) | 4.7 | 30.1 | 6.7 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | 406 | 664 | 671 | 651 | 635 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 389 | 356 | 379 | 400 | 400 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 389 | 356 | 379 | 400 | 400 |
| | Ammonia, Total (as N) (mg/L) | 0.0108 | 0.0252 | 0.0150 | 0.0062 | 0.0061 |
| | Bromide (Br) (mg/L) | <0.050 | <0.25 ^{DLDS} | <0.25 ^{DLDS} | <0.25 ^{DLDS} | <0.25 ^{DLDS} |
| | Chloride (Cl) (mg/L) | 5.40 | <2.5 ^{DLDS} | <2.5 ^{DLDS} | <2.5 ^{DLDS} | <2.5 ^{DLDS} |
| | Nitrate and Nitrite (as N) (mg/L) | 0.133 | 0.158 | 0.391 | 0.052 | 0.069 |
| | Nitrate (as N) (mg/L) | 0.0348 | 0.033 | 0.077 | <0.025 ^{DLDS} | <0.025 ^{DLDS} |
| | Nitrite (as N) (mg/L) | 0.0981 | 0.125 | 0.314 | 0.0522 | 0.0688 |
| | Sulfate (SO4) (mg/L) | 1.14 | 222 | 221 | 197 | 182 |
| | Anion Sum (meq/L) | 7.96 | 11.7 | 12.2 | 12.1 | 11.8 |
| | Cation Sum (meq/L) | 8.43 | 12.3 | 12.5 | 12.4 | 12.4 |
| | Cation - Anion Balance (%) | 2.9 | 2.3 | 1.1 | 1.1 | 2.5 |
| | Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | | 0.0157 | 0.0013 | 0.0019 | 0.0024 | 0.0011 |
| Antimony (Sb)-Dissolved (mg/L) | | 0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Arsenic (As)-Dissolved (mg/L) | | 0.00663 | 0.00380 | 0.00056 | 0.00242 | 0.00074 |
| Barium (Ba)-Dissolved (mg/L) | | 0.212 | 0.0249 | 0.0252 | 0.0174 | 0.0418 |
| Beryllium (Be)-Dissolved (mg/L) | | 0.000100 | 0.000052 | 0.000026 | 0.000028 | <0.000020 |
| Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Dissolved (mg/L) | | 0.144 | 0.084 | 0.071 | 0.059 | 0.058 |
| Cadmium (Cd)-Dissolved (mg/L) | | 0.0000104 | 0.0000076 | <0.0000050 | 0.0000067 | 0.0000112 |
| Calcium (Ca)-Dissolved (mg/L) | | 84.6 | 144 | 120 | 112 | 105 |
| Chromium (Cr)-Dissolved (mg/L) | | 0.00402 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00151 |
| Copper (Cu)-Dissolved (mg/L) | | 0.00068 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Iron (Fe)-Dissolved (mg/L) | | 0.273 | 1.18 | 1.39 | 0.774 | 0.016 |
| Lead (Pb)-Dissolved (mg/L) | | 0.000051 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved (mg/L) | | 0.0091 | 0.0084 | 0.0077 | 0.0065 | 0.0061 |
| Magnesium (Mg)-Dissolved (mg/L) | 19.1 | 38.5 | 56.7 | 61.0 | 65.0 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2041421-6 | L2041421-7 | | |
|--------------------------------------|---|---------------------------------------|-----------------------|------------------------|-------|--|
| | | Description | Water | Water | | |
| | | Sampled Date | 31-DEC-17 | 31-DEC-17 | | |
| | | Sampled Time | 14:45 | | | |
| | | Client ID | MW12-06-06 | DUP | | |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 817 | 961 | | |
| | Hardness (as CaCO3) (mg/L) | | 423 | 520 | | |
| | pH (pH) | | 7.98 | 7.96 | | |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | | |
| | TDS (Calculated) (mg/L) | | 527 | 640 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 314 | 398 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 314 | 398 | | |
| | Ammonia, Total (as N) (mg/L) | | <0.0050 | <0.0050 | | |
| | Bromide (Br) (mg/L) | | <0.25 ^{DLDS} | <0.25 ^{DLDS} | | |
| | Chloride (Cl) (mg/L) | | 6.8 | <2.5 ^{DLDS} | | |
| | Nitrate and Nitrite (as N) (mg/L) | | 1.10 | 0.025 | | |
| | Nitrate (as N) (mg/L) | | 1.02 | <0.025 ^{DLDS} | | |
| | Nitrite (as N) (mg/L) | | 0.0773 | 0.0252 | | |
| | Sulfate (SO4) (mg/L) | | 155 | 190 | | |
| | Anion Sum (meq/L) | | 9.78 | 11.9 | | |
| | Cation Sum (meq/L) | | 9.99 | 12.1 | | |
| | Cation - Anion Balance (%) | | 1.0 | 0.7 | | |
| | Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | |
| Dissolved Metals Filtration Location | | | FIELD | FIELD | | |
| Aluminum (Al)-Dissolved (mg/L) | | | <0.0010 | <0.0010 | | |
| Antimony (Sb)-Dissolved (mg/L) | | | <0.00010 | <0.00010 | | |
| Arsenic (As)-Dissolved (mg/L) | | | <0.00010 | 0.00070 | | |
| Barium (Ba)-Dissolved (mg/L) | | | 0.0148 | 0.0431 | | |
| Beryllium (Be)-Dissolved (mg/L) | | | <0.000020 | <0.000020 | | |
| Bismuth (Bi)-Dissolved (mg/L) | | | <0.000050 | <0.000050 | | |
| Boron (B)-Dissolved (mg/L) | | | 0.054 | 0.060 | | |
| Cadmium (Cd)-Dissolved (mg/L) | | | 0.0000104 | 0.0000095 | | |
| Calcium (Ca)-Dissolved (mg/L) | | | 82.8 | 109 | | |
| Chromium (Cr)-Dissolved (mg/L) | | | <0.00010 | <0.00010 | | |
| Cobalt (Co)-Dissolved (mg/L) | | | <0.00010 | 0.00119 | | |
| Copper (Cu)-Dissolved (mg/L) | | | 0.00025 | <0.00020 | | |
| Iron (Fe)-Dissolved (mg/L) | | | <0.010 | 0.152 | | |
| Lead (Pb)-Dissolved (mg/L) | | | <0.000050 | <0.000050 | | |
| Lithium (Li)-Dissolved (mg/L) | | | 0.0047 | 0.0063 | | |
| Magnesium (Mg)-Dissolved (mg/L) | | | 52.6 | 59.9 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2041421-1 | L2041421-2 | L2041421-3 | L2041421-4 | L2041421-5 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 31-DEC-17 | 31-DEC-17 | 31-DEC-17 | 31-DEC-17 | 31-DEC-17 |
| | | Sampled Time | 11:15 | 11:50 | 13:30 | 13:50 | 14:15 |
| | | Client ID | MW12-06-01 | MW12-06-02 | MW12-06-03 | MW12-06-04 | MW12-06-05 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | 0.0802 | 0.0267 | 0.0158 | 0.0444 | 0.396 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.000996 | 0.00784 | 0.00400 | 0.00906 | 0.00993 |
| | Nickel (Ni)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00069 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 2.73 | 3.85 | 4.24 | 3.96 | 4.33 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000622 | 0.000057 | <0.000050 | <0.000050 | <0.000050 |
| | Silicon (Si)-Dissolved (mg/L) | | 7.93 | 10.9 | 9.96 | 9.18 | 8.97 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 58.6 | 41.0 | 38.1 | 37.2 | 39.0 |
| | Strontium (Sr)-Dissolved (mg/L) | | 3.51 | 10.7 | 4.93 | 3.16 | 2.55 |
| | Sulfur (S)-Dissolved (mg/L) | | 5.06 | 76.3 | 77.1 | 67.6 | 66.6 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00015 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | 0.00293 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000699 | 0.00242 | 0.00269 | 0.00601 | 0.00417 |
| | Vanadium (V)-Dissolved (mg/L) | | 0.0146 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0037 | 0.0058 | 0.0096 | 0.0114 | 0.0236 |
| | Zirconium (Zr)-Dissolved (mg/L) | | 0.00122 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2041421-6 | L2041421-7 | | |
|-------------------------|----------------------------------|--------------|------------|------------|--|--|
| | | Description | Water | Water | | |
| | | Sampled Date | 31-DEC-17 | 31-DEC-17 | | |
| | | Sampled Time | 14:45 | | | |
| | | Client ID | MW12-06-06 | DUP | | |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | 0.0373 | 0.366 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00607 | 0.00948 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | 0.00059 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 3.74 | 3.96 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000280 | <0.000050 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 7.32 | 8.92 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 33.0 | 36.4 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 1.62 | 2.90 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 57.4 | 67.8 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00430 | 0.00613 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0356 | 0.0134 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|------------------------------------|
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2041421-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2041421-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2041421-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2041421-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2041421-1, -2, -3, -4, -5, -6, -7 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |

Reference Information

| | | | |
|--|-------|---------------------------------------|---------------------------|
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2018-01-03 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.


Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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| | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|-------------------------|--|--------------------|-------------------------------------|-----------------------|-------------------------|--|---------------------------|--------------------------------|--|--------------------------|--|------------|--|--|--|--|--|----------------------|---|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | | | | | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | Location: | | | | | | | | | | | | | | | | | | | |
| LSD: | | ALS Contact: | | Sampler: | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals (TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, Alkalinity, Anions | Dissolved Bromide (Br-D) | | | | | | | | Number of Containers | |
| | MW12-06-01 | | | 31-Dec-17 | 11:15 | Water | | R | | R | R | | R | R | | | | | | | | | 4 |
| | MW12-06-02 | | | 31-Dec-17 | 11:50 | Water | | R | | R | R | | R | R | | | | | | | | | 4 |
| | MW12-06-03 | | | 31-Dec-17 | 13:30 | Water | | R | | R | R | | R | R | | | | | | | | | 4 |
| | MW12-06-04 | | | 31-Dec-17 | 13:50 | Water | | R | | R | R | | R | R | | | | | | | | | 4 |
| | MW12-06-05 | | | 31-Dec-17 | 14:15 | Water | | R | | R | R | | R | R | | | | | | | | | 4 |
| | MW12-06-06 | | | 31-Dec-17 | 14:45 | Water | | R | | R | R | | R | R | | | | | | | | | 4 |
| | DUP | | | 31-Dec-17 | | Water | | R | | R | R | | R | R | | | | | | | | | 4 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C: 10C. FINAL COOLER TEMPERATURES °C: 5 6 | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2018-01-03 | | Time: 11:00 | Received by:  | | Date: JAN 4 18 | | Time: 10:45 | Received by: SC | | | Date: JAN - 5 2018 | | | Time: 1325 | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 PRGNT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 12-DEC-17
Report Date: 29-DEC-17 17:14 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2034344
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-12-12 B
Legal Site Desc:

Comments:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2034344-1 | Water | 09-DEC-17 | 11:15 | MW17-DP03 |
|-----------------------------|--|---------------------------------|-------|-----------|-------|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 1140 | | | | |
| | Hardness (as CaCO3) (mg/L) | 408 | | | | |
| | pH (pH) | 8.20 | | | | |
| | Total Suspended Solids (mg/L) | <3.0 | | | | |
| | TDS (Calculated) (mg/L) | 812 | | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 210 | | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 210 | | | | |
| | Ammonia, Total (as N) (mg/L) | 4.70 | | | | |
| | Bromide (Br) (mg/L) | <0.25 ^{DLDS} | | | | |
| | Chloride (Cl) (mg/L) | 13.6 | | | | |
| | Nitrate and Nitrite (as N) (mg/L) | <0.025 ^{DLDS} | | | | |
| | Nitrate (as N) (mg/L) | <0.025 ^{DLDS} | | | | |
| | Nitrite (as N) (mg/L) | <0.0050 ^{DLDS} | | | | |
| | Sulfate (SO4) (mg/L) | 403 | | | | |
| | Anion Sum (meq/L) | 13.0 | | | | |
| | Cation Sum (meq/L) | 13.2 | | | | |
| | Cation - Anion Balance (%) | 0.9 | | | | |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 2.48 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0287 | | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | | | | |
| | Arsenic (As)-Total (mg/L) | 0.00063 | | | | |
| | Barium (Ba)-Total (mg/L) | 0.0254 | | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | | | | |
| | Boron (B)-Total (mg/L) | 0.105 | | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.000407 | | | | |
| | Calcium (Ca)-Total (mg/L) | 97.8 | | | | |
| | Chromium (Cr)-Total (mg/L) | <0.00010 | | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00105 | | | | |
| | Copper (Cu)-Total (mg/L) | 0.0543 | | | | |
| | Iron (Fe)-Total (mg/L) | 0.057 | | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | | | | |
| | Lithium (Li)-Total (mg/L) | 0.0082 | | | | |
| | Magnesium (Mg)-Total (mg/L) | 33.1 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2034344-1 | | | |
|-------------------------|--|------------------------|-----------|-------|-----------|
| | | Water | 09-DEC-17 | 11:15 | MW17-DP03 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Manganese (Mn)-Total (mg/L) | 0.826 | | | |
| | Mercury (Hg)-Total (mg/L) | <0.0000050 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.0384 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00370 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | | | |
| | Potassium (K)-Total (mg/L) | 36.6 | | | |
| | Selenium (Se)-Total (mg/L) | 0.00117 | | | |
| | Silicon (Si)-Total (mg/L) | 3.92 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 70.9 | | | |
| | Strontium (Sr)-Total (mg/L) | 9.78 | | | |
| | Sulfur (S)-Total (mg/L) | 136 | | | |
| | Thallium (Tl)-Total (mg/L) | 0.000022 | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | <0.0015 ^{DLM} | | | |
| | Uranium (U)-Total (mg/L) | 0.00222 | | | |
| | Vanadium (V)-Total (mg/L) | <0.00050 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0018 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00067 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0274 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.096 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000424 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 99.4 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00102 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0519 | | | |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0073 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 38.9 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2034344-1 | Water | 09-DEC-17 | 11:15 | MW17-DP03 |
|-------------------------|--|------------|-------|-----------|-------|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | 0.942 | | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0383 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00368 | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | | | | |
| | Potassium (K)-Dissolved (mg/L) | 43.2 | | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00139 | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 3.80 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 81.8 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 10.5 | | | | |
| | Sulfur (S)-Dissolved (mg/L) | 134 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | 0.000018 | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00206 | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0015 | | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|------------------------------|-----------|-----------------------------|
| Method Blank | Alkalinity, Total (as CaCO3) | B | L2034344-1 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2034344-1 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2034344-1 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2034344-1 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2034344-1 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L2034344-1 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2034344-1 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2034344-1 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L2034344-1 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L2034344-1 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2034344-1 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2034344-1 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L2034344-1 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2034344-1 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2034344-1 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2034344-1 |
| Matrix Spike | Boron (B)-Total | MS-B | L2034344-1 |
| Matrix Spike | Cadmium (Cd)-Total | MS-B | L2034344-1 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2034344-1 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2034344-1 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2034344-1 |
| Matrix Spike | Copper (Cu)-Total | MS-B | L2034344-1 |
| Matrix Spike | Copper (Cu)-Total | MS-B | L2034344-1 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2034344-1 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2034344-1 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2034344-1 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2034344-1 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2034344-1 |
| Matrix Spike | Molybdenum (Mo)-Total | MS-B | L2034344-1 |
| Matrix Spike | Potassium (K)-Total | MS-B | L2034344-1 |
| Matrix Spike | Potassium (K)-Total | MS-B | L2034344-1 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2034344-1 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2034344-1 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2034344-1 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2034344-1 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2034344-1 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2034344-1 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L2034344-1 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L2034344-1 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L2034344-1 |
| Matrix Spike | Nitrate (as N) | MS-B | L2034344-1 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2034344-1 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| B | Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable. |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|------------------|--------------------|
|---------------|--------|------------------|--------------------|

Reference Information

| | | | |
|---|-------|--|---|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et | | | |

Reference Information

al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
 This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
 This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
 The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
 This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-12-12 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Statement of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2034344-COFC

COC Number: 2017-12-12 B

Page of

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|--|---|--|------------------|--|---|-------------------------------------|-------------------------|--|---------------------------|--|---|-------------------------|------------------------|--------------------|-------|---|---|---|---|----------------------|---|---|---|---|--|--|--|--|---|
| Report To Contact and companyname below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | P | F/P | P | F/P | P | F/P | | | | | | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | Total Metals(TM) | Disolved Metals (DM) | Total Mercury, Hardness | Disolved Mercury | Ammonia (Total Nutrients) | Disolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | Disolved Bromide (Br-D) | | | | | | | | Number of Containers | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | | | | | | | | | | Sampler: | | SR/CP | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | | | | | | | | | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | |
| | MW17-DP03 | | | 9-Dec-17 | | | | | | | | | 11:15 | Water | | R | R | R | R | | R | R | R | R | | | | | 7 |
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| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | | |
| | | | | | 3.0 | | | | | 3 | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | |
| Released by: Shaun Roberts | Date: 2017-12-12 | Time: 11:00 | Received by: LHF | Date: 12 Dec 2017 | Time: 15:40 | Received by: Cade | Date: Dec 13 | Time: 1315 | | | | | | | | | | | | | | | | | | | | | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 11-DEC-17
Report Date: 20-DEC-17 17:44 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2033487
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-12-08 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2033487-1 Water 07-DEC-17 15:00 MW09-03-01 | L2033487-2 Water 07-DEC-17 15:30 MW09-03-02 | L2033487-3 Water 07-DEC-17 DUP1 | L2033487-4 Water 07-DEC-17 DUP2 | |
|---|---|---|--|--|-----------|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 303 | 377 | | |
| | Hardness (as CaCO3) (mg/L) | 151 | 198 | | 201 |
| | pH (pH) | 8.22 | 8.24 | | |
| | Total Suspended Solids (mg/L) | 4.0 | 3.4 | | |
| | TDS (Calculated) (mg/L) | 175 | 225 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 148 | 197 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 148 | 197 | | |
| | Ammonia, Total (as N) (mg/L) | 0.0360 | <0.0050 | 0.0356 | |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | | |
| | Chloride (Cl) (mg/L) | <0.50 | 0.66 | | |
| | Fluoride (F) (mg/L) | 1.70 | 0.350 | | |
| | Nitrate (as N) (mg/L) | 0.0231 | 3.72 | | |
| | Nitrite (as N) (mg/L) | 0.151 | 0.136 | | |
| | Sulfate (SO4) (mg/L) | 19.7 | 6.97 | | |
| | Anion Sum (meq/L) | 3.46 | 4.39 | | |
| | Cation Sum (meq/L) | 3.45 | 4.27 | | |
| | Cation - Anion Balance (%) | -0.1 | -1.5 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0029 | <0.0010 | | <0.0010 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00012 | 0.00012 | | 0.00015 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00075 | <0.00010 | | <0.00010 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0643 | 0.0219 | | 0.0200 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.165 | 0.146 | | 0.170 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000167 | | 0.0000125 |
| | Calcium (Ca)-Dissolved (mg/L) | 41.8 | 66.1 | | 67.4 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | <0.00020 | 0.00266 | | 0.00260 |
| | Iron (Fe)-Dissolved (mg/L) | 0.340 | <0.010 | | <0.010 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0037 | 0.0011 | | 0.0012 |
| | Magnesium (Mg)-Dissolved (mg/L) | 11.2 | 7.96 | | 7.90 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2033487-1 | L2033487-2 | L2033487-3 | L2033487-4 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 07-DEC-17 | 07-DEC-17 | 07-DEC-17 | 07-DEC-17 |
| | | Sampled Time | 15:00 | 15:30 | | |
| | | Client ID | MW09-03-01 | MW09-03-02 | DUP1 | DUP2 |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | 0.0802 | 0.00208 | | 0.00134 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00442 | 0.00345 | | 0.00357 |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00073 | <0.00050 | | <0.00050 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 2.04 | 2.61 | | 2.50 |
| | Selenium (Se)-Dissolved (mg/L) | | <0.000050 | 0.000209 | | 0.000248 |
| | Silicon (Si)-Dissolved (mg/L) | | 5.33 | 5.35 | | 5.46 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 8.51 | 5.64 | | 5.76 |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.944 | 0.384 | | 0.388 |
| | Sulfur (S)-Dissolved (mg/L) | | 5.98 | 2.22 | | 2.09 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000876 | 0.00327 | | 0.00334 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0103 | 0.0195 | | 0.0185 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2033487-1, -2, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2033487-1, -2, -4 |
| Matrix Spike | Iron (Fe)-Dissolved | MS-B | L2033487-1, -2, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2033487-1, -2, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2033487-1, -2, -4 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L2033487-1, -2, -4 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L2033487-1, -2, -4 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2033487-1, -2, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2033487-1, -2, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| F-IC-N-VA | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |

Reference Information

| | | | |
|---|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-12-08 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

of Custody (COC) / Analytical
Form



L2033487-COFC

COC Number: 2017-12-08 B

Page of

800 668 9878

| Report Format / Distribution | | | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | |
|--|---|------------------|--------------------------|-----------------|--|-------------------------------------|-------------------------|-------------------|--|---|---|--------------------------|--|--|--|---|--|--|
| Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | |
| Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | |
| <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | 3 day [P3] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | |
| Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | |
| Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | |
| For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | |
| Invoice Distribution | | | | | Analysis Request | | | | | | | | | | | | | |
| Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | |
| Email 1 or Fax ap@mintomine.com | | | | | P | F/P | P | F/P | P | F/P | | | | | | | | |
| Email 2 | | | | | | | | | | | | | | | | | | |
| Email 3 | | | | | | | | | | | | | | | | | | |
| Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | |
| AFE/Cost Center: PO# | | | | | Total Metals(TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | Dissolved Bromide (Br-D) | | | | | | |
| Major/Minor Code: Routing Code: | | | | | | | | | | | | | | | | | | |
| Requisitioner: | | | | | | | | | | | | | | | | | | |
| Location: | | | | | | | | | | | | | | | | | | |
| ALS Contact: Sampler: SR/CP | | | | | Number of Containers | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | |
| | MW09-03-01 | 7-Dec-17 | 15:00 | Water | | R | | R | R | | R | R | | | | 4 | | |
| | MW09-03-01 | 7-Dec-17 | 15:30 | Water | | R | | R | R | | R | R | | | | 4 | | |
| | DUP1 | 7-Dec-17 | | Water | | | | | R | | | | | | | 1 | | |
| | DUP2 | 7-Dec-17 | | Water | | R | | | | | | | | | | 1 | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| SHIPPING INFORMATION | | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | |
| SHIPPING RELEASE (client use) | | | | | FROZEN <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | |
| SHIPPING RELEASE (client use) | | | | | 1°C | | | | | 12°C | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | |
| Released by: Shaun Roberts | Date: 2017-12-08 | Time: 12:00 | Received by: [Signature] | Date: Dec 11/17 | Time: 09:35 | Received by: [Signature] | Date: Dec 12/17 | Time: 12:00 | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 FAILURE TO COMPLETE ALL PORTIONS OF THIS FORM MAY DELAY ANALYSIS. PLEASE FILL IN THIS FORM LEGIBLY. BY THE USE OF THIS FORM THE USER ACKNOWLEDGES AND AGREES WITH THE TERMS AND CONDITIONS AS SPECIFIED ON THE BACKPAGE OF THE WHITE - REPORT COPY
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.
 WHITE - LABORATORY COPY YELLOW - CLIENT COPY
 OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 21-NOV-17
Report Date: 28-NOV-17 14:16 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2025311
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-11-21 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2025311-1 Water 20-NOV-17 11:30 MW17-08-01 | L2025311-2 Water 20-NOV-17 13:30 MW17-08-02 | L2025311-3 Water 20-NOV-17 13:45 MW17-08-03 | L2025311-4 Water 20-NOV-17 14:00 MW17-08-04 | L2025311-5 Water 20-NOV-17 15:55 MW17-10-01 | |
|---|---|---|---|---|---|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 472 | 293 | 279 | | 367 |
| | Hardness (as CaCO3) (mg/L) | 274 | 195 | 158 | 88.8 | 196 |
| | pH (pH) | 8.15 | 8.13 | 8.16 | | 8.10 |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | <3.0 | | 6.7 |
| | TDS (Calculated) (mg/L) | 281 | 180 | 160 | | 233 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 230 | 154 | 151 | | 120 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 230 | 154 | 151 | | 120 |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | <0.0050 | <0.0050 | | 0.0275 |
| | Bromide (Br) (mg/L) | 0.149 | <0.050 | <0.050 | | 4.21 |
| | Chloride (Cl) (mg/L) | 0.52 | 0.41 | 0.43 | | 2.44 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.378 | 0.684 | 0.851 | | 3.14 |
| | Nitrate (as N) (mg/L) | 0.365 | 0.684 | 0.851 | | 3.10 |
| | Nitrite (as N) (mg/L) | 0.0136 | <0.0010 | <0.0010 | | 0.0484 |
| | Sulfate (SO4) (mg/L) | 43.1 | 11.7 | 5.7 | | 61.9 |
| | Anion Sum (meq/L) | 5.55 | 3.40 | 3.23 | | 4.03 |
| | Cation Sum (meq/L) | 5.84 | 4.16 | 3.35 | | 4.49 |
| | Cation - Anion Balance (%) | 2.5 | 10.1 | 1.9 | | 5.4 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0014 | 0.0027 | 0.0036 | 0.0038 | 0.0084 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00051 | 0.00017 | 0.00013 | 0.00036 | 0.00042 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00026 | 0.00033 | 0.00023 | 0.00028 | 0.00064 |
| | Barium (Ba)-Dissolved (mg/L) | 0.00978 | 0.105 | 0.0959 | 0.0278 | 0.0290 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.028 | 0.013 | <0.010 | <0.010 | 0.015 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000635 | 0.0000258 | 0.0000131 | 0.0000910 | 0.0000884 |
| | Calcium (Ca)-Dissolved (mg/L) | 55.6 | 45.7 | 40.5 | 26.5 | 50.3 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00019 | <0.00010 | <0.00010 | 0.00017 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00029 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00068 | 0.00240 | 0.00069 | 0.00053 | 0.00430 |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0022 | <0.0010 | <0.0010 | <0.0010 | 0.0021 |
| | Magnesium (Mg)-Dissolved (mg/L) | 32.9 | 19.7 | 13.8 | 5.50 | 17.1 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2025311-6 Water 20-NOV-17 16:10 MW17-10-02 | L2025311-7 Water 20-NOV-17 16:45 MW17-10-03 | L2025311-8 Water 20-NOV-17 DUP | | |
|---|---|---|---|-----------|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 388 | 405 | 382 | |
| | Hardness (as CaCO3) (mg/L) | 210 | 205 | 210 | |
| | pH (pH) | 8.07 | 8.10 | 8.09 | |
| | Total Suspended Solids (mg/L) | 7.3 | <3.0 | 6.0 | |
| | TDS (Calculated) (mg/L) | 255 | 262 | 256 | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 116 | 115 | 117 | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 116 | 115 | 117 | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | <0.0050 | <0.0050 | |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.050 | |
| | Chloride (Cl) (mg/L) | 0.85 | 0.88 | 0.82 | |
| | Nitrate and Nitrite (as N) (mg/L) | 17.7 | 19.9 | 17.7 | |
| | Nitrate (as N) (mg/L) | 17.7 | 19.9 | 17.7 | |
| | Nitrite (as N) (mg/L) | 0.0016 | 0.0036 | 0.0022 | |
| | Sulfate (SO4) (mg/L) | 24.8 | 23.3 | 24.8 | |
| | Anion Sum (meq/L) | 4.14 | 4.25 | 4.16 | |
| | Cation Sum (meq/L) | 4.53 | 4.42 | 4.54 | |
| | Cation - Anion Balance (%) | 4.5 | 1.9 | 4.4 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0026 | 0.0032 | 0.0033 | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00011 | 0.00014 | 0.00011 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00021 | 0.00012 | 0.00015 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0332 | 0.0334 | 0.0332 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000365 | 0.0000561 | 0.0000369 | |
| | Calcium (Ca)-Dissolved (mg/L) | 55.9 | 55.9 | 56.7 | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00055 | 0.00071 | 0.00056 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00343 | 0.00295 | 0.00355 | |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0013 | 0.0012 | 0.0013 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 17.0 | 15.8 | 16.7 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2025311-1 | L2025311-2 | L2025311-3 | L2025311-4 | L2025311-5 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 20-NOV-17 | 20-NOV-17 | 20-NOV-17 | 20-NOV-17 | 20-NOV-17 |
| | | Sampled Time | 11:30 | 13:30 | 13:45 | 14:00 | 15:55 |
| | | Client ID | MW17-08-01 | MW17-08-02 | MW17-08-03 | MW17-08-04 | MW17-10-01 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | 0.00136 | 0.00310 | 0.00252 | 0.00129 | 0.0764 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00908 | 0.00372 | 0.00114 | 0.000714 | 0.0381 |
| | Nickel (Ni)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | 0.00100 | 0.0136 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 1.91 | 1.10 | 1.01 | 0.73 | 2.22 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000665 | 0.000729 | 0.000682 | 0.000659 | 0.00290 |
| | Silicon (Si)-Dissolved (mg/L) | | 5.68 | 5.78 | 4.81 | 4.44 | 6.02 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000014 |
| | Sodium (Na)-Dissolved (mg/L) | | 7.08 | 5.32 | 3.84 | 3.52 | 11.8 |
| | Strontium (Sr)-Dissolved (mg/L) | | 7.94 | 1.38 | 0.919 | 0.209 | 1.35 |
| | Sulfur (S)-Dissolved (mg/L) | | 14.6 | 4.80 | 2.30 | 0.90 | 22.4 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | 0.00025 | 0.00012 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000263 | 0.000182 | 0.000145 | 0.000076 | 0.00195 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | 0.00088 | 0.00065 | 0.00114 | 0.00080 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0336 | 0.0224 | 0.0209 | 0.137 | 0.0463 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2025311-6 Water 20-NOV-17 16:10 MW17-10-02 | L2025311-7 Water 20-NOV-17 16:45 MW17-10-03 | L2025311-8 Water 20-NOV-17 DUP | | |
|-------------------------|---|---|---|---|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | 0.00642 | 0.00485 | 0.00649 | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00910 | 0.00902 | 0.00942 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00633 | 0.00592 | 0.00629 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 1.93 | 1.94 | 1.93 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00153 | 0.00145 | 0.00141 | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.99 | 5.72 | 5.91 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 6.73 | 6.33 | 6.75 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 1.04 | 0.906 | 1.06 | | |
| | Sulfur (S)-Dissolved (mg/L) | 9.20 | 8.22 | 9.22 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00123 | 0.00112 | 0.00122 | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00053 | 0.00058 | 0.00055 | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0365 | 0.0559 | 0.0370 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2025311-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2025311-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2025311-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2025311-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2025311-1, -2, -3, -4, -5, -6, -7, -8 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-WR | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-11-21 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2025311-COFC

COC Number: 2017- 11-21 A

Page 1 of 1

www.alsglobal.com

| Report To Contact and company name below will appear on the final report Company: Minto Explorations Ltd. Contact: Minto Environment - Coordinator Phone: 1-604-759-4659 Company address below will appear on the final report | | Report Format / Distribution Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax minto_environment@mintomine.com Email 2 Email 3 | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply PRIORITY (Business Days): 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> EMERGENCY: 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|---|---------------------|---|--------------------------|---------------------------------------|--------------------------------|---------------------------------------|----------------------------------|---------------------------------------|--|---------------------------------|--|--|--|--|--|-----------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Street: 2100-510 West Georgia St. City/Province: Vancouver, British Columbia Postal Code: V6B 0M3 | | Date and Time Required for all E&P TATs: | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Company: Minto Explorations Ltd. Contact: Ruth Cayetano | | Invoice Distribution Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax ap@mintomine.com Email 2 | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below <table border="1"> <thead> <tr> <th>P</th> <th>F/P</th> <th>P</th> <th>F/P</th> <th>P</th> <th>F/P</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> | | P | F/P | P | F/P | P | F/P | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| P | F/P | P | F/P | P | F/P | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Project Information ALS Account # / Quote #: Job #: PO / AFE: 224161 (GW) LSD: | | Oil and Gas Required Fields (client use) AFE/Cost Center: PO# Major/Minor Code: Routing Code: Requisitioner: Location: | | ALS Lab Work Order # (lab use only) ALS Contact: Sampler: CR/CH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals (TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | Dissolved Bromide (Br-D) | | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW17-08-01 | 20-11-2017 | 11:30 | Water | R | R | R | R | R | R | R | R | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW17-08-02 | 20-11-2017 | 13:30 | Water | R | R | R | R | R | R | R | R | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW17-08-03 | 20-11-2017 | 13:45 | Water | R | R | R | R | R | R | R | R | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW17-08-04 | 20-11-2017 | 14:00 | Water | R | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW17-10-01 | 20-11-2017 | 15:55 | Water | R | R | R | R | R | R | R | R | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW17-10-02 | 20-11-2017 | 16:10 | Water | R | R | R | R | R | R | R | R | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW17-10-03 | 20-11-2017 | 16:45 | Water | R | R | R | R | R | R | R | R | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | DUP | 20-11-2017 | | Water | R | R | R | R | R | R | R | R | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input type="checkbox"/> | | INITIAL COOLER TEMPERATURES °C 3°C | | FINAL COOLER TEMPERATURES °C 4 3 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) Released by: Corey Roberts Date: 2017-11-21 Time: | | INITIAL SHIPMENT RECEPTION (lab use only) Received by: <i>[Signature]</i> Date: Nov 21, 2017 Time: 15:40 | | FINAL SHIPMENT RECEPTION (lab use only) Received by: <i>[Signature]</i> Date: Nov 23 Time: 13:00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.
 WHITE - LABORATORY COPY YELLOW - CLIENT COPY OCTOBER 2016 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 20-NOV-17
Report Date: 28-NOV-17 12:17 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2024714
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-11-20 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2024714-1 Water 18-NOV-17 14:50 MW17-11-01 | L2024714-2 Water 18-NOV-17 15:20 MW17-11-02 | L2024714-3 Water 18-NOV-17 16:00 MW17-11-03 | L2024714-4 Water 18-NOV-17 16:20 MW17-11-04 | L2024714-5 Water 18-NOV-17 16:50 MW17-11-05 | |
|---|---|---|---|---|---|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 308 | 319 | 323 | 496 | 474 |
| | Hardness (as CaCO3) (mg/L) | 130 | 123 | 167 | 280 | 273 |
| | pH (pH) | 8.27 | 8.25 | 8.32 | 8.27 | 8.28 |
| | Total Suspended Solids (mg/L) | 28.7 | 20.0 | 3.3 | 10.0 | 4.0 |
| | TDS (Calculated) (mg/L) | 183 | 192 | 194 | 313 | 305 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 120 | 147 | 158 | 248 | 241 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | 2.8 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 120 | 147 | 161 | 248 | 241 |
| | Ammonia, Total (as N) (mg/L) | 0.0067 | <0.0050 | <0.0050 | 0.0145 | <0.0050 |
| | Bromide (Br) (mg/L) | 3.23 | 0.144 | <0.050 | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | 1.85 | 3.19 | 0.39 | 0.89 | 0.82 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.111 | 0.0801 | 0.374 | 9.12 | 9.23 |
| | Nitrate (as N) (mg/L) | 0.0674 | 0.0748 | 0.335 | 9.10 | 9.23 |
| | Nitrite (as N) (mg/L) | 0.0435 | 0.0053 | 0.0395 | 0.0181 | 0.0045 |
| | Sulfate (SO4) (mg/L) | 38.7 | 28.7 | 21.1 | 6.3 | 4.7 |
| | Anion Sum (meq/L) | 3.37 | 3.74 | 3.79 | 5.78 | 5.60 |
| | Cation Sum (meq/L) | 3.50 | 3.58 | 3.91 | 6.01 | 5.81 |
| | Cation - Anion Balance (%) | 2.0 | -2.1 | 1.6 | 2.0 | 1.9 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0229 | 0.0047 | 0.0056 | 0.0035 | 0.0014 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00052 | 0.00029 | 0.00011 | 0.00052 | 0.00024 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00063 | 0.00183 | 0.00046 | 0.00024 | 0.00010 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0426 | 0.0374 | 0.0719 | 0.126 | 0.211 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.050 | 0.022 | 0.012 | <0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000538 | 0.0000187 | <0.000050 | 0.0000491 | 0.0000083 |
| | Calcium (Ca)-Dissolved (mg/L) | 36.0 | 32.5 | 44.1 | 95.3 | 96.2 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00017 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00018 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00052 | 0.00061 | 0.00033 | 0.00674 | 0.00229 |
| | Iron (Fe)-Dissolved (mg/L) | 0.026 | 0.069 | <0.010 | <0.010 | <0.010 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | 0.000082 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0052 | 0.0045 | 0.0053 | 0.0026 | 0.0019 |
| | Magnesium (Mg)-Dissolved (mg/L) | 9.75 | 10.1 | 13.7 | 10.3 | 7.95 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2024714-6 | | | |
|-----------------------------|--|------------|--|--|--|
| | | Water | | | |
| | | 18-NOV-17 | | | |
| | | DUP | | | |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 320 | | | |
| | Hardness (as CaCO3) (mg/L) | 157 | | | |
| | pH (pH) | 8.27 | | | |
| | Total Suspended Solids (mg/L) | 13.3 | | | |
| | TDS (Calculated) (mg/L) | 196 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 151 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 151 | | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | | | |
| | Bromide (Br) (mg/L) | 0.092 | | | |
| | Chloride (Cl) (mg/L) | 0.85 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.0147 | | | |
| | Nitrate (as N) (mg/L) | 0.0127 | | | |
| | Nitrite (as N) (mg/L) | 0.0020 | | | |
| | Sulfate (SO4) (mg/L) | 29.5 | | | |
| | Anion Sum (meq/L) | 3.77 | | | |
| | Cation Sum (meq/L) | 3.87 | | | |
| | Cation - Anion Balance (%) | 1.4 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0070 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00130 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0450 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.017 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000073 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 43.4 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.00020 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.085 | | | |
| | Lead (Pb)-Dissolved (mg/L) | 0.000058 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0057 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 11.7 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L2024714-1 | L2024714-2 | L2024714-3 | L2024714-4 | L2024714-5 |
|-------------------------|----------------------------------|--------------|--------------|------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 18-NOV-17 | 14:50 | MW17-11-01 | 18-NOV-17 | 18-NOV-17 | 18-NOV-17 | 18-NOV-17 | 18-NOV-17 |
| | | | | | 15:20 | 15:20 | 16:00 | 16:20 | 16:50 |
| | | | | | MW17-11-01 | MW17-11-02 | MW17-11-03 | MW17-11-04 | MW17-11-05 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | | | 0.0331 | 0.0532 | 0.102 | 0.0488 | 0.00650 |
| | Mercury (Hg)-Dissolved (mg/L) | | | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | | | 0.0257 | 0.00669 | 0.00615 | 0.00407 | 0.00114 |
| | Nickel (Ni)-Dissolved (mg/L) | | | | 0.00102 | 0.00069 | <0.00050 | 0.00136 | 0.00067 |
| | Phosphorus (P)-Dissolved (mg/L) | | | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | | | 3.15 | 2.36 | 3.86 | 4.46 | 3.50 |
| | Selenium (Se)-Dissolved (mg/L) | | | | 0.000596 | 0.00261 | 0.000586 | 0.000502 | 0.000349 |
| | Silicon (Si)-Dissolved (mg/L) | | | | 4.98 | 5.35 | 5.47 | 7.26 | 6.98 |
| | Silver (Ag)-Dissolved (mg/L) | | | | <0.000010 | <0.000010 | <0.000010 | 0.000011 | 0.000011 |
| | Sodium (Na)-Dissolved (mg/L) | | | | 18.9 | 24.5 | 11.1 | 6.68 | 6.13 |
| | Strontium (Sr)-Dissolved (mg/L) | | | | 0.945 | 0.844 | 1.16 | 0.612 | 0.403 |
| | Sulfur (S)-Dissolved (mg/L) | | | | 13.7 | 8.47 | 7.49 | 2.52 | 1.79 |
| | Thallium (Tl)-Dissolved (mg/L) | | | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | | | 0.00034 | 0.00025 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | | | 0.00165 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | | | 0.000399 | 0.000757 | 0.00190 | 0.00383 | 0.00338 |
| | Vanadium (V)-Dissolved (mg/L) | | | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | | | 0.0240 | 0.0656 | 0.0112 | 0.0453 | 0.0450 |
| | Zirconium (Zr)-Dissolved (mg/L) | | | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | Sample ID | Description | Sampled Date | Sampled Time | Client ID |
|-------------------------|----------------------------------|------------|-------------|--------------|--------------|-----------|
| | | L2024714-6 | Water | 18-NOV-17 | | DUP |
| WATER | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | | 0.0588 | | |
| | Mercury (Hg)-Dissolved (mg/L) | | | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | | 0.00628 | | |
| | Nickel (Ni)-Dissolved (mg/L) | | | <0.00050 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | | | 2.76 | | |
| | Selenium (Se)-Dissolved (mg/L) | | | 0.000382 | | |
| | Silicon (Si)-Dissolved (mg/L) | | | 5.58 | | |
| | Silver (Ag)-Dissolved (mg/L) | | | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | | | 15.3 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | | 1.13 | | |
| | Sulfur (S)-Dissolved (mg/L) | | | 10.3 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | | | 0.000729 | | |
| | Vanadium (V)-Dissolved (mg/L) | | | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | | 0.0159 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|---------------------------|-----------|--------------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2024714-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2024714-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2024714-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2024714-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L2024714-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2024714-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2024714-1, -2, -3, -4, -5, -6 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| F-IC-N-WR | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |

Reference Information

| | | | |
|---|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-MAN-WR | Water | Total Suspended Solids by Gravimetric | APHA 2540 D |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|-----------------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-11-20 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-NOV-17
Report Date: 27-NOV-17 15:06 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2023142
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-11-15 C
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2023142-1 Water 14-NOV-17 13:55 MW12-06-01 | L2023142-2 Water 14-NOV-17 14:30 MW12-06-02 | L2023142-3 Water 14-NOV-17 14:55 MW12-06-03 | L2023142-4 Water 14-NOV-17 15:10 MW12-06-04 | L2023142-5 Water 14-NOV-17 15:45 MW12-06-05 |
|---|---|---|---|---|---|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 700 | 952 | 953 | 937 | 948 |
| | Hardness (as CaCO3) (mg/L) | 286 | 496 | 518 | 528 | 491 |
| | pH (pH) | 8.33 | 8.20 | 8.25 | 8.23 | 8.21 |
| | Total Suspended Solids (mg/L) | <3.0 | 137 | 6.7 | 5.3 | 4.7 |
| | TDS (Calculated) (mg/L) | 400 | 647 | 641 | 634 | 622 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 387 | 358 | 377 | 399 | 406 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 6.2 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 394 | 358 | 377 | 399 | 406 |
| | Ammonia, Total (as N) (mg/L) | 0.0067 | 0.0427 | 0.0352 | 0.0068 | <0.0050 |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | 5.10 | 0.57 | 0.48 | 0.43 | 0.44 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.0518 | 0.333 | 0.168 | 0.0783 | 0.0666 |
| | Nitrate (as N) (mg/L) | 0.0139 | 0.0668 | 0.0346 | 0.0160 | 0.0155 |
| | Nitrite (as N) (mg/L) | 0.0379 | 0.266 | 0.133 | 0.0623 | 0.0511 |
| | Sulfate (SO4) (mg/L) | <5.0 | 211 | 202 | 182 | 181 |
| | Anion Sum (meq/L) | 8.07 | 11.7 | 11.8 | 11.8 | 12.0 |
| | Cation Sum (meq/L) | 8.08 | 11.7 | 12.0 | 12.2 | 11.2 |
| | Cation - Anion Balance (%) | 0.1 | 0.2 | 0.8 | 1.5 | -3.2 |
| | Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | | 0.0150 | 0.0011 | 0.0028 | 0.0017 | 0.0018 |
| Antimony (Sb)-Dissolved (mg/L) | | 0.00013 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Arsenic (As)-Dissolved (mg/L) | | 0.00590 | 0.00362 | 0.00052 | 0.00227 | 0.00058 |
| Barium (Ba)-Dissolved (mg/L) | | 0.205 | 0.0226 | 0.0226 | 0.0164 | 0.0344 |
| Beryllium (Be)-Dissolved (mg/L) | | 0.000088 | 0.000045 | 0.000028 | 0.000027 | <0.000020 |
| Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Dissolved (mg/L) | | 0.124 | 0.069 | 0.053 | 0.049 | 0.048 |
| Cadmium (Cd)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Calcium (Ca)-Dissolved (mg/L) | | 83.1 | 138 | 113 | 110 | 108 |
| Chromium (Cr)-Dissolved (mg/L) | | 0.00312 | <0.00010 | 0.00019 | 0.00014 | <0.00010 |
| Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00097 |
| Copper (Cu)-Dissolved (mg/L) | | 0.00057 | <0.00020 | <0.00020 | <0.00020 | 0.00033 |
| Iron (Fe)-Dissolved (mg/L) | | 0.256 | 1.13 | 1.33 | 0.723 | 0.120 |
| Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved (mg/L) | | 0.0094 | 0.0074 | 0.0068 | 0.0055 | 0.0059 |
| Magnesium (Mg)-Dissolved (mg/L) | 19.0 | 36.6 | 57.2 | 61.4 | 53.8 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2023142-6 Water 14-NOV-17 16:05 MW12-06-06 | L2023142-7 Water 14-NOV-17 DUP | | |
|-----------------------------|--|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 816 | 946 | | |
| | Hardness (as CaCO3) (mg/L) | 429 | 531 | | |
| | pH (pH) | 8.30 | 8.29 | | |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | | |
| | TDS (Calculated) (mg/L) | 529 | 639 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 316 | 402 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 4.8 | 2.2 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 321 | 404 | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.0064 | | |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | | |
| | Chloride (Cl) (mg/L) | 6.62 | 0.36 | | |
| | Nitrate and Nitrite (as N) (mg/L) | 1.10 | 0.0441 | | |
| | Nitrate (as N) (mg/L) | 1.06 | 0.0089 | | |
| | Nitrite (as N) (mg/L) | 0.0455 | 0.0352 | | |
| | Sulfate (SO4) (mg/L) | 154 | 183 | | |
| | Anion Sum (meq/L) | 9.92 | 12.0 | | |
| | Cation Sum (meq/L) | 9.98 | 12.2 | | |
| | Cation - Anion Balance (%) | 0.3 | 1.1 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | <0.0010 | 0.0021 | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | <0.00010 | 0.00229 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0132 | 0.0167 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | 0.000030 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | 0.047 | 0.046 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 83.3 | 112 | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.00020 | <0.00020 | | |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | 0.707 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0044 | 0.0054 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 53.6 | 61.0 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2023142-1 | L2023142-2 | L2023142-3 | L2023142-4 | L2023142-5 |
|-------------------------|----------------------------------|--------------|------------------------|------------------------|------------------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 14-NOV-17 | 14-NOV-17 | 14-NOV-17 | 14-NOV-17 | 14-NOV-17 |
| | | Sampled Time | 13:55 | 14:30 | 14:55 | 15:10 | 15:45 |
| | | Client ID | MW12-06-01 | MW12-06-02 | MW12-06-03 | MW12-06-04 | MW12-06-05 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | 0.0731 | 0.0249 | 0.0149 | 0.0404 | 0.299 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.000954 | 0.00791 | 0.00353 | 0.00865 | 0.00973 |
| | Nickel (Ni)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 2.40 | 3.38 | 3.73 | 3.65 | 3.15 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.00374 | 0.000643 | 0.000422 | 0.000261 | 0.000168 |
| | Silicon (Si)-Dissolved (mg/L) | | 7.79 | 10.5 | 9.42 | 8.92 | 8.63 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 52.5 | 38.2 | 34.8 | 35.1 | 30.2 |
| | Strontium (Sr)-Dissolved (mg/L) | | 3.60 | 10.8 | 4.82 | 3.22 | 2.96 |
| | Sulfur (S)-Dissolved (mg/L) | | 6.39 | 72.8 | 72.1 | 63.7 | 65.5 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00015 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.0030 ^{DLM} | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000637 | 0.00232 | 0.00253 | 0.00595 | 0.00594 |
| | Vanadium (V)-Dissolved (mg/L) | | 0.0136 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | <0.0040 ^{DLB} | <0.0050 ^{DLB} | <0.0040 ^{DLB} | 0.0084 | 0.0100 |
| | Zirconium (Zr)-Dissolved (mg/L) | | 0.00111 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2023142-6 Water 14-NOV-17 16:05 MW12-06-06 | L2023142-7 Water 14-NOV-17 DUP | | |
|-------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | 0.0367 | 0.0410 | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00572 | 0.00876 | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | <0.00050 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 3.29 | 3.56 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000291 | 0.000074 | | |
| | Silicon (Si)-Dissolved (mg/L) | 7.01 | 9.08 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 30.4 | 34.2 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 1.60 | 3.16 | | |
| | Sulfur (S)-Dissolved (mg/L) | 54.1 | 64.5 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00411 | 0.00575 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0116 | 0.0065 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|------------------------------------|
| Method Blank | Zinc (Zn)-Dissolved | MB-LOR | L2023142-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2023142-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L2023142-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2023142-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2023142-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2023142-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2023142-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2023142-1, -2, -3, -4, -5, -6, -7 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLB | Detection Limit Raised. Analyte detected at comparable level in Method Blank. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-WR | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| F-IC-N-WR | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

Reference Information

| | | | |
|---|-------|--|---|
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-MAN-WR | Water | Total Suspended Solids by Gravimetric | APHA 2540 D |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-11-15 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|--|-------------------|--|--|--------------|-------------------------------------|--|---|-------------------------------------|---|--|---|-------|-------------------|-----------------------|-------------------------|-------------------|---------------------------|--------------------------------|---|--------------------------|--------------------------------|---|--------------------------|----------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | Priority (Business Day) | | | | | Emergency | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | | 2 day [P2] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | P F/P P F/P P F/P | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | | <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td rowspan="2" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Metals (TM)</td> <td rowspan="2" style="writing-mode: vertical-rl; transform: rotate(180deg);">Dissolved Metals (DM)</td> <td rowspan="2" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Mercury, Hardness</td> <td rowspan="2" style="writing-mode: vertical-rl; transform: rotate(180deg);">Dissolved Mercury</td> <td rowspan="2" style="writing-mode: vertical-rl; transform: rotate(180deg);">Ammonia (Total Nutrients)</td> <td rowspan="2" style="writing-mode: vertical-rl; transform: rotate(180deg);">Dissolved Organic Carbon (DOC)</td> <td rowspan="2" style="writing-mode: vertical-rl; transform: rotate(180deg);">pH, Cond., TSS, TDS, Alkalinity, Anions</td> <td rowspan="2" style="writing-mode: vertical-rl; transform: rotate(180deg);">Dissolved Bromide (Br-D)</td> <td colspan="10" style="text-align: center;">Number of Containers</td> </tr> <tr> <td colspan="10"></td> </tr> </table> | | | | | | | | | | Total Metals (TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | Dissolved Bromide (Br-D) | Number of Containers | | | | | | | | | | | | | | | | | | | |
| Total Metals (TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | | | | | | | | | | | | | | | | | | | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | Dissolved Bromide (Br-D) | Number of Containers | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | | Sampler: | | SR/CP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW12-06-01 | | | 14-Nov-17 | 13:55 | Water | R | R | R | R | R | R | R | R | R | R | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW12-06-02 | | | 14-Nov-17 | 14:30 | Water | R | R | R | R | R | R | R | R | R | R | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW12-06-03 | | | 14-Nov-17 | 14:55 | Water | R | R | R | R | R | R | R | R | R | R | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW12-06-04 | | | 14-Nov-17 | 15:10 | Water | R | R | R | R | R | R | R | R | R | R | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW12-06-05 | | | 14-Nov-17 | 15:45 | Water | R | R | R | R | R | R | R | R | R | R | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MW12-06-06 | | | 14-Nov-17 | 16:05 | Water | R | R | R | R | R | R | R | R | R | R | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | DUP | | | 14-Nov-17 | | Water | R | R | R | R | R | R | R | R | R | R | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | 1°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-11-15 | | Time: 12:00 | | Received by: | | Date: NOV 16/17 | | Time: 08:42 | | Received by: | | Date: | | Time: | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-NOV-17
Report Date: 27-NOV-17 15:57 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2023138
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-11-15 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2023138-1 Water 12-NOV-17 10:50 MW17-12-01 | L2023138-2 Water 12-NOV-17 11:25 MW17-12-02 | L2023138-3 Water 12-NOV-17 13:00 MW17-12-03 | L2023138-4 Water 12-NOV-17 13:20 MW17-12-04 | L2023138-5 Water 12-NOV-17 13:45 MW17-12-05 | |
|---|---|---|---|---|---|-------------------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 2530 | 2190 | 851 | 746 | 755 |
| | Hardness (as CaCO3) (mg/L) | 1100 | 865 | 361 | 388 | 393 |
| | pH (pH) | 7.93 | 7.98 | 8.21 | 8.19 | 8.21 |
| | Total Suspended Solids (mg/L) | 13.6 | 19.6 | 5.0 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | 2160 | 1840 | 561 | 480 | 474 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 197 | 223 | 373 | 339 | 352 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 197 | 223 | 373 | 339 | 352 |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | <0.0050 | <0.0050 | <0.0050 | 0.0060 |
| | Bromide (Br) (mg/L) | <1.0 ^{DLDS} | <1.0 ^{DLDS} | <0.25 ^{DLDS} | <0.25 ^{DLDS} | <0.25 ^{DLDS} |
| | Chloride (Cl) (mg/L) | 13 | 12 | <2.5 ^{DLDS} | <2.5 ^{DLDS} | <2.5 ^{DLDS} |
| | Nitrate (as N) (mg/L) | <0.10 ^{DLDS} | <0.10 ^{DLDS} | 0.274 | 0.261 | 0.336 |
| | Nitrite (as N) (mg/L) | <0.020 ^{DLDS} | <0.020 ^{DLDS} | <0.0050 ^{DLDS} | <0.0050 ^{DLDS} | <0.0050 ^{DLDS} |
| | Sulfate (SO4) (mg/L) | 1370 | 1140 | 142 | 115 | 102 |
| | Anion Sum (meq/L) | 32.9 | 28.6 | 10.5 | 9.24 | 9.24 |
| | Cation Sum (meq/L) | 33.0 | 27.7 | 10.3 | 9.31 | 9.34 |
| | Cation - Anion Balance (%) | 0.1 | -1.6 | -1.2 | 0.3 | 0.5 |
| | Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | | 0.0023 | 0.0022 | 0.0024 | 0.0035 | 0.0037 |
| Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | <0.00020 | <0.00010 | <0.00010 | <0.00010 |
| Arsenic (As)-Dissolved (mg/L) | | 0.00232 | 0.00213 | 0.00104 | 0.00018 | <0.00010 |
| Barium (Ba)-Dissolved (mg/L) | | 0.00783 | 0.0109 | 0.0189 | 0.0263 | 0.0410 |
| Beryllium (Be)-Dissolved (mg/L) | | 0.000077 | <0.000040 | <0.000020 | <0.000020 | <0.000020 |
| Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.00010 | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Dissolved (mg/L) | | 0.147 | 0.144 | 0.056 | 0.036 | 0.033 |
| Cadmium (Cd)-Dissolved (mg/L) | | 0.0000087 | <0.000010 | <0.0000050 | 0.0000113 | 0.0000151 |
| Calcium (Ca)-Dissolved (mg/L) | | 342 | 269 | 84.8 | 69.9 | 69.2 |
| Chromium (Cr)-Dissolved (mg/L) | | <0.00010 | <0.00020 | <0.00010 | <0.00010 | <0.00010 |
| Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00020 | 0.00010 | 0.00012 | 0.00026 |
| Copper (Cu)-Dissolved (mg/L) | | <0.00020 | <0.00040 | <0.00020 | 0.00374 | 0.00086 |
| Iron (Fe)-Dissolved (mg/L) | | 3.08 | 2.29 | 0.470 | <0.010 | <0.010 |
| Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.00010 | <0.000050 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved (mg/L) | | 0.0181 | 0.0134 | 0.0085 | 0.0069 | 0.0071 |
| Magnesium (Mg)-Dissolved (mg/L) | | 60.7 | 46.9 | 36.3 | 51.8 | 53.5 |
| Manganese (Mn)-Dissolved (mg/L) | 0.108 | 0.0537 | 0.104 | 0.0149 | 0.0764 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2023138-6 | L2023138-7 | L2023138-8 |
|--------------------------------------|---|---------------------------------------|-------------------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 12-NOV-17 | 12-NOV-17 | 12-NOV-17 |
| | | Sampled Time | 14:05 | 14:30 | 14:50 |
| | | Client ID | MW17-12-06 | MW17-12-07 | MW17-12-08 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 730 | 556 | 557 |
| | Hardness (as CaCO3) (mg/L) | | 385 | 285 | 285 |
| | pH (pH) | | 8.27 | 8.23 | 8.27 |
| | Total Suspended Solids (mg/L) | | 3.4 | <3.0 | 4.6 |
| | TDS (Calculated) (mg/L) | | 462 | 333 | 337 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 348 | 251 | 255 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 348 | 251 | 255 |
| | Ammonia, Total (as N) (mg/L) | | <0.0050 | <0.0050 | <0.0050 |
| | Bromide (Br) (mg/L) | | <0.25 ^{DLDS} | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | | <2.5 ^{DLDS} | 4.03 | 4.00 |
| | Nitrate (as N) (mg/L) | | 0.046 | 0.970 | 0.963 |
| | Nitrite (as N) (mg/L) | | <0.0050 ^{DLDS} | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 94.1 | 60.9 | 60.8 |
| | Anion Sum (meq/L) | | 8.96 | 6.49 | 6.58 |
| | Cation Sum (meq/L) | | 9.26 | 6.69 | 6.75 |
| | Cation - Anion Balance (%) | | 1.7 | 1.5 | 1.3 |
| | Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD |
| Dissolved Metals Filtration Location | | | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | | | 0.0028 | 0.0030 | 0.0024 |
| Antimony (Sb)-Dissolved (mg/L) | | | <0.00010 | <0.00010 | <0.00010 |
| Arsenic (As)-Dissolved (mg/L) | | | <0.00010 | <0.00010 | <0.00010 |
| Barium (Ba)-Dissolved (mg/L) | | | 0.0511 | 0.0227 | 0.0240 |
| Beryllium (Be)-Dissolved (mg/L) | | | <0.000020 | <0.000020 | <0.000020 |
| Bismuth (Bi)-Dissolved (mg/L) | | | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Dissolved (mg/L) | | | 0.032 | 0.024 | 0.024 |
| Cadmium (Cd)-Dissolved (mg/L) | | | 0.0000223 | <0.000050 | 0.0000075 |
| Calcium (Ca)-Dissolved (mg/L) | | | 67.6 | 50.0 | 50.5 |
| Chromium (Cr)-Dissolved (mg/L) | | | <0.00010 | <0.00010 | <0.00010 |
| Cobalt (Co)-Dissolved (mg/L) | | | 0.00054 | <0.00010 | <0.00010 |
| Copper (Cu)-Dissolved (mg/L) | | | 0.00077 | 0.00122 | 0.00151 |
| Iron (Fe)-Dissolved (mg/L) | | | <0.010 | <0.010 | <0.010 |
| Lead (Pb)-Dissolved (mg/L) | | | <0.000050 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved (mg/L) | | | 0.0095 | 0.0055 | 0.0056 |
| Magnesium (Mg)-Dissolved (mg/L) | | | 52.5 | 38.8 | 38.6 |
| Manganese (Mn)-Dissolved (mg/L) | | 0.531 | 0.00558 | 0.00518 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2023138-1 | L2023138-2 | L2023138-3 | L2023138-4 | L2023138-5 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 12-NOV-17 | 12-NOV-17 | 12-NOV-17 | 12-NOV-17 | 12-NOV-17 |
| | | Sampled Time | 10:50 | 11:25 | 13:00 | 13:20 | 13:45 |
| | | Client ID | MW17-12-01 | MW17-12-02 | MW17-12-03 | MW17-12-04 | MW17-12-05 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00748 | 0.00840 | 0.00601 | 0.00711 | 0.00780 |
| | Nickel (Ni)-Dissolved (mg/L) | | <0.00050 | <0.0010 | 0.00069 | 0.00103 | 0.00136 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.10 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 3.75 | 3.32 | 2.94 | 3.34 | 3.78 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000060 | <0.00010 | <0.000050 | 0.000569 | 0.000588 |
| | Silicon (Si)-Dissolved (mg/L) | | 7.67 | 7.74 | 7.97 | 7.04 | 7.14 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000020 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 246 | 235 | 68.1 | 33.9 | 31.8 |
| | Strontium (Sr)-Dissolved (mg/L) | | 10.5 | 10.9 | 3.79 | 1.49 | 1.67 |
| | Sulfur (S)-Dissolved (mg/L) | | 522 | 391 | 44.7 | 37.7 | 33.7 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000020 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00051 | <0.00020 | 0.00014 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00060 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000232 | 0.000530 | 0.00455 | 0.00434 | 0.00446 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.0010 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0385 | 0.0230 | 0.0286 | 0.0257 | 0.0372 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2023138-6 | L2023138-7 | L2023138-8 | | |
|-------------------------|----------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 12-NOV-17 | 12-NOV-17 | 12-NOV-17 | | |
| | | Sampled Time | 14:05 | 14:30 | 14:50 | | |
| | | Client ID | MW17-12-06 | MW17-12-07 | MW17-12-08 | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0448 | 0.00801 | 0.0110 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00268 | <0.00050 | <0.00050 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 4.88 | 2.71 | 2.78 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000532 | 0.000345 | 0.000340 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.59 | 6.66 | 6.84 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 32.8 | 21.5 | 22.6 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 1.92 | 1.01 | 1.01 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 33.0 | 20.9 | 21.4 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00372 | 0.00270 | 0.00266 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00062 | 0.00066 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0218 | 0.0180 | 0.0213 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--|
| Method Blank | Zinc (Zn)-Dissolved | MB-LOR | L2023138-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2023138-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L2023138-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2023138-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2023138-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2023138-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2023138-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2023138-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2023138-1, -2, -3, -4, -5, -6, -7, -8 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| F-IC-N-VA | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |

Reference Information

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

| | | | |
|---|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". | | | |
| The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-11-15 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2023138-COFC

COC Number: 2017-11-15 B

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| | | | | | | | | | | | | | | | | | |
|--|---|--|--|--|--|---------------------------------|-------------------------------------|--|--|------------------------------|--|--------------------------------|---|--------------------------|---|-------|----------------------|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | Priority (Business Days) | | 4 day [P4] <input type="checkbox"/> | | Emergency | | 1 Business day [E1] <input type="checkbox"/> | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | | Sampler: | | SR | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals (TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nitrogen) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | Dissolved Bromide (Br-D) | | | Number of Containers |
| MW17-12-01 | | | | 12-Nov-17 | 10:50 | Water | R | R | R | R | R | R | R | R | R | R | 4 |
| MW17-12-02 | | | | 12-Nov-17 | 11:25 | Water | R | R | R | R | R | R | R | R | R | R | 4 |
| MW17-12-03 | | | | 12-Nov-17 | 13:00 | Water | R | R | R | R | R | R | R | R | R | R | 4 |
| MW17-12-04 | | | | 12-Nov-17 | 13:20 | Water | R | R | R | R | R | R | R | R | R | R | 4 |
| MW17-12-05 | | | | 12-Nov-17 | 13:45 | Water | R | R | R | R | R | R | R | R | R | R | 4 |
| MW17-12-06 | | | | 12-Nov-17 | 14:05 | Water | R | R | R | R | R | R | R | R | R | R | 4 |
| MW17-12-07 | | | | 12-Nov-17 | 14:30 | Water | R | R | R | R | R | R | R | R | R | R | 4 |
| MW17-12-08 | | | | 12-Nov-17 | 14:50 | Water | R | R | R | R | R | R | R | R | R | R | 4 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | 20C | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-11-15 | | Time: 12:00 | | Received by: <i>(Signature)</i> | | Date: Nov 16/17 | | Time: 08:42 | | Received by: | | Date: | | Time: | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-NOV-17
Report Date: 28-NOV-17 11:32 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2023110
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-11-15 A
Legal Site Desc:

Comments:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2023110-1 Water 11-NOV-17 10:45 MW12-05-01 | L2023110-2 Water 11-NOV-17 11:15 MW12-05-02 | L2023110-3 Water 11-NOV-17 11:35 MW12-05-03 | L2023110-4 Water 11-NOV-17 11:55 MW12-05-04 | L2023110-5 Water 11-NOV-17 13:35 MW12-05-05 | |
|---|---|---|---|---|---|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 2110 | 2060 | 1800 | 487 | 479 |
| | Hardness (as CaCO3) (mg/L) | 940 | 1000 | 818 | 221 | 250 |
| | pH (pH) | 7.89 | 8.06 | 7.95 | 8.14 | 8.15 |
| | Total Suspended Solids (mg/L) | 9.0 | 4.6 | 9.0 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | 1780 | 1700 | 1430 | 273 | 286 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 133 | 184 | 234 | 245 | 220 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 133 | 184 | 234 | 245 | 220 |
| | Ammonia, Total (as N) (mg/L) | 0.0249 | 0.0175 | 0.0122 | 0.0173 | 0.0119 |
| | Bromide (Br) (mg/L) | <0.50 ^{DLDS} | <0.50 ^{DLDS} | <0.50 ^{DLDS} | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | 13.0 | 11.7 | 9.7 | 5.18 | 5.17 |
| | Nitrate and Nitrite (as N) (mg/L) | <0.051 ^{DLDS} | <0.051 ^{DLDS} | <0.051 ^{DLDS} | 0.0293 | 0.238 |
| | Nitrate (as N) (mg/L) | <0.050 ^{DLDS} | <0.050 ^{DLDS} | <0.050 ^{DLDS} | <0.0050 | 0.194 |
| | Nitrite (as N) (mg/L) | 0.043 | 0.035 | 0.036 | 0.0293 | 0.0438 |
| | Sulfate (SO4) (mg/L) | 1170 | 1070 | 883 | 25.2 | 47.9 |
| | Anion Sum (meq/L) | 27.4 | 26.3 | 23.4 | 5.60 | 5.59 |
| | Cation Sum (meq/L) | 26.0 | 26.4 | 21.3 | 5.40 | 5.74 |
| | Cation - Anion Balance (%) | -2.7 | 0.1 | -4.7 | -1.8 | 1.3 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0054 | 0.0048 | 0.0029 | 0.0049 | 0.0025 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00010 | <0.00010 | <0.00010 | 0.00011 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00064 | 0.00030 | 0.00021 | 0.00014 | 0.00061 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0369 | 0.0871 | 0.0438 | 0.0677 | 0.0696 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.110 | 0.104 | 0.093 | 0.065 | 0.063 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000081 |
| | Calcium (Ca)-Dissolved (mg/L) | 312 | 312 | 210 | 44.6 | 52.2 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00023 | 0.00029 | <0.00010 | 0.00017 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00021 | <0.00020 | <0.00020 | <0.00020 | 0.00117 |
| | Iron (Fe)-Dissolved (mg/L) | 0.032 | 0.071 | 0.531 | 0.101 | 0.012 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0086 | 0.0058 | 0.0047 | 0.0031 | 0.0036 |
| | Magnesium (Mg)-Dissolved (mg/L) | 38.9 | 54.0 | 71.5 | 26.7 | 29.1 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2023110-6 Water 11-NOV-17 13:55 MW12-05-06 | L2023110-7 Water 11-NOV-17 14:15 MW12-05-07 | | |
|-----------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 480 | 494 | | |
| | Hardness (as CaCO3) (mg/L) | 250 | 258 | | |
| | pH (pH) | 8.14 | 8.16 | | |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | | |
| | TDS (Calculated) (mg/L) | 284 | 291 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 217 | 242 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 217 | 242 | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.0238 | | |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | | |
| | Chloride (Cl) (mg/L) | 5.08 | 4.84 | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.276 | 0.0087 | | |
| | Nitrate (as N) (mg/L) | 0.229 | <0.0050 | | |
| | Nitrite (as N) (mg/L) | 0.0470 | 0.0087 | | |
| | Sulfate (SO4) (mg/L) | 48.8 | 38.7 | | |
| | Anion Sum (meq/L) | 5.55 | 5.81 | | |
| | Cation Sum (meq/L) | 5.70 | 5.89 | | |
| | Cation - Anion Balance (%) | 1.4 | 0.7 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0021 | 0.0018 | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00012 | <0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00047 | 0.00044 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0613 | 0.333 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | 0.062 | 0.027 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000142 | <0.0000050 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 52.6 | 55.3 | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00011 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00130 | <0.00020 | | |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | 0.365 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0037 | 0.0031 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 28.8 | 29.2 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2023110-1 | L2023110-2 | L2023110-3 | L2023110-4 | L2023110-5 |
|-------------------------|----------------------------------|--------------|------------------------|------------------------|------------------------|------------------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 11-NOV-17 | 11-NOV-17 | 11-NOV-17 | 11-NOV-17 | 11-NOV-17 |
| | | Sampled Time | 10:45 | 11:15 | 11:35 | 11:55 | 13:35 |
| | | Client ID | MW12-05-01 | MW12-05-02 | MW12-05-03 | MW12-05-04 | MW12-05-05 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | 0.148 | 0.827 | 2.31 | 0.500 | 0.132 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.000125 | 0.000231 | 0.000229 | 0.00311 | 0.00371 |
| | Nickel (Ni)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 3.82 | 4.17 | 4.15 | 2.26 | 1.89 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000295 | 0.000222 | 0.000122 | 0.000107 | 0.000110 |
| | Silicon (Si)-Dissolved (mg/L) | | 7.56 | 6.88 | 7.04 | 6.35 | 6.33 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 163 | 142 | 109 | 20.6 | 15.9 |
| | Strontium (Sr)-Dissolved (mg/L) | | 8.51 | 11.2 | 7.83 | 0.833 | 0.758 |
| | Sulfur (S)-Dissolved (mg/L) | | 479 | 425 | 277 | 12.5 | 15.6 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | 0.00011 | <0.00010 | 0.00019 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000892 | 0.000567 | 0.00123 | 0.00138 | 0.00265 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | <0.0030 ^{DLB} | <0.0045 ^{DLB} | <0.0040 ^{DLB} | <0.0035 ^{DLB} | 0.0202 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2023110-6 Water 11-NOV-17 13:55 MW12-05-06 | L2023110-7 Water 11-NOV-17 14:15 MW12-05-07 | | |
|-------------------------|--|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | 0.0816 | 0.696 | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00379 | 0.00246 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00060 | <0.00050 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 1.82 | 1.71 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000161 | 0.000233 | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.17 | 6.46 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 15.2 | 14.6 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.748 | 0.756 | | |
| | Sulfur (S)-Dissolved (mg/L) | 15.7 | 18.4 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00011 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00287 | 0.00451 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0373 | <0.0010 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|------------------------------------|
| Method Blank | Zinc (Zn)-Dissolved | MB-LOR | L2023110-1, -2, -3, -4 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2023110-1, -2, -3, -4 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L2023110-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2023110-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2023110-1, -2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2023110-1, -2, -3, -4 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L2023110-1, -2, -3, -4 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2023110-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2023110-1, -2, -3, -4 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L2023110-1, -2, -3, -4 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2023110-1, -2, -3, -4, -5, -6, -7 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLB | Detection Limit Raised. Analyte detected at comparable level in Method Blank. |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| F-IC-N-VA | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |

Reference Information

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-11-15 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form



L2023110-COFC

COC Number: 2017-11-15 A

Page of

| | | | | | | | | | | | | | | | | | | |
|--|---|--|--|--|--|--------------|---|-----------------------|-------------------------|--|---------------------------|--------------------------------|---|--------------------------|----------------------|-------|--|--|
| Company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business days) 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> | | EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | 3d-mm-yy hh:mm | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: SR/CP | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | Total Metals (TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | Dissolved Bromide (Br-D) | Number of Containers | | | |
| 1 | MW12-05-01 | | | 11-Nov-17 | 10:45 | Water | | R | | R | R | | R | R | 4 | | | |
| 2 | MW12-05-02 | | | 11-Nov-17 | 11:15 | Water | | R | | R | R | | R | R | 4 | | | |
| 3 | MW12-05-03 | | | 11-Nov-17 | 11:35 | Water | | R | | R | R | | R | R | 4 | | | |
| 4 | MW12-05-04 | | | 11-Nov-17 | 11:55 | Water | | R | | R | R | | R | R | 4 | | | |
| 5 | MW12-05-05 | | | 11-Nov-17 | 13:35 | Water | | R | | R | R | | R | R | 4 | | | |
| 6 | MW12-05-06 | | | 11-Nov-17 | 13:55 | Water | | R | | R | R | | R | R | 4 | | | |
| 7 | MW12-05-07 | | | 11-Nov-17 | 14:15 | Water | | R | | R | R | | R | R | 4 | | | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | |
| | | | | | 1°C | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-11-15 | | Time: 12:00 | | Received by: | | Date: NOV 16/17 | | Time: 08:42 | | Received by: | | Date: | | Time: | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 - FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.





Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 14-NOV-17
Report Date: 28-NOV-17 16:38 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2021805
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-11-11 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2021805-1 | L2021805-2 | L2021805-3 | L2021805-4 | L2021805-5 |
|--------------------------------------|---|---------------------------------------|------------|------------|-----------------------|-----------------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 08-NOV-17 | 08-NOV-17 | 09-NOV-17 | 09-NOV-17 | 08-NOV-17 |
| | | Sampled Time | 15:30 | 16:20 | 10:10 | 10:55 | |
| | | Client ID | MW09-03-01 | MW09-03-02 | MW12-07-01 | MW12-07-02 | DUP |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 298 | 346 | 1180 | 1390 | 360 |
| | Hardness (as CaCO3) (mg/L) | | 155 | 194 | 554 | 716 | 202 |
| | pH (pH) | | 8.11 | 8.11 | 7.96 | 7.86 | 8.05 |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | <3.0 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | | 180 | 213 | 840 | 1150 | 217 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 150 | 183 | 374 | 102 | 184 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 150 | 183 | 374 | 102 | 184 |
| | Ammonia, Total (as N) (mg/L) | | 0.0371 | <0.0050 | 0.604 | 0.0340 | <0.0050 |
| | Bromide (Br) (mg/L) | | <0.050 | <0.050 | <0.25 ^{DLDS} | <0.25 ^{DLDS} | <0.050 |
| | Chloride (Cl) (mg/L) | | 0.37 | 0.67 | 1.30 | 1.12 | 0.60 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.955 | 3.41 | 0.648 | 0.326 | 3.40 |
| | Nitrate (as N) (mg/L) | | 0.0117 | 3.26 | 0.193 | 0.094 | 3.28 |
| | Nitrite (as N) (mg/L) | | 0.944 | 0.155 | 0.455 | 0.232 | 0.112 |
| | Sulfate (SO4) (mg/L) | | 20.3 | 6.4 | 311 | 747 | 6.5 |
| | Anion Sum (meq/L) | | 3.49 | 4.06 | 14.0 | 17.7 | 4.08 |
| | Cation Sum (meq/L) | | 3.60 | 4.19 | 15.0 | 17.7 | 4.35 |
| | Cation - Anion Balance (%) | | 1.6 | 1.6 | 3.5 | 0.1 | 3.2 |
| | Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD | FIELD |
| Dissolved Metals Filtration Location | | | FIELD | FIELD | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | | | 0.0024 | 0.0016 | 0.0020 | 0.0019 | 0.0011 |
| Antimony (Sb)-Dissolved (mg/L) | | | 0.00016 | 0.00010 | <0.00010 | <0.00010 | 0.00012 |
| Arsenic (As)-Dissolved (mg/L) | | | 0.00077 | <0.00010 | 0.00040 | 0.00135 | <0.00010 |
| Barium (Ba)-Dissolved (mg/L) | | | 0.0617 | 0.0191 | 0.104 | 0.0103 | 0.0186 |
| Beryllium (Be)-Dissolved (mg/L) | | | <0.000020 | <0.000020 | 0.000039 | <0.000020 | <0.000020 |
| Bismuth (Bi)-Dissolved (mg/L) | | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Dissolved (mg/L) | | | 0.260 | 0.126 | 0.568 | 0.296 | 0.158 |
| Cadmium (Cd)-Dissolved (mg/L) | | | 0.0000066 | 0.0000201 | <0.0000050 | <0.0000050 | 0.0000163 |
| Calcium (Ca)-Dissolved (mg/L) | | | 42.7 | 65.2 | 188 | 228 | 68.6 |
| Chromium (Cr)-Dissolved (mg/L) | | | <0.00010 | <0.00010 | 0.00040 | <0.00010 | <0.00010 |
| Cobalt (Co)-Dissolved (mg/L) | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Copper (Cu)-Dissolved (mg/L) | | | <0.00020 | 0.00250 | <0.00020 | 0.00037 | 0.00249 |
| Iron (Fe)-Dissolved (mg/L) | | | 0.350 | <0.010 | 0.060 | 0.141 | <0.010 |
| Lead (Pb)-Dissolved (mg/L) | | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved (mg/L) | | | 0.0041 | 0.0012 | 0.0294 | 0.0330 | 0.0013 |
| Magnesium (Mg)-Dissolved (mg/L) | | | 11.9 | 7.67 | 20.6 | 35.7 | 7.54 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2021805-1 | L2021805-2 | L2021805-3 | L2021805-4 | L2021805-5 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 08-NOV-17 | 08-NOV-17 | 09-NOV-17 | 09-NOV-17 | 08-NOV-17 |
| | | Sampled Time | 15:30 | 16:20 | 10:10 | 10:55 | |
| | | Client ID | MW09-03-01 | MW09-03-02 | MW12-07-01 | MW12-07-02 | DUP |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | 0.0863 | 0.00190 | 0.111 | 0.117 | 0.00162 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00512 | 0.00382 | 0.000968 | 0.0194 | 0.00384 |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00093 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 2.16 | 2.40 | 2.71 | 2.93 | 2.43 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000112 | 0.000219 | 0.00128 | 0.000230 | 0.000244 |
| | Silicon (Si)-Dissolved (mg/L) | | 5.62 | 5.59 | 8.38 | 5.98 | 5.53 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 9.45 | 5.51 | 88.4 | 75.8 | 5.63 |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.972 | 0.376 | 8.20 | 10.8 | 0.386 |
| | Sulfur (S)-Dissolved (mg/L) | | 6.49 | 2.05 | 114 | 253 | 2.03 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00020 | 0.00020 | <0.00010 | <0.00010 | 0.00053 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000962 | 0.00316 | 0.000113 | 0.00185 | 0.00314 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | 0.00121 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0130 | 0.0266 | 0.0039 | 0.0120 | 0.0244 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2021805-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2021805-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2021805-1, -2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2021805-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2021805-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2021805-1, -2, -3, -4, -5 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L2021805-1, -2, -3, -4, -5 |
| Matrix Spike | Ammonia, Total (as N) | MS-B | L2021805-3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-WR | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |

Reference Information

| | | | |
|---|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-MAN-WR | Water | Total Suspended Solids by Gravimetric | APHA 2540 D |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|-----------------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-11-11 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2021805-COFC

COC Number: 2017-11-11 A

Page of

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| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|---|-------------------------------------|--------------------------------|--|----------------------------------|---------------------------------------|--|--|-----|--------------|-----|---------------|-----|--|--|-----------------------------|--|--|--|--|--|--|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: _____ | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Total Metals(TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | | | | | | | | | Number of Containers | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | P | F/P | P | F/P | P | F/P | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: SR | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | | | | | |
| | MW09-03-01 | | | 8-Nov-17 | 15:30 | Water | R | | R | R | | R | | | | | | | | 4 | | | | | | | | |
| | MW09-03-02 | | | 8-Nov-17 | 16:20 | Water | R | | R | R | | R | | | | | | | | 4 | | | | | | | | |
| | MW12-07-01 | | | 9-Nov-17 | 10:10 | Water | R | | R | R | | R | | | | | | | | 4 | | | | | | | | |
| | MW12-07-02 | | | 9-Nov-17 | 10:55 | Water | R | | R | R | | R | | | | | | | | 4 | | | | | | | | |
| | DUP | | | 8-Nov-17 | | Water | R | | R | R | | R | | | | | | | | 4 | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | |
| | | | | | -1.0 | | | | | 5°C | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-11-11 | | Time: 11:00 | | Received by: EHF | | Date: 14 Nov 2017 | | Time: 09:15 | | Received by: Judy | | Date: Nov 15 | | Time: 2:20 PM | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 25-OCT-17
Report Date: 15-NOV-17 18:36 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2012848
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-10-24 B
Legal Site Desc:

Comments:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L2012848-1 | L2012848-2 | L2012848-3 | L2012848-4 | L2012848-5 |
|--------------------------------------|---|---------------------------------------|--------------|------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 20-OCT-17 | 14:05 | MW09-03-01 | 20-OCT-17 | 20-OCT-17 | 20-OCT-17 | 20-OCT-17 | 20-OCT-17 |
| | | | | | 14:05 | 14:40 | | | 16:45 |
| | | | | | MW09-03-01 | MW09-03-02 | DUP1 | DUP2 | MW12-07-01 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 297 | 371 | | | | | | 1150 |
| | Hardness (as CaCO3) (mg/L) | 140 | 184 | | | | | | 479 |
| | pH (pH) | 8.16 | 8.06 | | | | | | 8.02 |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | | | | | | 7.6 |
| | TDS (Calculated) (mg/L) | 171 | 213 | | | | | | 753 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 145 | 187 | | | | | | 459 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | | | | | | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | | | | | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 145 | 187 | | | | | | 459 |
| | Ammonia, Total (as N) (mg/L) | 0.0327 | <0.0050 | | | | | | 0.587 |
| | Chloride (Cl) (mg/L) | <0.50 | 0.81 | | | | | | <2.5 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.196 | 3.27 | | | | | | 2.10 |
| | Nitrate (as N) (mg/L) | <0.0050 | 3.21 | 3.11 | | | | | 0.623 |
| | Nitrite (as N) (mg/L) | 0.196 | 0.0596 | | | | | | 1.47 |
| | Sulfate (SO4) (mg/L) | 20.4 | 6.96 | | | | | | 193 |
| | Anion Sum (meq/L) | 3.42 | 4.15 | | | | | | 13.4 |
| | Cation Sum (meq/L) | 3.30 | 4.07 | | | | | | 13.7 |
| | Cation - Anion Balance (%) | -1.8 | -0.9 | | | | | | 1.3 |
| | Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | | | | |
| Dissolved Metals Filtration Location | | FIELD | FIELD | | | | | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | | 0.0021 | 0.0015 | | | | | | 0.0045 |
| Antimony (Sb)-Dissolved (mg/L) | | 0.00012 | <0.00010 | | | | | | <0.00010 |
| Arsenic (As)-Dissolved (mg/L) | | 0.00074 | <0.00010 | | | | 0.00093 | | 0.00271 |
| Barium (Ba)-Dissolved (mg/L) | | 0.0645 | 0.0200 | | | | | | 0.112 |
| Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | | | | | | 0.000036 |
| Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | | | | | | <0.000050 |
| Boron (B)-Dissolved (mg/L) | | 0.206 | 0.079 | | | | | | 0.556 |
| Cadmium (Cd)-Dissolved (mg/L) | | <0.0000050 | 0.0000132 | | | | | | 0.0000113 |
| Calcium (Ca)-Dissolved (mg/L) | | 37.7 | 61.3 | | | | | | 160 |
| Chromium (Cr)-Dissolved (mg/L) | | <0.00010 | <0.00010 | | | | | | 0.00015 |
| Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | | | | | | <0.00010 |
| Copper (Cu)-Dissolved (mg/L) | | <0.00020 | 0.00271 | | | | | | 0.00036 |
| Iron (Fe)-Dissolved (mg/L) | | 0.321 | <0.010 | | | | | | 0.045 |
| Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | | | | | | <0.000050 |
| Lithium (Li)-Dissolved (mg/L) | | 0.0039 | 0.0016 | | | | | | 0.0239 |
| Magnesium (Mg)-Dissolved (mg/L) | 11.1 | 7.53 | | | | | | 19.4 | |
| Manganese (Mn)-Dissolved (mg/L) | 0.0805 | 0.00263 | | | | | | 0.111 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2012848-6 | | | |
|--------------------------------------|--|---------------------------------------|-----------|-------|------------|
| | | Water | 20-OCT-17 | 17:15 | MW12-07-02 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 1430 | | | |
| | Hardness (as CaCO3) (mg/L) | 661 | | | |
| | pH (pH) | 7.92 | | | |
| | Total Suspended Solids (mg/L) | 3.8 | | | |
| | TDS (Calculated) (mg/L) | 1140 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 104 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 104 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0220 | | | |
| | Chloride (Cl) (mg/L) | <2.5 ^{DLDS} | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.355 | | | |
| | Nitrate (as N) (mg/L) | 0.107 | | | |
| | Nitrite (as N) (mg/L) | 0.248 | | | |
| | Sulfate (SO4) (mg/L) | 752 | | | |
| | Anion Sum (meq/L) | 17.8 | | | |
| | Cation Sum (meq/L) | 16.7 | | | |
| | Cation - Anion Balance (%) | -3.2 | | | |
| | Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | | |
| Dissolved Metals Filtration Location | | FIELD | | | |
| Aluminum (Al)-Dissolved (mg/L) | | 0.0026 | | | |
| Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | | | |
| Arsenic (As)-Dissolved (mg/L) | | 0.00292 | | | |
| Barium (Ba)-Dissolved (mg/L) | | 0.0119 | | | |
| Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | | | |
| Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | | | |
| Boron (B)-Dissolved (mg/L) | | 0.213 | | | |
| Cadmium (Cd)-Dissolved (mg/L) | | 0.0000252 | | | |
| Calcium (Ca)-Dissolved (mg/L) | | 207 | | | |
| Chromium (Cr)-Dissolved (mg/L) | | <0.00010 | | | |
| Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | | | |
| Copper (Cu)-Dissolved (mg/L) | | 0.00056 | | | |
| Iron (Fe)-Dissolved (mg/L) | | 0.114 | | | |
| Lead (Pb)-Dissolved (mg/L) | | <0.000050 | | | |
| Lithium (Li)-Dissolved (mg/L) | | 0.0276 | | | |
| Magnesium (Mg)-Dissolved (mg/L) | | 34.8 | | | |
| Manganese (Mn)-Dissolved (mg/L) | | 0.109 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2012848-1 | L2012848-2 | L2012848-3 | L2012848-4 | L2012848-5 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 20-OCT-17 | 20-OCT-17 | 20-OCT-17 | 20-OCT-17 | 20-OCT-17 |
| | | Sampled Time | 14:05 | 14:40 | | | 16:45 |
| | | Client ID | MW09-03-01 | MW09-03-02 | DUP1 | DUP2 | MW12-07-01 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | | | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00461 | 0.00329 | | | 0.000840 |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00102 | <0.00050 | | | 0.00061 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | | | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 2.07 | 2.30 | | | 2.83 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000056 | 0.000254 | | | 0.00348 |
| | Silicon (Si)-Dissolved (mg/L) | | 5.25 | 5.40 | | | 8.70 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | | | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 9.81 | 7.64 | | | 92.9 |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.937 | 0.347 | | | 7.22 |
| | Sulfur (S)-Dissolved (mg/L) | | 6.22 | 1.93 | | | 71.4 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | | | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | 0.00184 | | | 0.00028 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | | | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000961 | 0.00301 | | | 0.000161 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | | | 0.00144 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0174 | 0.0137 | | | 0.0127 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | | | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2012848-6 | Water | 20-OCT-17 | 17:15 | MW12-07-02 |
|-------------------------|--|------------|-------|-----------|-------|------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0180 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.83 | | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000203 | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.73 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 78.8 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 10.7 | | | | |
| | Sulfur (S)-Dissolved (mg/L) | 245 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00164 | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0051 | | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2012848-1, -2, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2012848-1, -2, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2012848-1, -2, -5, -6 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2012848-1, -2, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2012848-1, -2, -5, -6 |
| Matrix Spike | Ammonia, Total (as N) | MS-B | L2012848-5 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2012848-1, -2, -5, -6 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| F-IC-N-VA | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |

Reference Information

| | | | |
|---|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-10-24 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|--|--|---------------------------|---|--|-----|--|------------------|-------|--------------|--------------|----------------------|-------|-----------------|-------|-------------|---|-----|---|-----|--|---|--|--|--|--|--|--|--|------------------|-----------------------|-------------------------|-------------------|---------------------------|--------------------------------|---|-----|--------------|--|--|--|--|----------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Contact and companyname below will appear on the final report | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: | 1-604-759-4659 | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 2 | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | | | | <table border="1"> <thead> <tr> <th>P</th> <th>F/P</th> <th>P</th> <th>F/P</th> <th>P</th> <th>F/P</th> <th colspan="2"></th> <th colspan="2"></th> <th colspan="2"></th> <th colspan="2"></th> <th></th> </tr> </thead> <tbody> <tr> <td rowspan="7" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Metals(TM)</td> <td rowspan="7" style="writing-mode: vertical-rl; transform: rotate(180deg);">Dissolved Metals (DM)</td> <td rowspan="7" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Mercury, Hardness</td> <td rowspan="7" style="writing-mode: vertical-rl; transform: rotate(180deg);">Dissolved Mercury</td> <td rowspan="7" style="writing-mode: vertical-rl; transform: rotate(180deg);">Ammonia (Total Nutrients)</td> <td rowspan="7" style="writing-mode: vertical-rl; transform: rotate(180deg);">Dissolved Organic Carbon (DOC)</td> <td rowspan="7" style="writing-mode: vertical-rl; transform: rotate(180deg);">pH, Cond., TSS, TDS, Alkalinity, Anions</td> <td rowspan="7" style="writing-mode: vertical-rl; transform: rotate(180deg);">NO3</td> <td rowspan="7" style="writing-mode: vertical-rl; transform: rotate(180deg);">Dissolved As</td> <td colspan="4"></td> <td rowspan="7" style="writing-mode: vertical-rl; transform: rotate(180deg);">Number of Containers</td> </tr> <tr><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td></tr> </tbody> </table> | | | | | | | | | | | P | F/P | P | F/P | P | F/P | | | | | | | | | | Total Metals(TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | NO3 | Dissolved As | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | |
| P | F/P | P | F/P | P | F/P | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Metals(TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | NO3 | Dissolved As | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Invoice To | | Invoice Distribution | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | | Sampler: | | | CH/CR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 <i>h</i> | MW09-03-01 | | | 20-Oct-17 | 14:05 | Water | | R | | R | R | | R | | | | | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 <i>h</i> | MW09-03-02 | | | 20-Oct-17 | 14:40 | Water | | R | | R | R | | R | | | | | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 <i>h</i> | DUP1 | | | 20-Oct-17 | | Water | | | | | | | | | R | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 <i>h</i> | DUP2 | | | 20-Oct-17 | | Water | | | | | | | | | | | R | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 <i>h</i> | MW12-07-01 | | | 20-Oct-17 | 16:45 | Water | | R | | R | R | | R | | | | | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 <i>h</i> | MW12-07-02 | | | 20-Oct-17 | 17:15 | Water | | R | | R | R | | R | | | | | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | INITIAL COOLER TEMPERATURES °C: <i>4°C</i> FINAL COOLER TEMPERATURES °C: <i>6</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: | Chris Harry | Date: | 2017-10-24 9:00 | Time: | | Received by: | | Date: | <i>OCT 25/17</i> | Time: | <i>11:02</i> | Received by: | <i>SL</i> | Date: | <i>10/26/17</i> | Time: | <i>12pm</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 23-OCT-17
Report Date: 09-NOV-17 13:28 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2011870
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-10-20 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2011870-1 Water 19-OCT-17 15:45 MW17-DP01 | L2011870-2 Water 19-OCT-17 16:10 MW17-DP02 | L2011870-3 Water 19-OCT-17 16:30 MW17-DP03 | |
|-----------------------------------|---|--|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 868 | 1610 | 1180 | |
| | Hardness (as CaCO3) (mg/L) | | 662 | 334 | |
| | pH (pH) | 8.32 | 8.14 | 8.20 | |
| | Total Suspended Solids (mg/L) | 7500 | 87.4 | 327 | |
| | TDS (Calculated) (mg/L) | 540 | 1190 | 798 | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 218 | 231 | 166 | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 5.4 | <1.0 | <1.0 | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 223 | 231 | 166 | |
| | Ammonia, Total (as N) (mg/L) | 1.62 | 11.5 | 3.71 | |
| | Chloride (Cl) (mg/L) | 25.6 | 44.7 | 17.7 | |
| | Nitrate and Nitrite (as N) (mg/L) | <0.025 | 24.2 | 0.039 | |
| | Nitrate (as N) (mg/L) | <0.025 ^{DLDS} | 23.8 | 0.030 | |
| | Nitrite (as N) (mg/L) | 0.0060 | 0.422 | 0.0093 | |
| | Sulfate (SO4) (mg/L) | 192 | 575 | 425 | |
| | Anion Sum (meq/L) | 9.37 | 19.6 | 12.8 | |
| | Cation Sum (meq/L) | 8.43 | 17.1 | 12.0 | |
| | Cation - Anion Balance (%) | -5.3 | -6.9 | -3.0 | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 9.56 | 5.76 | 5.03 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 6.76 | 3.76 | |
| | Antimony (Sb)-Total (mg/L) | | 0.00033 | 0.00033 | |
| | Arsenic (As)-Total (mg/L) | | 0.00178 | 0.00252 | |
| | Barium (Ba)-Total (mg/L) | | 0.162 | 0.0903 | |
| | Beryllium (Be)-Total (mg/L) | | 0.000224 | 0.000373 | |
| | Bismuth (Bi)-Total (mg/L) | | 0.000072 | 0.000070 | |
| | Boron (B)-Total (mg/L) | | 0.268 | 0.133 | |
| | Cadmium (Cd)-Total (mg/L) | | 0.000992 | 0.00121 | |
| | Calcium (Ca)-Total (mg/L) | | 168 | 92.7 | |
| | Chromium (Cr)-Total (mg/L) | | 0.0225 | 0.0283 | |
| | Cobalt (Co)-Total (mg/L) | | 0.00599 | 0.00625 | |
| | Copper (Cu)-Total (mg/L) | | 0.628 | 2.43 | |
| | Iron (Fe)-Total (mg/L) | | 13.0 | 12.6 | |
| | Lead (Pb)-Total (mg/L) | | 0.00334 | 0.00681 | |
| | Lithium (Li)-Total (mg/L) | | 0.0152 | 0.0097 | |
| | Magnesium (Mg)-Total (mg/L) | | 65.8 | 31.4 | |
| | Manganese (Mn)-Total (mg/L) | | 1.92 | 1.64 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2011870-1 Water 19-OCT-17 15:45 MW17-DP01 | L2011870-2 Water 19-OCT-17 16:10 MW17-DP02 | L2011870-3 Water 19-OCT-17 16:30 MW17-DP03 | |
|-------------------------|---|--|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | | ^{DLM} <0.000025 | 0.000252 | |
| | Molybdenum (Mo)-Total (mg/L) | | 0.107 | 0.0199 | |
| | Nickel (Ni)-Total (mg/L) | | 0.0200 | 0.0285 | |
| | Phosphorus (P)-Total (mg/L) | | 0.280 | 0.621 | |
| | Potassium (K)-Total (mg/L) | | 33.0 | 42.7 | |
| | Selenium (Se)-Total (mg/L) | | 0.00201 | 0.00132 | |
| | Silicon (Si)-Total (mg/L) | | 15.9 | 9.64 | |
| | Silver (Ag)-Total (mg/L) | | 0.000241 | 0.000055 | |
| | Sodium (Na)-Total (mg/L) | | 50.2 | 89.4 | |
| | Strontium (Sr)-Total (mg/L) | | 20.2 | 8.83 | |
| | Sulfur (S)-Total (mg/L) | | 193 | 152 | |
| | Thallium (Tl)-Total (mg/L) | | 0.000129 | 0.000091 | |
| | Tin (Sn)-Total (mg/L) | | 0.00092 | 0.00031 | |
| | Titanium (Ti)-Total (mg/L) | | 0.404 | 0.0721 | |
| | Uranium (U)-Total (mg/L) | | 0.0103 | 0.00147 | |
| | Vanadium (V)-Total (mg/L) | | 0.0279 | 0.0222 | |
| | Zinc (Zn)-Total (mg/L) | | 0.0625 | 0.0554 | |
| | Zirconium (Zr)-Total (mg/L) | | 0.00055 | 0.00077 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0149 | 0.0128 | 0.0103 | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00074 | 0.00021 | 0.00026 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00074 | 0.00072 | 0.00066 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0401 | 0.0277 | 0.0434 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | 0.257 | 0.246 | 0.125 | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000494 | 0.000599 | 0.000255 | |
| | Calcium (Ca)-Dissolved (mg/L) | 41.9 | 161 | 84.9 | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00098 | 0.00030 | 0.00055 | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00093 | 0.00236 | 0.00161 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0733 | 0.0518 | 0.0724 | |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | 0.013 | 0.012 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0054 | 0.0120 | 0.0078 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 13.6 | 62.9 | 29.7 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.498 | 1.61 | 1.27 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2011870-1 Water 19-OCT-17 15:45 MW17-DP01 | L2011870-2 Water 19-OCT-17 16:10 MW17-DP02 | L2011870-3 Water 19-OCT-17 16:30 MW17-DP03 | | |
|-------------------------|---|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | 0.0000137 ^{DTMF} | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0407 | 0.108 | 0.0328 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0210 | 0.0136 | 0.0183 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 24.5 | 32.3 | 42.7 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000710 | 0.00200 | 0.00162 ^{DTMF} | | |
| | Silicon (Si)-Dissolved (mg/L) | 2.69 | 3.96 | 3.96 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | 0.000013 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 103 | 50.0 | 90.5 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 3.15 | 20.3 | 8.52 | | |
| | Sulfur (S)-Dissolved (mg/L) | 60.7 | 193 | 145 | | |
| | Thallium (Tl)-Dissolved (mg/L) | 0.000013 | 0.000039 | 0.000041 | | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00060 | 0.00026 | 0.00013 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00060 ^{DLM} | <0.00060 ^{DLM} | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000711 | 0.00962 | 0.000488 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0258 | 0.0103 | 0.0050 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2011870-1, -2, -3 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2011870-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2011870-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2011870-1 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2011870-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2011870-1 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2011870-1 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2011870-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2011870-1 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2011870-1 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2011870-1 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2011870-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2011870-1 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2011870-1 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2011870-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2011870-1 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2011870-1 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L2011870-1 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2011870-2, -3 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2011870-2, -3 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2011870-2, -3 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2011870-2, -3 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2011870-2, -3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2011870-2, -3 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2011870-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| DTMF | Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants were likely introduced to dissolved sample during field filtration. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are | | | |

Reference Information

determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CL-IC-N-VA Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-10-20 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 30-AUG-17
Report Date: 05-OCT-17 19:35 (MT)
Version: FINAL REV. 2

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1983905
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-08-30 B
Legal Site Desc:

Comments: 5-OCT-2017 Please note, this report has been revised to include additional bromide data.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1983905-1 Water 29-AUG-17 10:35 MW12-06-01 | L1983905-2 Water 29-AUG-17 11:05 MW12-06-02 | L1983905-3 Water 29-AUG-17 11:25 MW12-06-03 | L1983905-4 Water 29-AUG-17 11:40 MW12-06-04 | L1983905-5 Water 29-AUG-17 13:25 MW12-06-05 | |
|---|---|---|---|---|---|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 801 | 1040 | 1040 | 1020 | 1000 |
| | Hardness (as CaCO3) (mg/L) | 267 | 453 | 475 | 483 | 494 |
| | pH (pH) | 7.60 | 7.66 | 7.74 | 7.83 | 7.81 |
| | Total Suspended Solids (mg/L) | 3.3 | 80.0 | 5.3 | 4.0 | 6.0 |
| | TDS (Calculated) (mg/L) | 387 | 644 | 619 | 627 | 630 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 364 | 357 | 354 | 398 | 400 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 364 | 357 | 354 | 398 | 400 |
| | Ammonia, Total (as N) (mg/L) | 0.612 | 0.0519 | 0.0673 | 0.0110 | 0.0131 |
| | Bromide (Br) (mg/L) | | | | | |
| | Chloride (Cl) (mg/L) | 5.02 | 0.77 | 0.65 | 0.64 | 0.64 |
| | Nitrate and Nitrite (as N) (mg/L) | 1.19 | 0.343 | 0.169 | 0.153 | 0.151 |
| | Nitrate (as N) (mg/L) | 0.251 | 0.083 | 0.038 | 0.034 | 0.034 |
| | Nitrite (as N) (mg/L) | 0.936 | 0.259 | 0.131 | 0.118 | 0.117 |
| | Sulfate (SO4) (mg/L) | <5.0 | 224 | 206 | 190 | 188 |
| | Anion Sum (meq/L) | 7.51 | 11.8 | 11.4 | 11.9 | 11.9 |
| | Cation Sum (meq/L) | 8.07 | 10.9 | 11.2 | 11.3 | 11.5 |
| | Cation - Anion Balance (%) | 3.6 | -4.0 | -0.7 | -2.7 | -1.7 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0182 | 0.0012 | 0.0017 | 0.0015 | 0.0015 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00042 | <0.00010 | 0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00828 | 0.00403 | 0.00062 | 0.00238 | 0.00076 |
| | Barium (Ba)-Dissolved (mg/L) | 0.224 | 0.0305 | 0.0256 | 0.0176 | 0.0418 |
| | Beryllium (Be)-Dissolved (mg/L) | 0.000095 | 0.000039 | 0.000022 | 0.000028 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.989 | 0.182 | 0.108 | 0.101 | 0.101 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000112 | <0.0000050 | 0.0000247 | 0.0000054 | 0.0000103 |
| | Calcium (Ca)-Dissolved (mg/L) | 79.0 | 127 | 107 | 103 | 102 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00314 | <0.00010 | 0.00026 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00117 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00337 | <0.00020 | <0.00020 | <0.00020 | 0.00024 |
| | Iron (Fe)-Dissolved (mg/L) | 0.222 | 1.10 | 1.14 | 0.706 | 0.137 |
| | Lead (Pb)-Dissolved (mg/L) | 0.000064 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0090 | 0.0078 | 0.0072 | 0.0061 | 0.0062 |
| | Magnesium (Mg)-Dissolved (mg/L) | 17.0 | 32.8 | 50.7 | 54.8 | 58.2 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1983905-6 Water 29-AUG-17 13:40 MW12-06-06 | L1983905-7 Water 29-AUG-17 DUP | L1983905-8 Water 29-AUG-17 16:28 MW17-09-01 | |
|-----------------------------|---|---|---|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 845 | 833 | 400 | |
| | Hardness (as CaCO3) (mg/L) | 401 | 402 | 808 | |
| | pH (pH) | 7.84 | 7.87 | 8.15 | |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | 89.0 | |
| | TDS (Calculated) (mg/L) | 519 | 522 | 621 | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 315 | 318 | 175 | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 315 | 318 | 175 | |
| | Ammonia, Total (as N) (mg/L) | 0.0050 | <0.0050 | 0.120 | |
| | Bromide (Br) (mg/L) | | | <0.050 | |
| | Chloride (Cl) (mg/L) | 6.48 | 6.51 | 44.1 | |
| | Nitrate and Nitrite (as N) (mg/L) | 1.18 | 1.17 | 1.18 | |
| | Nitrate (as N) (mg/L) | 1.10 | 1.10 | 1.11 | |
| | Nitrite (as N) (mg/L) | 0.0793 | 0.0756 | 0.0653 | |
| | Sulfate (SO4) (mg/L) | 155 | 155 | 56.8 | |
| | Anion Sum (meq/L) | 9.80 | 9.86 | 6.01 | |
| | Cation Sum (meq/L) | 9.50 | 9.50 | 21.8 | |
| | Cation - Anion Balance (%) | -1.5 | -1.9 | 56.8 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0016 | <0.0010 | 0.0056 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00425 | |
| | Arsenic (As)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00276 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0146 | 0.0144 | 0.113 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000040 ^{DLM} | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.00010 ^{DLM} | |
| | Boron (B)-Dissolved (mg/L) | 0.075 | 0.077 | 0.129 ^{DLM} | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000055 | 0.0000070 | <0.00025 ^{DLM} | |
| | Calcium (Ca)-Dissolved (mg/L) | 77.4 | 79.7 | 198 | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00020 | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00277 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00036 | 0.00032 | 0.00459 | |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | <0.010 | 1.41 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | 0.00016 | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0047 | 0.0048 | 0.0256 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 50.5 | 49.3 | 76.2 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

05-OCT-17 19:35 (MT)

Version: FINAL REV. 2

| | | Sample ID | L1983905-1 | L1983905-2 | L1983905-3 | L1983905-4 | L1983905-5 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 29-AUG-17 | 29-AUG-17 | 29-AUG-17 | 29-AUG-17 | 29-AUG-17 |
| | | Sampled Time | 10:35 | 11:05 | 11:25 | 11:40 | 13:25 |
| | | Client ID | MW12-06-01 | MW12-06-02 | MW12-06-03 | MW12-06-04 | MW12-06-05 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | 0.0799 | 0.0260 | 0.0149 | 0.0408 | 0.356 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00104 | 0.00715 | 0.00174 | 0.00771 | 0.00850 |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00073 | <0.00050 | <0.00050 | <0.00050 | 0.00083 |
| | Phosphorus (P)-Dissolved (mg/L) | | 0.055 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 2.55 | 3.53 | 3.96 | 3.72 | 3.96 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000560 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Silicon (Si)-Dissolved (mg/L) | | 7.67 | 10.1 | 9.35 | 8.73 | 8.31 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 60.0 | 39.4 | 36.6 | 35.0 | 35.7 |
| | Strontium (Sr)-Dissolved (mg/L) | | 3.04 | 9.24 | 4.11 | 2.85 | 2.56 |
| | Sulfur (S)-Dissolved (mg/L) | | 2.48 | 71.4 | 69.8 | 62.5 | 60.5 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00022 | <0.00010 | 0.00013 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | 0.00236 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000720 | 0.00234 | 0.00215 | 0.00562 | 0.00589 |
| | Vanadium (V)-Dissolved (mg/L) | | 0.0136 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0066 | 0.0029 | 0.0092 | 0.0125 | 0.0185 |
| | Zirconium (Zr)-Dissolved (mg/L) | | 0.00109 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1983905-6 Water 29-AUG-17 13:40 MW12-06-06 | L1983905-7 Water 29-AUG-17 DUP | L1983905-8 Water 29-AUG-17 16:28 MW17-09-01 | |
|-------------------------|---|---|---|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | 0.0383 | 0.0384 | 0.490 | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00514 | 0.00539 | 0.464 | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.0183 | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.10 ^{DLM} | |
| | Potassium (K)-Dissolved (mg/L) | 3.50 | 3.49 | 15.4 | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000316 | 0.000332 | 0.0111 | |
| | Silicon (Si)-Dissolved (mg/L) | 7.22 | 6.82 | 27.6 ^{DLM} | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000020 | |
| | Sodium (Na)-Dissolved (mg/L) | 32.0 | 31.5 | 118 | |
| | Strontium (Sr)-Dissolved (mg/L) | 1.42 | 1.51 | 3.17 | |
| | Sulfur (S)-Dissolved (mg/L) | 55.0 | 52.0 | 127 | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000020 ^{DLM} | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00290 | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00075 ^{DLM} | |
| | Uranium (U)-Dissolved (mg/L) | 0.00403 | 0.00407 | 0.000552 ^{DLM} | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.0010 ^{DLM} | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0133 | 0.0147 | 0.141 | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--|
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1983905-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Cadmium (Cd)-Dissolved | MS-B | L1983905-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1983905-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1983905-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1983905-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1983905-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1983905-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1983905-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Zinc (Zn)-Dissolved | MS-B | L1983905-1, -2, -3, -4, -5, -6, -7, -8 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |

Reference Information

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

| | | | |
|---|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-MAN-WR | Water | Total Suspended Solids by Gravimetric | APHA 2540 D |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-08-30 B

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

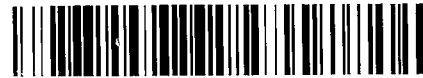
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



COC Number: 2017-08-30 B

Page 1 of 1

Canada Toll Free: 1 800 668 9878

L1983905-COFC

www.alsglobal.com

| | | | | | | | | | | | | | | | | | | | | |
|--|--|--|-------|--------------|--|--------------|--------------|------------------|-----------------------|--|-------------|--|--|--|----------------------|-------------------|---------------------------|--------------------------------|------------------------------------|---|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | EMERGENCY | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | 4 day [P4] <input type="checkbox"/> | | | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | P F/P P F/P P F/P | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | P F/P P F/P P F/P | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | Total Metals(TM) | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | Dissolved Metals (DM) | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | Total Mercury, Hardness | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: PO# | | | Dissolved Mercury | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: Routing Code: | | | Ammonia (Total Nutrients) | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | Dissolved Organic Carbon (DOC) | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | pH, Cond., TSS, Alkalinity, Anions | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | | Sampler: | | | CH/CR | | | RUSH | | | | Number of Containers | | | | | |
| ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals(TM) | Dissolved Metals (DM) | Total Mercury, Hardness | | | | | | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, Alkalinity, Anions | |
| | | MW12-06-01 | | | 29-Aug-17 | 10:35 | Water | E1 | E1 | E1 | | | | | | E1 | E1 | E1 | E1 | 4 |
| | | MW12-06-02 | | | 29-Aug-17 | 11:05 | Water | E1 | E1 | E1 | | | | | | E1 | E1 | E1 | E1 | 4 |
| | | MW12-06-03 | | | 29-Aug-17 | 11:25 | Water | E1 | E1 | E1 | | | | | | E1 | E1 | E1 | E1 | 4 |
| | | MW12-06-04 | | | 29-Aug-17 | 11:40 | Water | E1 | E1 | E1 | | | | | | E1 | E1 | E1 | E1 | 4 |
| | | MW12-06-05 | | | 29-Aug-17 | 13:25 | Water | E1 | E1 | E1 | | | | | | E1 | E1 | E1 | E1 | 4 |
| | | MW12-06-06 | | | 29-Aug-17 | 13:40 | Water | E1 | E1 | E1 | | | | | | E1 | E1 | E1 | E1 | 4 |
| | | DUP | | | 29-Aug-17 | | Water | E1 | E1 | E1 | | | | | | E1 | E1 | E1 | E1 | 4 |
| | | MW17-09-01 | | | 29-Aug-17 | 16:28 | Water | E1 | E1 | E1 | | | | | | E1 | E1 | E1 | E1 | 4 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> | | | | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> | | | | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | | | | | |
| | | | | | 7°C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | |
| | | | | | 10 | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-08-30 7:45 | Time: | Received by: | Date: Aug 30 17 | Time: 14:33 | Received by: | Date: 9/1/17 | Time: 18:30 | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-AUG-17
Report Date: 29-AUG-17 15:24 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1976082
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-08-16 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1976082-1 | L1976082-2 | L1976082-3 | | |
|--------------------------------------|---|---------------------------------------|----------------------|----------------------|----------------------|-------|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 15-AUG-17 | 15-AUG-17 | 15-AUG-17 | | |
| | | Sampled Time | 15:35 | 16:00 | | | |
| | | Client ID | MW12-07-01 | MW12-07-02 | DUP | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 1100 | 1460 | 1450 | | |
| | Hardness (as CaCO3) (mg/L) | | 454 | 660 | 671 | | |
| | pH (pH) | | 7.83 | 7.88 | 7.87 | | |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | 4.0 | | |
| | TDS (Calculated) (mg/L) | | 599 | 1130 | 1140 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 554 | 106 | 105 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 554 | 106 | 105 | | |
| | Ammonia, Total (as N) (mg/L) | | 0.218 | 0.0387 | 0.0234 | | |
| | Chloride (Cl) (mg/L) | | <2.5 ^{DLDS} | <2.5 ^{DLDS} | <2.5 ^{DLDS} | | |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.133 | 0.281 | 0.283 | | |
| | Nitrate (as N) (mg/L) | | 0.044 | 0.081 | 0.088 | | |
| | Nitrite (as N) (mg/L) | | 0.0891 | 0.199 | 0.195 | | |
| | Sulfate (SO4) (mg/L) | | 12.4 | 754 | 756 | | |
| | Anion Sum (meq/L) | | 11.3 | 17.8 | 17.9 | | |
| | Cation Sum (meq/L) | | 12.6 | 16.2 | 16.5 | | |
| | Cation - Anion Balance (%) | | 5.4 | -4.7 | -4.0 | | |
| | Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD | |
| Dissolved Metals Filtration Location | | | FIELD | FIELD | FIELD | | |
| Aluminum (Al)-Dissolved (mg/L) | | | 0.0049 | 0.0047 | 0.0025 | | |
| Antimony (Sb)-Dissolved (mg/L) | | | 0.00013 | 0.00012 | 0.00010 | | |
| Arsenic (As)-Dissolved (mg/L) | | | 0.00034 | 0.00142 | 0.00144 | | |
| Barium (Ba)-Dissolved (mg/L) | | | 0.127 | 0.0137 | 0.0137 | | |
| Beryllium (Be)-Dissolved (mg/L) | | | 0.000046 | <0.000020 | <0.000020 | | |
| Bismuth (Bi)-Dissolved (mg/L) | | | <0.000050 | <0.000050 | <0.000050 | | |
| Boron (B)-Dissolved (mg/L) | | | 0.388 | 0.204 | 0.209 | | |
| Cadmium (Cd)-Dissolved (mg/L) | | | <0.0000050 | 0.0000115 | <0.0000050 | | |
| Calcium (Ca)-Dissolved (mg/L) | | | 155 | 213 | 217 | | |
| Chromium (Cr)-Dissolved (mg/L) | | | 0.00025 | <0.00010 | <0.00010 | | |
| Cobalt (Co)-Dissolved (mg/L) | | | <0.00010 | <0.00010 | <0.00010 | | |
| Copper (Cu)-Dissolved (mg/L) | | | <0.00020 | 0.00070 | 0.00028 | | |
| Iron (Fe)-Dissolved (mg/L) | | | 0.035 | 0.132 | 0.132 | | |
| Lead (Pb)-Dissolved (mg/L) | | | 0.000380 | <0.000050 | <0.000050 | | |
| Lithium (Li)-Dissolved (mg/L) | | | 0.0261 | 0.0282 | 0.0285 | | |
| Magnesium (Mg)-Dissolved (mg/L) | | | 16.3 | 30.9 | 31.6 | | |
| Manganese (Mn)-Dissolved (mg/L) | | | 0.103 | 0.0986 | 0.100 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1976082-1 | L1976082-2 | L1976082-3 | | |
|-------------------------|----------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 15-AUG-17 | 15-AUG-17 | 15-AUG-17 | | |
| | | Sampled Time | 15:35 | 16:00 | | | |
| | | Client ID | MW12-07-01 | MW12-07-02 | DUP | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.000252 | 0.0178 | 0.0179 | | |
| | Nickel (Ni)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | | 2.62 | 2.74 | 2.73 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.00145 | 0.000193 | 0.000137 | | |
| | Silicon (Si)-Dissolved (mg/L) | | 9.16 | 5.90 | 5.93 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 79.9 | 68.3 | 69.3 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 6.50 | 10.5 | 10.5 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 31.4 | 245 | 253 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00258 | 0.00043 | 0.00043 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | 0.00053 | 0.00042 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.000152 | 0.00180 | 0.00175 | | |
| | Vanadium (V)-Dissolved (mg/L) | | 0.00162 | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0041 | 0.0032 | 0.0027 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Antimony (Sb)-Dissolved | MS-B | L1976082-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1976082-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1976082-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1976082-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1976082-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1976082-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1976082-1, -2, -3 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L1976082-1, -2, -3 |
| Matrix Spike | Zinc (Zn)-Dissolved | MS-B | L1976082-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |

Reference Information

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

| | | | |
|--|-------|--|---|
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| SO4-IC-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-MAN-WR | Water | Total Suspended Solids by Gravimetric | APHA 2540 D |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

Reference Information

2017-08-16 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1976082-COFC

COC Number: 2017-08-16 B

Page 1 of 1

| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | |
|--|--|--|-----------------|--------------|---|---|---|-------------------|--|--------------------------------|---|-------------|--|--|--|--|--|--|--|---|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> | EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | Analysis Request | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | P | F/P | P | F/P | P | F/P | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Total Metals(TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | PO# | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | Routing Code: | | | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Sampler: CH/CP | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals(TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | | | | | | | | | |
| 1 | MW12-07-01 | 15-Aug-17 | 15:35 | Water | | R | | R | R | | R | | | | | | | | | 4 |
| 2 | MW12-07-02 | 15-Aug-17 | 16:00 | Water | | | | | | | | | | | | | | | | 4 |
| 3 | DUP | 15-Aug-17 | | Water | | | | | | | | | | | | | | | | 4 |
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| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> | | Ice Cubes <input type="checkbox"/> | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | |
| | | | | | 5 °C | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-08-16 8:30 | Time: | Received by: | Date: Aug 16/17. | Time: 14:22 | Received by: | | | | Date: Aug 17/17 | Time: 13:18 | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 WHITE - LABORATORY COPY YELLOW - CLIENT COPY OCTOBER 2015 FRONT
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white -report copy.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

6.7.30C



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-AUG-17
Report Date: 25-AUG-17 17:56 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1975619
Project P.O. #: 224161
Job Reference:
C of C Numbers: 2017-08-15 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1975619-1 Water 13-AUG-17 09:20 MW09-03-01 | L1975619-2 Water 13-AUG-17 10:00 MW09-03-02 | L1975619-3 Water 13-AUG-17 DUP1 | L1975619-4 Water 13-AUG-17 DUP2 | |
|---|---|---|--|--|---------|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 310 | 379 | | |
| | Hardness (as CaCO3) (mg/L) | 140 | 183 | 140 | |
| | pH (pH) | 8.28 | 8.28 | | |
| | Total Suspended Solids (mg/L) | <3.0 | 15.3 | | |
| | TDS (Calculated) (mg/L) | 169 | 213 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 147 | 196 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 147 | 196 | | |
| | Ammonia, Total (as N) (mg/L) | 0.0404 | <0.0050 | | <0.0050 |
| | Chloride (Cl) (mg/L) | <0.50 | 0.70 | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.0654 | 2.76 | | |
| | Nitrate (as N) (mg/L) | <0.0050 | 2.69 | | |
| | Nitrite (as N) (mg/L) | 0.0654 | 0.0683 | | |
| | Sulfate (SO4) (mg/L) | 20.0 | 6.5 | | |
| | Anion Sum (meq/L) | 3.36 | 4.27 | | |
| | Cation Sum (meq/L) | 3.27 | 3.95 | | |
| | Cation - Anion Balance (%) | -1.3 | -3.9 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0031 | 0.0040 | 0.0025 | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00033 | 0.00010 | 0.00028 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00095 | 0.00012 | 0.00086 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0717 | 0.0674 | 0.0715 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | 0.234 | 0.093 | 0.236 | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000136 | 0.0000194 | 0.0000073 | |
| | Calcium (Ca)-Dissolved (mg/L) | 37.3 | 60.0 | 37.8 | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00012 | <0.00010 | <0.00010 | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Copper (Cu)-Dissolved (mg/L) | <0.00040 ^{DLB} | 0.00340 | <0.00020 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.339 | 0.015 | 0.339 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0040 | 0.0014 | 0.0040 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 11.4 | 8.05 | 11.1 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0873 | 0.0178 | 0.0874 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1975619-1 | L1975619-2 | L1975619-3 | L1975619-4 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 13-AUG-17 | 13-AUG-17 | 13-AUG-17 | 13-AUG-17 |
| | | Sampled Time | 09:20 | 10:00 | | |
| | | Client ID | MW09-03-01 | MW09-03-02 | DUP1 | DUP2 |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00448 | 0.00511 | 0.00454 | |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00102 | <0.00050 | 0.00099 | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | |
| | Potassium (K)-Dissolved (mg/L) | | 2.18 | 2.51 | 2.14 | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000082 | 0.000211 | 0.000080 | |
| | Silicon (Si)-Dissolved (mg/L) | | 5.25 | 5.04 | 5.06 | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | |
| | Sodium (Na)-Dissolved (mg/L) | | 8.98 | 5.15 | 8.86 | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.909 | 0.378 | 0.927 | |
| | Sulfur (S)-Dissolved (mg/L) | | 6.94 | 2.38 | 6.60 | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00016 | 0.00027 | 0.00017 | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | |
| | Uranium (U)-Dissolved (mg/L) | | 0.000982 | 0.00358 | 0.00101 | |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0304 | 0.0179 | 0.0308 | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Method Blank | Copper (Cu)-Dissolved | MB-LOR | L1975619-1, -3 |
| Method Blank | Lead (Pb)-Dissolved | MB-LOR | L1975619-1, -3 |
| Method Blank | Zinc (Zn)-Dissolved | MB-LOR | L1975619-1, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1975619-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1975619-2 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1975619-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1975619-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1975619-2 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1975619-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1975619-2 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1975619-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1975619-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1975619-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1975619-2 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1975619-2 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLB | Detection Limit Raised. Analyte detected at comparable level in Method Blank. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are

Reference Information

included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-08-15 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



COC Number: 2017-08-15 A

Canada Toll Free: 1 800 668 9878

L1975619-COFC

www.alsglobal.com

| Report To | | Report Format / Distribution | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|--------------|--|-------------------------------------|-------------------------|-------------------|------------------------------|--|------------------------------------|---------------|--|--|--|--|--|--|--|----------------------|--|---|--|--|--|--|--|--|--|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | P | F/P | P | F/P | P | F/P | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | Total Metals(TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, Alkalinity, Anions | | | | | | | | | Number of Containers | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | | | | | | | PO# | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | | | | | | | Routing Code: | | | | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | Location: | | | | | | | | | | | | | | | | | | |
| LSD: | | ALS Contact: | | Sampler: CH/CP | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | | | | | | | | |
| MW09-03-01 | | 13-Aug-17 | 9:20 | Water | | R | | R | R | | R | | | | | | | | | | 4 | | | | | | | | |
| MW09-03-02 | | 13-Aug-17 | 10:00 | Water | | R | | R | R | | R | | | | | | | | | | 4 | | | | | | | | |
| DUP1 | | 13-Aug-17 | | Water | | R | | | | | | | | | | | | | | | 1 | | | | | | | | |
| DUP2 | | 13-Aug-17 | | Water | | | | | R | | | | | | | | | | | | 1 | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | INITIAL COOLER TEMPERATURES °C | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | | | | |
| | | | | 5°C | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: Chris Harry | Date: 2017-08-15 8:00 | Time: | Received by: | Date: Aug 16, 2017 | Time: 09:15 | Received by: | Date: Aug 17/17 | Time: 1315 | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

OCTOBER 2015 FRONT
6, 7, 3°C



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 01-AUG-17
Report Date: 14-AUG-17 13:18 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1968910
Project P.O. #: 224161 (GW)
Job Reference:
C of C Numbers: 2017-08-01 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1968910-1 WATER 28-JUL-17 14:00 MW12-07-01 | L1968910-2 WATER 28-JUL-17 14:45 MW12-07-02 | L1968910-3 WATER 29-JUL-17 10:55 MW09-03-01 | L1968910-4 WATER 29-JUL-17 11:50 MW09-03-02 | L1968910-5 WATER 29-JUL-17 DUP 1 |
|---|---|---|---|---|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 1100 | 1450 | 319 | 352 |
| | Hardness (as CaCO3) (mg/L) | 480 | 700 | 151 | 183 |
| | pH (pH) | 7.85 | 7.85 | 8.17 | 8.03 |
| | Total Suspended Solids (mg/L) | 6.1 | 4.3 | <3.0 | 9.1 |
| | TDS (Calculated) (mg/L) | 637 | 1130 | 178 | 202 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 573 | 111 | 148 | 179 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 573 | 111 | 148 | 179 |
| | Ammonia, Total (as N) (mg/L) | 0.279 | 0.0221 | 0.0853 | 0.0088 |
| | Chloride (Cl) (mg/L) | <2.5 ^{DLDS} | <2.5 ^{DLDS} | 0.42 | 0.57 |
| | Fluoride (F) (mg/L) | 1.01 | 1.23 | 1.76 | 0.427 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.188 | 0.302 | 0.270 | 2.32 |
| | Nitrate (as N) (mg/L) | 0.060 | 0.094 | 0.0211 | 2.18 |
| | Nitrite (as N) (mg/L) | 0.128 | 0.208 | 0.249 | 0.145 |
| | Sulfate (SO4) (mg/L) | 15.9 | 722 | 21.9 | 7.1 |
| | Anion Sum (meq/L) | 11.9 | 17.3 | 3.53 | 3.93 |
| | Cation Sum (meq/L) | 13.7 | 17.5 | 3.52 | 4.00 |
| | Cation - Anion Balance (%) | 7.4 | 0.4 | -0.2 | 0.8 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | LAB | LAB | LAB | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0026 | 0.0014 | 0.0026 | 0.0028 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00026 | 0.00014 | 0.00041 | 0.00016 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00081 | 0.00164 | 0.00085 | 0.00021 |
| | Barium (Ba)-Dissolved (mg/L) | 0.146 | 0.0167 | 0.0695 | 0.169 |
| | Beryllium (Be)-Dissolved (mg/L) | 0.000037 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.399 | 0.245 | 0.216 | 0.153 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000050 | <0.000010 ^{DLM} | <0.000050 | 0.0000732 |
| | Calcium (Ca)-Dissolved (mg/L) | 159 | 219 | 40.2 | 58.5 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00020 | <0.00010 | <0.00010 | 0.00013 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | <0.00020 | <0.00020 | 0.00029 | 0.00229 |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | 0.000127 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0267 | 0.0287 | 0.0039 | 0.0013 |
| | Magnesium (Mg)-Dissolved (mg/L) | 20.1 | 37.4 | 12.3 | 8.86 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1968910-6 | WATER | 29-JUL-17 | DUP 2 |
|-----------------------------|--|------------|-------|-----------|-------|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) Hardness (as CaCO3) (mg/L) pH (pH) Total Suspended Solids (mg/L) TDS (Calculated) (mg/L) | | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) Alkalinity, Carbonate (as CaCO3) (mg/L) Alkalinity, Hydroxide (as CaCO3) (mg/L) Alkalinity, Total (as CaCO3) (mg/L) Ammonia, Total (as N) (mg/L) Chloride (Cl) (mg/L) Fluoride (F) (mg/L) Nitrate and Nitrite (as N) (mg/L) Nitrate (as N) (mg/L) Nitrite (as N) (mg/L) Sulfate (SO4) (mg/L) Anion Sum (meq/L) Cation Sum (meq/L) Cation - Anion Balance (%) | 0.0076 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location Dissolved Metals Filtration Location Aluminum (Al)-Dissolved (mg/L) Antimony (Sb)-Dissolved (mg/L) Arsenic (As)-Dissolved (mg/L) Barium (Ba)-Dissolved (mg/L) Beryllium (Be)-Dissolved (mg/L) Bismuth (Bi)-Dissolved (mg/L) Boron (B)-Dissolved (mg/L) Cadmium (Cd)-Dissolved (mg/L) Calcium (Ca)-Dissolved (mg/L) Chromium (Cr)-Dissolved (mg/L) Cobalt (Co)-Dissolved (mg/L) Copper (Cu)-Dissolved (mg/L) Iron (Fe)-Dissolved (mg/L) Lead (Pb)-Dissolved (mg/L) Lithium (Li)-Dissolved (mg/L) Magnesium (Mg)-Dissolved (mg/L) | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1968910-1 | L1968910-2 | L1968910-3 | L1968910-4 | L1968910-5 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | WATER | WATER | WATER | WATER | WATER |
| | | Sampled Date | 28-JUL-17 | 28-JUL-17 | 29-JUL-17 | 29-JUL-17 | 29-JUL-17 |
| | | Sampled Time | 14:00 | 14:45 | 10:55 | 11:50 | |
| | | Client ID | MW12-07-01 | MW12-07-02 | MW09-03-01 | MW09-03-02 | DUP 1 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | 0.114 | 0.110 | 0.0859 | 0.0111 | 0.0874 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.000473 | 0.0192 | 0.00491 | 0.0106 | 0.0158 |
| | Nickel (Ni)-Dissolved (mg/L) | | <0.00050 | <0.00050 | 0.00122 | 0.00084 | 0.00106 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 3.24 | 3.25 | 2.48 | 3.16 | 2.62 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000277 | 0.000104 | <0.000050 | 0.000202 | 0.000418 |
| | Silicon (Si)-Dissolved (mg/L) | | 9.72 | 6.31 | 5.45 | 5.32 | 6.39 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | 0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 92.9 | 78.6 | 9.69 | 6.10 | 27.9 |
| | Strontium (Sr)-Dissolved (mg/L) | | 6.79 | 11.1 | 1.01 | 0.405 | 0.939 |
| | Sulfur (S)-Dissolved (mg/L) | | 11.1 | 267 | 7.85 | 2.72 | 6.92 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | 0.00020 | 0.00011 | 0.00047 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000159 | 0.00180 | 0.000981 | 0.00341 | 0.000939 |
| | Vanadium (V)-Dissolved (mg/L) | | 0.00183 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0327 | 0.0153 | 0.0228 | 0.0291 | 0.0213 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1968910-6 | WATER | 29-JUL-17 | DUP 2 |
|-------------------------|--|------------|-------|-----------|-------|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | | | |
| | Mercury (Hg)-Dissolved (mg/L) | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | | | | |
| | Potassium (K)-Dissolved (mg/L) | | | | |
| | Selenium (Se)-Dissolved (mg/L) | | | | |
| | Silicon (Si)-Dissolved (mg/L) | | | | |
| | Silver (Ag)-Dissolved (mg/L) | | | | |
| | Sodium (Na)-Dissolved (mg/L) | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | | | | |
| | Sulfur (S)-Dissolved (mg/L) | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | | | | |
| | Tin (Sn)-Dissolved (mg/L) | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | | | | |
| | Uranium (U)-Dissolved (mg/L) | | | | |
| | Vanadium (V)-Dissolved (mg/L) | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------|-----------|-----------------------------|
| Matrix Spike | Fluoride (F) | MS-B | L1968910-1, -2 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| F-IC-N-VA | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| F-IC-N-WR | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |

Reference Information

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

| | | | |
|---|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| SO4-IC-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-08-01 B

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



COC Number: 2017-08-01 B

Canada Toll Free: 1 800 668 9878

L1968910-COFC

Page 1 of 1

www.alsglobal.com

| Report To | | Report Format / Distribution | | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|--|-----------------|---------------|------------------|---|-------------------------|-------------------|---------------------------|---|--|---------------------|--|-------------|--|----------------------|--|---|--|--|--|--|--|--|--|--|--|--|--|-----------------------------|-------------------------------------|--|--|--|--|------------------|--|--|--|--|--|--|--|--|--|--|-------------------------------------|--|--|--|--|--|--|--|--|--|--|-------------------------------------|--|--|--|--|--|--|--|--|--|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="6" style="text-align: center;">Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply</td> <td colspan="6"></td> </tr> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">PRIORITY (Business Days)</td> <td colspan="5">4 day [P4] <input type="checkbox"/></td> <td colspan="5" rowspan="3" style="text-align: center;">EMERGENCY</td> <td colspan="6">1 Business day [E1] <input type="checkbox"/></td> </tr> <tr> <td colspan="5">3 day [P3] <input type="checkbox"/></td> <td colspan="6">Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/></td> </tr> <tr> <td colspan="5">2 day [P2] <input type="checkbox"/></td> <td colspan="6"></td> </tr> </table> | | | | | | | | | | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | | EMERGENCY | | | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | 3 day [P3] <input type="checkbox"/> | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | |
| Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | | EMERGENCY | | | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 day [P3] <input type="checkbox"/> | | | | | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals(TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MW12-07-01 | | 28-Jul-17 | 14:00 | Water | | R | | R | R | | R | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MW12-07-02 | | 28-Jul-17 | 14:45 | Water | | R | | R | R | | R | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MW09-03-01 | | 29-Jul-17 | 10:55 | Water | | R | | R | R | | R | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MW09-03-02 | | 29-Jul-17 | 11:50 | Water | | R | | R | R | | R | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DUP 1 | | 29-Jul-17 | | Water | | | | R | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DUP 2 | | 29-Jul-17 | | Water | | | | | R | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | INITIAL COOLER TEMPERATURES °C: 10.0 FINAL COOLER TEMPERATURES °C: 5.4, 7.5, 9.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: Emilie Bouchard | | Date: August 1st, 2017 | | Time: | | Received by: EIT | | Date: 2 Aug 2017 | | Time: 13:30 | | Received by: Shayan | | Date: Aug 3 | | Time: 1130 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-JUN-17
Report Date: 10-JUL-17 17:36 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1949598
Project P.O. #: 224161 (GW)
Job Reference:
C of C Numbers: 2017-06-23 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | | | | | |
|-----------------------------|---|---|---|---|---|----------------------|
| | L1949598-1 Water 22-JUN-17 16:30 MW09-03-01 | L1949598-2 Water 22-JUN-17 16:45 MW09-03-02 | L1949598-3 Water 23-JUN-17 08:10 MW12-07-01 | L1949598-4 Water 23-JUN-17 08:30 MW12-07-02 | L1949598-5 Water 23-JUN-17 DUP | |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 314 | 311 | 1090 | 1440 | 1110 |
| | Hardness (as CaCO3) (mg/L) | 152 | 148 | 499 | 707 | 497 |
| | pH (pH) | 8.18 | 8.23 | 8.13 | 7.95 | 8.13 |
| | Total Suspended Solids (mg/L) | <3.0 | 7.0 | <3.0 | <3.0 | 3.4 |
| | TDS (Calculated) (mg/L) | 173 | 177 | 646 | 1140 | 646 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 144 | 149 | 571 | 106 | 574 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 144 | 149 | 571 | 106 | 574 |
| | Ammonia, Total (as N) (mg/L) | 0.0466 | 0.0165 | 0.325 | 0.0402 | 0.233 |
| | Chloride (Cl) (mg/L) | <0.50 | 0.53 | <2.5 ^{DLDS} | <2.5 ^{DLDS} | <2.5 ^{DLDS} |
| | Nitrate and Nitrite (as N) (mg/L) | 0.311 | 3.35 | 0.294 | 0.200 | 0.261 |
| | Nitrate (as N) (mg/L) | 0.0053 | 2.27 | 0.089 | 0.060 | 0.080 |
| | Nitrite (as N) (mg/L) | 0.306 | 1.08 | 0.206 | 0.140 | 0.180 |
| | Sulfate (SO4) (mg/L) | 20.5 | 9.11 | 25.3 | 735 | 25.3 |
| | Anion Sum (meq/L) | 3.34 | 3.42 | 12.0 | 17.4 | 12.0 |
| | Cation Sum (meq/L) | 3.53 | 3.30 | 13.8 | 17.4 | 13.7 |
| | Cation - Anion Balance (%) | 2.8 | -1.8 | 7.1 | -0.2 | 6.7 |
| Dissolved Metals | Dissolved Mercury Filtration Location | LAB | LAB | LAB | LAB | LAB |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0027 | 0.0026 | 0.0015 | 0.0024 | 0.0018 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00019 | 0.00032 | 0.00023 | 0.00010 | 0.00020 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00106 | 0.00031 | 0.00061 | 0.00174 | 0.00060 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0676 | 0.0257 | 0.132 | 0.0142 | 0.130 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | 0.000039 | <0.000020 | 0.000035 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.253 | 0.431 | 0.497 | 0.246 | 0.496 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000205 | 0.0000916 | <0.0000050 | 0.0000071 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 41.3 | 49.2 | 169 | 224 | 168 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00017 | 0.00031 | <0.00010 | 0.00030 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00015 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00032 | 0.00225 | <0.00020 | 0.00043 | <0.00020 |
| | Iron (Fe)-Dissolved (mg/L) | 0.292 | 0.014 | 0.016 | 0.123 | 0.015 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0039 | 0.0013 | 0.0262 | 0.0278 | 0.0256 |
| | Magnesium (Mg)-Dissolved (mg/L) | 11.9 | 6.08 | 18.8 | 35.8 | 19.0 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0894 | 0.0513 | 0.119 | 0.112 | 0.119 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

10-JUL-17 17:36 (MT)

Version: FINAL

| | | Sample ID | L1949598-1 | L1949598-2 | L1949598-3 | L1949598-4 | L1949598-5 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 22-JUN-17 | 22-JUN-17 | 23-JUN-17 | 23-JUN-17 | 23-JUN-17 |
| | | Sampled Time | 16:30 | 16:45 | 08:10 | 08:30 | |
| | | Client ID | MW09-03-01 | MW09-03-02 | MW12-07-01 | MW12-07-02 | DUP |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00478 | 0.00769 | 0.000889 | 0.0182 | 0.000820 |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00130 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 2.23 | 2.29 | 2.95 | 2.98 | 2.91 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000067 | 0.000216 | 0.000378 | 0.000073 | 0.000271 |
| | Silicon (Si)-Dissolved (mg/L) | | 5.60 | 5.00 | 9.79 | 6.13 | 9.66 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 9.30 | 6.38 | 85.1 | 72.8 | 85.6 |
| | Strontium (Sr)-Dissolved (mg/L) | | 1.00 | 0.309 | 6.99 | 11.1 | 7.03 |
| | Sulfur (S)-Dissolved (mg/L) | | 6.62 | 2.70 | 13.8 | 243 | 13.6 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00250 | 0.00091 | 0.00042 | <0.00010 | 0.00042 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000874 | 0.00207 | 0.000181 | 0.00156 | 0.000169 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | 0.00182 | <0.00050 | 0.00180 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0092 | 0.0240 | <0.0010 | 0.0029 | 0.0011 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---|---|-----------|-----------------------------|
| Qualifiers for Individual Parameters Listed: | | | |
| Qualifier | Description | | |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. | | |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

| | |
|----|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |
|----|---|

Chain of Custody Numbers:

2017-06-23 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1949598-COFC

COC Number: 2017-06-23 A

Page 1 of 1

| Report To | | Contact and company name below will appear on the final report | | | Report Format / Di. | | | All E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | |
|---|---|--|--|------------------|--|--------------------------------|---|--|-------------------------------|---|---|--------------------------------|---|---------------------|------------------------------|--------------------------|--|--------------------------|--|-----|--|----------------------|--|--|
| Company: | Minto Explorations Ltd. | Select Report Format: | | | <input checked="" type="checkbox"/> PDF | <input type="checkbox"/> EXCEL | <input checked="" type="checkbox"/> EDD (DIGITAL) | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report | | | <input checked="" type="checkbox"/> YES | <input type="checkbox"/> NO | PRIORITY (Business Days) | | 4 day [P4] | | <input type="checkbox"/> | EMERGENCY | | 1 Business day [E1] | | <input type="checkbox"/> | | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | Select Distribution: | | <input checked="" type="checkbox"/> EMAIL | <input type="checkbox"/> MAIL | <input type="checkbox"/> FAX | 3 day [P3] | | <input type="checkbox"/> | Same Day, Weekend or Statutory holiday [E0] | | <input type="checkbox"/> | 2 day [P2] | | <input type="checkbox"/> | | | | | | |
| Company address below will appear on the final report | | Street: | | | 2100-510 West Georgia St. | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | |
| City/Province: | | Vancouver, British Columbia | | | Email 1 or Fax | | | minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| Postal Code: | | V6B 0M3 | | | Email 2 | | | Analysis Request | | | | | | | | | | | | | | | | |
| Invoice To | | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report | | <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Select Invoice Distribution: | | | <input checked="" type="checkbox"/> EMAIL | <input type="checkbox"/> MAIL | <input type="checkbox"/> FAX | P F/P P F/P P F/P | | | | | | | | | | | | | |
| Company: | | Minto Explorations Ltd. | | | Email 1 or Fax | | | ap@mintomine.com | | | Total Metals (TM) | | | | | | | | | | | | | |
| Contact: | | Ruth Cayetano | | | Email 2 | | | Number of Containers | | | | | | | | | | | | | | | | |
| Project Information | | | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | | |
| Job #: | | | | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | |
| PO / AFE: | | | | | 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | | | | |
| LSD: | | | | | Location: | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | | ALS Contact: | | Sampler: | | | CH | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals (TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | | | | | | | | | Number of Containers | | |
| 1 | MW09-03-01 | | | 22-Jun-17 | 16:30 | Water | R | | R | R | R | R | | | | | | | | | | 4 | | |
| 2 | MW09-03-02 | | | 22-Jun-17 | 16:45 | Water | R | | R | R | R | R | | | | | | | | | | 4 | | |
| 3 | MW12-07-01 | | | 23-Jun-17 | 8:10 | Water | R | | R | R | R | R | | | | | | | | | | 4 | | |
| 4 | MW12-07-02 | | | 23-Jun-17 | 8:30 | Water | R | | R | R | R | R | | | | | | | | | | 4 | | |
| 5 | DUP | | | 23-Jun-17 | | Water | R | | R | R | R | R | | | | | | | | | | 4 | | |
| Drinking Water (DW) Samples ¹ (client use) | | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? | | | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | |
| <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | |
| Are samples for human drinking water use? | | | | | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | | |
| <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | INITIAL COOLER TEMPERATURES °C | | | | | 16.0 | | | | | FINAL COOLER TEMPERATURES °C | | | | | 9 9 | | | | |
| SHIPMENT RELEASE (client use) | | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-06-23 10:30 | | Time: | | Received by: EHF | | Date: 27 June 2017 | | Time: 15:30 | | Received by: ND | | Date: 6/28/17 | | Time: 15:40 | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.
 WHITE - LABORATORY COPY YELLOW - CLIENT COPY
 OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 23-MAY-17
Report Date: 08-JUN-17 18:33 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1929689
Project P.O. #: 224161 (GW)
Job Reference:
C of C Numbers: 2017-05-22 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1929689-1 WATER 20-MAY-17 14:30 MW09-03-01 | L1929689-2 WATER 20-MAY-17 17:45 MW09-03-02 | L1929689-3 WATER 21-MAY-17 16:20 MW12-07-01 | L1929689-4 WATER 21-MAY-17 16:45 MW12-07-02 |
|---------------------------------|---|---|---|---|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 299 | 315 | 1080 | 1390 |
| | Hardness (as CaCO3) (mg/L) | 141 | 149 | 512 | 685 |
| | pH (pH) | 8.25 | 8.32 | 8.23 | 8.00 |
| | Total Suspended Solids (mg/L) | <3.0 | 5.3 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | 170 | 178 | 629 | 1130 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 140 | 139 | 517 | 99.0 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | 3.2 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 140 | 142 | 517 | 99.0 |
| | Ammonia, Total (as N) (mg/L) | 0.0445 | 0.0355 | 0.243 | 0.0384 |
| | Chloride (Cl) (mg/L) | <0.50 | 0.54 | <2.5 ^{DLDS} | <2.5 ^{DLDS} |
| | Nitrate and Nitrite (as N) (mg/L) | 0.286 | 3.93 | 0.306 | 0.293 |
| | Nitrate (as N) (mg/L) | 0.0130 | 1.99 | 0.090 | 0.085 |
| | Nitrite (as N) (mg/L) | 0.273 | 1.93 | 0.216 | 0.208 |
| | Sulfate (SO4) (mg/L) | 20.4 | 11.7 | 34.6 | 741 |
| | Anion Sum (meq/L) | 3.25 | 3.38 | 11.1 | 17.4 |
| | Cation Sum (meq/L) | 3.31 | 3.51 | 14.1 | 17.0 |
| | Cation - Anion Balance (%) | 1.0 | 1.9 | 12.1 | -1.2 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0028 | 0.0021 | 0.0030 | 0.0175 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00058 | 0.00036 | <0.00010 | <0.00020 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00020 | 0.00078 | 0.00050 | 0.00174 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0534 | 0.0664 | 0.123 | 0.0150 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | 0.000041 | <0.000040 ^{DLA} |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} |
| | Boron (B)-Dissolved (mg/L) | 0.787 | 0.423 | 0.422 | 0.210 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000890 | 0.0000083 | 0.0000130 | 0.000030 |
| | Calcium (Ca)-Dissolved (mg/L) | 46.5 | 40.2 | 174 | 219 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00039 | <0.00010 | 0.00028 | <0.00020 ^{DLA} |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00056 | <0.00010 | <0.00010 | <0.00020 ^{DLA} |
| | Copper (Cu)-Dissolved (mg/L) | 0.00133 | <0.00020 | <0.00020 | 0.00123 |
| | Iron (Fe)-Dissolved (mg/L) | 0.021 | 0.299 | 0.051 | 0.148 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} |
| | Lithium (Li)-Dissolved (mg/L) | 0.0011 | 0.0035 | 0.0262 | 0.0268 |
| Magnesium (Mg)-Dissolved (mg/L) | 6.16 | 11.8 | 18.8 | 33.6 | |
| Manganese (Mn)-Dissolved (mg/L) | 0.149 | 0.0982 | 0.125 | 0.110 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1929689-1 | L1929689-2 | L1929689-3 | L1929689-4 |
|-------------------------|----------------------------------|--------------|--------------|------------|--------------------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER |
| | | 20-MAY-17 | 14:30 | MW09-03-01 | 20-MAY-17 | 17:45 | 21-MAY-17 | 21-MAY-17 |
| | | | | | MW09-03-01 | MW09-03-02 | MW12-07-01 | MW12-07-02 |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0124 | 0.00528 | 0.000484 | 0.0181 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00128 | 0.00107 | <0.00050 | <0.0010 ^{DLA} | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.10 ^{DLA} | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.65 | 2.19 | 2.80 | 3.02 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000239 | 0.000109 | 0.00196 | 0.00013 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.02 | 5.60 | 9.69 | 6.02 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} | | | |
| | Sodium (Na)-Dissolved (mg/L) | 9.33 | 10.5 | 87.0 | 74.4 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.321 | 0.960 | 7.10 | 10.6 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 3.93 | 7.02 | 33.3 | 256 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} | | | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00118 | 0.00014 | 0.00011 | <0.00020 ^{DLA} | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00060 ^{DLA} | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00218 | 0.000902 | 0.000168 | 0.00160 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00176 | <0.0010 ^{DLA} | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0593 | 0.0067 | 0.0027 | 0.0027 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1929689-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1929689-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1929689-1, -2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1929689-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1929689-1, -2, -3, -4 |
| Matrix Spike | Nitrite (as N) | MS-B | L1929689-1, -2, -3, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| $\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$ | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et | | | |

Reference Information

al.

| | | | |
|---|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-MAN-WR | Water | Total Suspended Solids by Gravimetric | APHA 2540 D |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-05-22 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1929689-COFC

COC Number: 2017-05-22 A

Page 1 of 1

| | | | | | | | | | | | | | | | | | | | | | | |
|--|---|---|--------------|---|------------------|--|--------------------------|--|---------------------------|--|---|--------------|--|--|-------|--|--|-------|--|--|--|----------------------|
| Report To Contact and company name below will appear on the final report | | Report Format | | All E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> <input type="checkbox"/> NO | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | |
| Phone: | 1-804-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | Data and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | Analysis Request | | | | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | P | F/P | P | F/P | P | F/P | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: CH/CP | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | Total Metals(TM) | Dissolved Metals (DM) | Total Mercury - Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | | | | | | | | | | | Number of Containers |
| | MW09-03-01 | 20-May-17 | 14:30 | Water | | R | R | R | | R | | | | | | | | | | | | 4 |
| | MW09-03-02 | 20-May-17 | 17:45 | Water | | R | R | R | | R | | | | | | | | | | | | 4 |
| | MW12-07-01 | 21-May-17 | 16:20 | Water | | R | R | R | | R | | | | | | | | | | | | 4 |
| | MW12-07-02 | 21-May-17 | 16:45 | Water | | R | R | R | | R | | | | | | | | | | | | 4 |
| Short Holding Time Rush Processing | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> <input checked="" type="checkbox"/> NO | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> <input checked="" type="checkbox"/> NO | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | |
| | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | |
| | | | | | | INITIAL COOLER TEMPERATURES °C: 7.4 | | | | | | | | | | | | | | | | |
| | | | | | | FINAL COOLER TEMPERATURES °C: | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-05-22 9:00 | | Time: | | Received by: VD | | Date: May 23/17 | | Time: 9:00 | | Received by: | | | Date: | | | Time: | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

COCCOCP R 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

OFF May 29/17 9:16 12540



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 04-MAY-17
Report Date: 15-MAY-17 18:00 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1921486
Project P.O. #: 224161 (GW)
Job Reference:
C of C Numbers: 2017-05-03 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1921486-1 Water 01-MAY-17 00:10 MW11-04 A | | | | |
|---|--|-----------|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Hardness (as CaCO3) (mg/L) | 134 | | | |
| Anions and Nutrients | Ammonia, Total (as N) (mg/L) | 0.0302 | | | |
| Dissolved Metals | Dissolved Metals Filtration Location | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.707 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00184 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00352 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.156 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000085 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 53.8 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00204 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0852 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.021 | | | |
| | Lead (Pb)-Dissolved (mg/L) | 0.000059 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0173 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | <0.10 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00119 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00271 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 3.58 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00261 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.77 | | | |
| | Silver (Ag)-Dissolved (mg/L) | 0.000012 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 3.81 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.222 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 2.10 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00021 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00055 | | | |
| | Uranium (U)-Dissolved (mg/L) | <0.000010 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.0160 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0024 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | | | |

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|-----------|-----------|-----------------------------|
|---------------------|-----------|-----------|-----------------------------|

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---|
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | APHA 3030B/6020A (mod) |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | APHA 3030B/6020A (mod) |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-05-03 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L1921486-COFC

| Report To | | Report Format | | Priority | |
|---|--|---|--|--|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | <input checked="" type="checkbox"/> Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | 4 day [P4] <input type="checkbox"/> | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | 3 day [P3] <input type="checkbox"/> | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | 2 day [P2] <input type="checkbox"/> | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | EMERGENCY: <input type="checkbox"/> 1 Business day [E1] <input type="checkbox"/> | |
| City/Province: Vancouver, British Columbia | | Email 2: | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | |
| Postal Code: V6B 0M3 | | Email 3: | | Date and Time Required for all E&P TATs: dd-mm-yy hh:mm | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution: Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | For tests that can not be performed according to the service level selected, you will be contacted. | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax: ap@mintomine.com | | Analysis Request | |
| Company: Minto Explorations Ltd. | | Email 2: | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | |
| Contact: Ruth Cayetano | | Email 3: | | P F/P P F/P P F/P | |
| Project Information | | Oil and Gas Required Fields (client use) | | Number of Containers | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | Total Metals(TM) | |
| Job #: | | Major/Minor Code: | | Dissolved Metals (DM) | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | Total Mercury, Hardness | |
| LSD: | | Location: | | Dissolved Mercury | |
| ALS Lab Work Order # (lab use only): | | ALS Contact: | | Ammonia (Total Nutrients) | |
| ALS Sample # (lab use only): | | Sampler: | | Dissolved Organic Carbon (DOC) | |
| Sample Identification and/or Coordinates (This description will appear on the report): | | Date (dd-mmm-yy): | | pH, Cond., TSS, Alkalinity, Antions | |
| MW11-04 A | | 1-May-17 | | | |
| Time (hh:mm): | | Sample Type: | | | |
| 12:10 | | Water | | | |
| Drinking Water (DW) Samples ¹ (client use): | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Frozen <input type="checkbox"/> | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> | |
| | | | | Cooling Initiated <input checked="" type="checkbox"/> | |
| | | | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | |
| | | | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | INITIAL COOLER TEMPERATURES °C: | |
| Released by: Chris Harry | | Received by: EHF | | 5.0 | |
| Date: 2017-05-03 7:00 | | Date: 4 May 2017 | | FINAL COOLER TEMPERATURES °C: | |
| Time: 7:00 | | Time: 09:15 | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | FINAL SHIPMENT RECEPTION (lab use only) | |
| Received by: Chris Harry | | Received by: | | Received by: | |
| Date: 2017-05-03 7:00 | | Date: | | Date: | |
| Time: 7:00 | | Time: | | Time: | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 26-APR-17
Report Date: 16-MAY-17 13:03 (MT)
Version: DRAFT REV. 2

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1917619
Project P.O. #: 224161 (GW)
Job Reference:
C of C Numbers: 2017-04-25 A
Legal Site Desc:

Comments: May 16 2017: Please note, this report has been revised to include bromide data.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1917619-1 Water 24-APR-17 14:45 MW12-06-01 | L1917619-2 Water 24-APR-17 15:45 MW12-06-02 | L1917619-3 Water 24-APR-17 16:00 MW12-06-03 | L1917619-4 Water 24-APR-17 16:15 MW12-06-04 | L1917619-5 Water 24-APR-17 16:45 MW12-06-05 |
|--------------------------------------|--|---|---|---|---|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 717 | 993 | 1010 | 991 | 1020 |
| | Hardness (as CaCO3) (mg/L) | 284 | 501 | 499 | 510 | 504 |
| | pH (pH) | 8.15 | 8.08 | 8.15 | 8.11 | 8.11 |
| | Total Suspended Solids (mg/L) | <3.0 | 34.0 | <3.0 | <3.0 | <3.0 |
| | Total Dissolved Solids (mg/L) | 499 | 649 | 629 | 614 | 610 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 386 | 359 | 385 | 408 | 414 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 386 | 359 | 385 | 408 | 414 |
| | Ammonia, Total (as N) (mg/L) | 0.100 | 0.0528 | 0.0579 | 0.0097 | 0.0054 |
| | Bromide (Br) (mg/L) | <0.25 ^{DLDS} | <0.25 ^{DLDS} | <0.25 ^{DLDS} | <0.25 ^{DLDS} | <0.25 ^{DLDS} |
| | Chloride (Cl) (mg/L) | 5.2 | <2.5 ^{DLDS} | <2.5 ^{DLDS} | <2.5 ^{DLDS} | <2.5 ^{DLDS} |
| | Nitrate and Nitrite (as N) (mg/L) | 0.141 | 0.160 | 0.143 | 0.149 | 0.122 |
| | Nitrate (as N) (mg/L) | 0.031 | 0.035 | 0.028 | 0.030 | 0.025 |
| | Nitrite (as N) (mg/L) | 0.110 ^{DLDS} | 0.126 | 0.115 | 0.120 | 0.0972 |
| | Sulfate (SO4) (mg/L) | <1.5 ^{DLDS} | 213 | 205 | 181 | 177 |
| | Anion Sum (meq/L) | 7.87 | 11.6 | 12.0 | 11.9 | 12.0 |
| | Cation Sum (meq/L) | 8.14 | 11.9 | 11.7 | 11.9 | 11.7 |
| | Cation - Anion Balance (%) | 1.7 | 1.1 | -1.1 | -0.1 | -1.0 |
| | Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | | 0.0169 | 0.0037 | 0.0010 | 0.0017 | 0.0026 |
| Antimony (Sb)-Dissolved (mg/L) | | 0.00017 | 0.00011 | 0.00012 | <0.00010 | <0.00010 |
| Arsenic (As)-Dissolved (mg/L) | | 0.00571 | 0.00398 | 0.00059 | 0.00237 | 0.00074 |
| Barium (Ba)-Dissolved (mg/L) | | 0.243 | 0.0336 | 0.0268 | 0.0172 | 0.0404 |
| Beryllium (Be)-Dissolved (mg/L) | | 0.000099 | 0.000042 | <0.000020 | 0.000024 | <0.000020 |
| Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Dissolved (mg/L) | | 0.143 | 0.118 | 0.092 | 0.084 | 0.076 |
| Cadmium (Cd)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Calcium (Ca)-Dissolved (mg/L) | | 83.1 | 143 | 110 | 104 | 102 |
| Chromium (Cr)-Dissolved (mg/L) | | 0.00362 | 0.00017 | 0.00030 | <0.00010 | <0.00010 |
| Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00107 |
| Copper (Cu)-Dissolved (mg/L) | | 0.00120 | 0.00039 | <0.00020 | <0.00020 | 0.00022 |
| Iron (Fe)-Dissolved (mg/L) | | 0.259 | 1.10 | 1.19 | 0.725 | 0.153 |
| Lead (Pb)-Dissolved (mg/L) | | 0.000085 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved (mg/L) | | 0.0094 | 0.0092 | 0.0081 | 0.0068 | 0.0066 |
| Magnesium (Mg)-Dissolved (mg/L) | 18.6 | 34.6 | 54.5 | 60.7 | 60.2 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1917619-6 Water 24-APR-17 17:15 MW12-06-06 | L1917619-7 Water 24-APR-17 DUP | | |
|--------------------------------------|---|---|---|-------|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 853 | 989 | | |
| | Hardness (as CaCO3) (mg/L) | 410 | 503 | | |
| | pH (pH) | 8.16 | 8.15 | | |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | | |
| | Total Dissolved Solids (mg/L) | 527 | 615 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 322 | 413 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 322 | 413 | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | <0.0050 | | |
| | Bromide (Br) (mg/L) | <0.25 ^{DLDS} | <0.25 ^{DLDS} | | |
| | Chloride (Cl) (mg/L) | 6.1 | <2.5 ^{DLDS} | | |
| | Nitrate and Nitrite (as N) (mg/L) | 1.14 | 0.126 | | |
| | Nitrate (as N) (mg/L) | 1.08 | 0.027 | | |
| | Nitrite (as N) (mg/L) | 0.0685 | 0.0992 | | |
| | Sulfate (SO4) (mg/L) | 155 | 180 | | |
| | Anion Sum (meq/L) | 9.91 | 12.0 | | |
| | Cation Sum (meq/L) | 9.67 | 11.7 | | |
| | Cation - Anion Balance (%) | -1.2 | -1.2 | | |
| | Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | |
| Dissolved Metals Filtration Location | | FIELD | FIELD | | |
| Aluminum (Al)-Dissolved (mg/L) | | 0.0027 | 0.0020 | | |
| Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | <0.00010 | | |
| Arsenic (As)-Dissolved (mg/L) | | <0.00010 | 0.00077 | | |
| Barium (Ba)-Dissolved (mg/L) | | 0.0143 | 0.0399 | | |
| Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | | |
| Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | | |
| Boron (B)-Dissolved (mg/L) | | 0.065 | 0.077 | | |
| Cadmium (Cd)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | | |
| Calcium (Ca)-Dissolved (mg/L) | | 77.9 | 101 | | |
| Chromium (Cr)-Dissolved (mg/L) | | <0.00010 | <0.00010 | | |
| Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | 0.00111 | | |
| Copper (Cu)-Dissolved (mg/L) | | 0.00060 | <0.00020 | | |
| Iron (Fe)-Dissolved (mg/L) | | 0.014 | 0.154 | | |
| Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | | |
| Lithium (Li)-Dissolved (mg/L) | | 0.0052 | 0.0068 | | |
| Magnesium (Mg)-Dissolved (mg/L) | | 52.4 | 60.9 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1917619-1 | L1917619-2 | L1917619-3 | L1917619-4 | L1917619-5 |
|-------------------------|----------------------------------|--------------|------------|-------------------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 24-APR-17 | 24-APR-17 | 24-APR-17 | 24-APR-17 | 24-APR-17 |
| | | Sampled Time | 14:45 | 15:45 | 16:00 | 16:15 | 16:45 |
| | | Client ID | MW12-06-01 | MW12-06-02 | MW12-06-03 | MW12-06-04 | MW12-06-05 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | 0.0890 | 0.0283 | 0.0154 | 0.0444 | 0.343 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00104 | 0.00743 | 0.00197 | 0.00841 | 0.00913 |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00051 | <0.00050 | <0.00050 | <0.00050 | 0.00055 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 2.43 | 3.34 | 3.68 | 3.60 | 3.56 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000170 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Silicon (Si)-Dissolved (mg/L) | | 7.29 | 9.77 | 8.84 | 8.31 | 7.96 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 54.6 | 39.8 | 36.1 | 36.4 | 35.8 |
| | Strontium (Sr)-Dissolved (mg/L) | | 3.35 | 10.7 | 4.42 | 2.97 | 2.69 |
| | Sulfur (S)-Dissolved (mg/L) | | 1.72 | 70.6 | 68.9 | 62.2 | 60.4 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00016 | <0.00010 | 0.00013 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | 0.00293 | <0.00060 ^{DLM} | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000653 | 0.00255 | 0.00217 | 0.00575 | 0.00585 |
| | Vanadium (V)-Dissolved (mg/L) | | 0.0134 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0025 | 0.0034 | 0.0020 | 0.0103 | 0.0094 |
| | Zirconium (Zr)-Dissolved (mg/L) | | 0.00101 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1917619-6 Water 24-APR-17 17:15 MW12-06-06 | L1917619-7 Water 24-APR-17 DUP | | |
|-------------------------|--|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | 0.0377 | 0.338 | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00575 | 0.00911 | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | 0.00057 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 3.25 | 3.57 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000294 | <0.000050 | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.63 | 8.22 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 31.8 | 36.2 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 1.53 | 2.69 | | |
| | Sulfur (S)-Dissolved (mg/L) | 52.4 | 62.1 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00031 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00406 | 0.00594 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0138 | 0.0129 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|------------------------------------|
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1917619-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1917619-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1917619-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1917619-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1917619-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1917619-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1917619-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1917619-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1917619-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1917619-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L1917619-1, -2, -3, -4, -5, -6, -7 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |

Reference Information

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-04-25 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

DRAFT



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1917619-COFC

COC Number: 2017-04-25 A

Page 1 of 1

www.alsglobal.com

| Report To | | Report Form | | Confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | |
|--|---|--|--|---|--|--|-------------------------|------------------|---------------------------|-------------------------------|------------------------------------|----------------------|
| Contact and company name below will appear on the final report | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | |
| Company: | Minto Explorations Ltd. | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | | | | |
| Contact: | Minto Environment - Coordinator | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | |
| Phone: | 1-804-759-4659 | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | 3 day [P3] <input type="checkbox"/> | | | | | | | |
| Company address below will appear on the final report | | Email 1 or Fax minto_environment@mintomine.com | | | 2 day [P2] <input type="checkbox"/> | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 2 | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 3 | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | |
| Postal Code: | V6B 0M3 | | | Analysis Request | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | P | F/P | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | P | F/P | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | P | F/P | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | P | F/P | | | | | | | |
| ALS Account # / Quote #: | | AFECost Center: | PO# | P | F/P | | | | | | | |
| Job #: | | Major/Minor Code: | Routing Code: | P | F/P | | | | | | | |
| PO / AFE: | 224161 (GW) | Requisitioner: | | P | F/P | | | | | | | |
| LSD: | | Location: | | P | F/P | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Sampler: CH/CP | P | F/P | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals(TM) | Disolved Metals (DM) | Total Mercury, Hardness | Disolved Mercury | Ammonia (Total Nutrients) | Disolved Organic Carbon (DOC) | pH, Cond., TSS, Alkalinity, Anions | Number of Containers |
| | MW12-06-01 | 24-Apr-17 | 14:45 | Water | | R | | R | R | R | | 4 |
| | MW12-06-02 | 24-Apr-17 | 15:45 | Water | | R | | R | R | R | | 4 |
| | MW12-06-03 | 24-Apr-17 | 16:00 | Water | | R | | R | R | R | | 4 |
| | MW12-06-04 | 24-Apr-17 | 16:15 | Water | | R | | R | R | R | | 4 |
| | MW12-06-05 | 24-Apr-17 | 16:45 | Water | | R | | R | R | R | | 4 |
| | MW12-06-06 | 24-Apr-17 | 17:15 | Water | | R | | R | R | R | | 4 |
| | DUP | 24-Apr-17 | | Water | | R | | R | R | R | | 4 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | |
| | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | |
| | | | | INITIAL COOLER TEMPERATURES °C: 9.0 | | | | | | | | |
| | | | | FINAL COOLER TEMPERATURES °C: | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | |
| Released by: Chris Harry | Date: 2017-04-25 8:00 | Time: | Received by: LNF | Date: 26 Apr 2017 | Time: 11:40 | Received by: | Date: | Time: | Received by: | Date: | Time: | |

Short Holding Time
Rush Processing

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 24-APR-17
Report Date: 16-MAY-17 13:37 (MT)
Version: DRAFT REV. 2

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1916507
Project P.O. #: 224161 (GW)
Job Reference:
C of C Numbers: 2017-04-24 B
Legal Site Desc:

Comments: May 16 2017: Please note, this report has been revised to include bromide data.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1916507-1 Water 21-APR-17 14:14 MW09-03-01 | L1916507-2 Water 21-APR-17 17:07 MW09-03-02 | L1916507-3 Water 21-APR-17 DUP1 | L1916507-4 Water 22-APR-17 14:12 MW12-07-01 | L1916507-5 Water 22-APR-17 14:17 MW12-07-02 |
|---|---|---|---|--|---|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 314 | 332 | 317 | 1170 | 1460 |
| | Hardness (as CaCO3) (mg/L) | 139 | 144 | 141 | 490 | 686 |
| | pH (pH) | 8.24 | 8.28 | 8.28 | 8.14 | 8.00 |
| | Total Suspended Solids (mg/L) | <3.0 | 4.8 | 3.4 | 6.2 | <3.0 |
| | Total Dissolved Solids (mg/L) | 201 | 219 | 198 | 906 | 1180 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 143 | 157 | 146 | 566 | 108 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 143 | 157 | 146 | 566 | 108 |
| | Ammonia, Total (as N) (mg/L) | 0.0401 | 0.0319 | 0.0422 | 0.248 | 0.0461 |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.050 | <0.25 ^{DLDS} | <0.25 ^{DLDS} |
| | Chloride (Cl) (mg/L) | <0.50 | <0.50 | <0.50 | <5.0 ^{DLCI} | <2.5 ^{DLCI} |
| | Nitrate and Nitrite (as N) (mg/L) | 0.196 | 2.71 | 0.113 | 0.298 | 0.248 |
| | Nitrate (as N) (mg/L) | 0.0051 | 1.91 | <0.0050 | 0.092 | 0.077 |
| | Nitrite (as N) (mg/L) | 0.191 | 0.803 | 0.113 | 0.206 | 0.170 |
| | Sulfate (SO4) (mg/L) | 19.4 | 11.1 | 19.5 | 43.5 | 722 |
| | Anion Sum (meq/L) | 3.28 | 3.56 | 3.33 | 12.2 | 17.2 |
| | Cation Sum (meq/L) | 3.16 | 3.23 | 3.22 | 13.2 | 16.6 |
| | Cation - Anion Balance (%) | -1.9 | -4.8 | -1.7 | 3.9 | -1.7 |
| | Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | | 0.0021 | 0.0018 | 0.0029 | 0.0055 | 0.0021 ^{DLA} |
| Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | 0.00035 | 0.00011 | <0.00010 | <0.00020 |
| Arsenic (As)-Dissolved (mg/L) | | 0.00064 | 0.00028 | 0.00063 | 0.00040 | 0.00141 |
| Barium (Ba)-Dissolved (mg/L) | | 0.0620 | 0.0462 | 0.0618 | 0.106 | 0.0129 ^{DLA} |
| Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000020 | 0.000048 | <0.000040 ^{DLA} |
| Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} |
| Boron (B)-Dissolved (mg/L) | | 0.111 | 0.477 | 0.175 | 0.395 | 0.226 ^{DLA} |
| Cadmium (Cd)-Dissolved (mg/L) | | 0.0000057 | 0.0000370 | 0.0000070 | 0.0000876 | <0.000010 |
| Calcium (Ca)-Dissolved (mg/L) | | 38.3 | 47.7 | 39.2 | 167 | 223 ^{DLA} |
| Chromium (Cr)-Dissolved (mg/L) | | <0.00010 | 0.00023 | <0.00010 | 0.00026 | <0.00020 ^{DLA} |
| Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | 0.00087 | <0.00010 | <0.00010 | <0.00020 ^{DLA} |
| Copper (Cu)-Dissolved (mg/L) | | <0.00020 | 0.00105 | 0.00082 | 0.00037 | <0.00040 ^{DLA} |
| Iron (Fe)-Dissolved (mg/L) | | 0.303 | 0.084 | 0.331 | 0.040 | 0.142 ^{DLA} |
| Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | 0.000054 | <0.00010 ^{DLA} |
| Lithium (Li)-Dissolved (mg/L) | | 0.0038 | 0.0014 | 0.0039 | 0.0246 | 0.0272 |
| Magnesium (Mg)-Dissolved (mg/L) | | 10.4 | 5.92 | 10.4 | 17.7 | 31.6 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

16-MAY-17 13:37 (MT)

Version: DRAFT REV.

| Sample ID Description Sampled Date Sampled Time Client ID | L1916507-6 Water 22-APR-17 DUP2 | L1916507-7 Water 23-APR-17 11:00 MW12-05-01 | L1916507-8 Water 23-APR-17 11:30 MW12-05-03 | L1916507-9 Water 23-APR-17 11:45 MW12-05-04 | L1916507-10 Water 23-APR-17 13:40 MW12-05-05 | |
|---|--|---|---|---|--|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 1460 | 2180 | 1710 | 489 | 496 |
| | Hardness (as CaCO3) (mg/L) | 682 | 924 | 740 | 211 | 212 |
| | pH (pH) | 7.98 | 8.15 | 8.31 | 8.32 | 8.13 |
| | Total Suspended Solids (mg/L) | 5.0 | 5.8 | 5.6 | <3.0 | <3.0 |
| | Total Dissolved Solids (mg/L) | 1170 | 1740 | 1350 | 296 | 287 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 106 | 140 | 229 | 232 | 212 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | 5.2 | 3.8 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 106 | 140 | 234 | 236 | 212 |
| | Ammonia, Total (as N) (mg/L) | 0.0382 | 0.0447 | 0.0296 | 0.0352 | 0.0122 |
| | Bromide (Br) (mg/L) | <0.25 ^{DLDS} | <0.50 ^{DLDS} | <0.50 ^{DLDS} | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | <2.5 ^{DLDS} | 12.0 | 7.6 | 5.10 | 5.00 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.288 | <0.051 ^{DLDS} | <0.051 ^{DLDS} | 0.0248 | 0.373 |
| | Nitrate (as N) (mg/L) | 0.087 | <0.050 | <0.050 | <0.0050 | 0.334 |
| | Nitrite (as N) (mg/L) | 0.201 | 0.032 | 0.028 | 0.0248 | 0.0388 |
| | Sulfate (SO4) (mg/L) | 728 | 1120 | 751 | 28.1 | 44.5 |
| | Anion Sum (meq/L) | 17.3 | 26.4 | 20.5 | 5.44 | 5.33 |
| | Cation Sum (meq/L) | 16.5 | 24.7 | 18.6 | 5.00 | 4.90 |
| | Cation - Anion Balance (%) | -2.2 | -3.5 | -4.8 | -4.2 | -4.2 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0026 | 0.0032 | 0.0034 | 0.0040 | 0.0026 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00133 | 0.00060 | 0.00022 | <0.00010 | <0.00010 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0119 | 0.0401 | 0.0395 | 0.0650 | 0.0610 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000040 ^{DLA} | <0.000040 ^{DLA} | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.227 | 0.092 | 0.075 | 0.047 | 0.046 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 ^{DLA} | <0.000010 ^{DLA} | <0.0000050 | <0.0000050 | 0.0000080 |
| | Calcium (Ca)-Dissolved (mg/L) | 221 | 310 | 190 | 43.8 | 46.2 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00020 ^{DLA} | 0.00029 | 0.00017 | 0.00021 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00044 | <0.00040 ^{DLA} | <0.00020 | 0.00021 | 0.00178 |
| | Iron (Fe)-Dissolved (mg/L) | 0.141 | 0.025 | 0.651 | 0.082 | <0.010 |
| | Lead (Pb)-Dissolved (mg/L) | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0263 | 0.0065 | 0.0031 | 0.0033 | 0.0038 |
| | Magnesium (Mg)-Dissolved (mg/L) | 31.6 | 36.0 | 64.4 | 24.6 | 23.6 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1916507-11 | L1916507-12 | L1916507-13 | L1916507-14 |
|--------------------------------------|---|---------------------------------------|-------------|--------------------------|-------------|-------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 23-APR-17 | 23-APR-17 | 23-APR-17 | 23-APR-17 |
| | | Sampled Time | 14:00 | 14:20 | | 14:50 |
| | | Client ID | MW12-05-06 | MW12-05-02 | DUP | MW12-05-07 |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 486 | 2200 | 504 | 514 |
| | Hardness (as CaCO3) (mg/L) | | 210 | 967 | 215 | 237 |
| | pH (pH) | | 8.13 | 8.22 | 8.31 | 8.20 |
| | Total Suspended Solids (mg/L) | | <3.0 | 5.2 | <3.0 | 217 |
| | Total Dissolved Solids (mg/L) | | 293 | 1870 | 293 | 306 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 209 | 173 | 233 | 236 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | 4.4 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 209 | 173 | 237 | 236 |
| | Ammonia, Total (as N) (mg/L) | | 0.0181 | 0.0334 | 0.0329 | 0.0248 |
| | Bromide (Br) (mg/L) | | <0.050 | <0.50 ^{DLDS} | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | | 4.96 | 11.7 | 5.05 | 4.65 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.453 | <0.051 ^{DLDS} | 0.0256 | 0.0098 |
| | Nitrate (as N) (mg/L) | | 0.423 | <0.050 ^{DLDS} | <0.0050 | <0.0050 |
| | Nitrite (as N) (mg/L) | | 0.0301 | 0.025 | 0.0256 | 0.0098 |
| | Sulfate (SO4) (mg/L) | | 45.5 | 1140 | 28.4 | 35.6 |
| | Anion Sum (meq/L) | | 5.30 | 27.6 | 5.48 | 5.59 |
| | Cation Sum (meq/L) | | 4.86 | 24.8 | 5.12 | 5.47 |
| | Cation - Anion Balance (%) | | -4.4 | -5.3 | -3.4 | -1.0 |
| | Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD |
| Dissolved Metals Filtration Location | | | FIELD | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | | | 0.0027 | 0.0045 | 0.0042 | 0.0032 |
| Antimony (Sb)-Dissolved (mg/L) | | | <0.00010 | <0.00020 ^{DLA} | <0.00010 | <0.00010 |
| Arsenic (As)-Dissolved (mg/L) | | | 0.00011 | <0.00020 ^{DLA} | 0.00010 | 0.00023 |
| Barium (Ba)-Dissolved (mg/L) | | | 0.0535 | 0.114 | 0.0680 | 0.396 |
| Beryllium (Be)-Dissolved (mg/L) | | | <0.000020 | <0.000040 ^{DLA} | <0.000020 | <0.000020 |
| Bismuth (Bi)-Dissolved (mg/L) | | | <0.000050 | <0.00010 ^{DLA} | <0.000050 | <0.000050 |
| Boron (B)-Dissolved (mg/L) | | | 0.042 | 0.075 | 0.046 | 0.034 |
| Cadmium (Cd)-Dissolved (mg/L) | | | 0.0000129 | <0.000010 ^{DLA} | <0.000050 | <0.000050 |
| Calcium (Ca)-Dissolved (mg/L) | | | 45.5 | 301 | 44.1 | 53.7 |
| Chromium (Cr)-Dissolved (mg/L) | | | <0.00010 | 0.00031 | 0.00023 | 0.00015 |
| Cobalt (Co)-Dissolved (mg/L) | | | <0.00010 | <0.00020 ^{DLA} | <0.00010 | <0.00010 |
| Copper (Cu)-Dissolved (mg/L) | | | 0.00132 | <0.00040 ^{DLA} | 0.00026 | <0.00020 |
| Iron (Fe)-Dissolved (mg/L) | | | <0.010 | 0.052 | 0.085 | 0.233 |
| Lead (Pb)-Dissolved (mg/L) | | | <0.000050 | <0.00010 ^{DLA} | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved (mg/L) | | | 0.0038 | 0.0053 | 0.0032 | 0.0032 |
| Magnesium (Mg)-Dissolved (mg/L) | | | 23.4 | 52.3 | 25.4 | 25.1 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

16-MAY-17 13:37 (MT)

Version: DRAFT REV.

| | | Sample ID | L1916507-1 | L1916507-2 | L1916507-3 | L1916507-4 | L1916507-5 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|--------------------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 21-APR-17 | 21-APR-17 | 21-APR-17 | 22-APR-17 | 22-APR-17 |
| | | Sampled Time | 14:14 | 17:07 | | 14:12 | 14:17 |
| | | Client ID | MW09-03-01 | MW09-03-02 | DUP1 | MW12-07-01 | MW12-07-02 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | | 0.0763 | 0.281 | 0.0768 | 0.111 | 0.102 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00441 | 0.0118 | 0.00481 | 0.000351 | 0.0196 |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00085 | 0.00072 | 0.00090 | <0.00050 | <0.0010 ^{DLA} |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 | <0.10 ^{DLA} |
| | Potassium (K)-Dissolved (mg/L) | | 1.87 | 2.23 | 1.88 | 2.46 | 2.53 |
| | Selenium (Se)-Dissolved (mg/L) | | <0.000050 | 0.000238 | <0.000050 | 0.00850 | 0.00072 |
| | Silicon (Si)-Dissolved (mg/L) | | 4.94 | 4.85 | 5.08 | 8.79 | 5.58 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} |
| | Sodium (Na)-Dissolved (mg/L) | | 7.35 | 6.67 | 7.76 | 76.9 | 65.4 |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.920 | 0.320 | 0.941 | 7.13 | 10.9 |
| | Sulfur (S)-Dissolved (mg/L) | | 5.86 | 3.66 | 6.30 | 63.7 | 239 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00033 | 0.00034 | 0.00024 | 0.00045 | <0.00020 ^{DLA} |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | 0.00039 | <0.00060 ^{DLA} |
| | Uranium (U)-Dissolved (mg/L) | | 0.000901 | 0.00264 | 0.000910 | 0.000177 | 0.00177 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | 0.00164 | <0.0010 ^{DLA} |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0067 | 0.0283 | 0.0086 | 0.0051 | <0.0020 ^{DLA} |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

16-MAY-17 13:37 (MT)

Version: DRAFT REV.

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1916507-6 | L1916507-7 | L1916507-8 | L1916507-9 | L1916507-10 |
|-------------------------|----------------------------------|--------------------------|--------------------------|-----------|------------|------------|------------|------------|-------------|
| | | | | | Water | Water | Water | Water | Water |
| | | | | | 22-APR-17 | 23-APR-17 | 23-APR-17 | 23-APR-17 | 23-APR-17 |
| | | | | | | 11:00 | 11:30 | 11:45 | 13:40 |
| | | | | | DUP2 | MW12-05-01 | MW12-05-03 | MW12-05-04 | MW12-05-05 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | 0.102 | 0.134 | 1.91 | 0.520 | 0.128 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0204 | 0.00022 | 0.000832 | 0.00248 | 0.00393 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.0010 ^{DLA} | <0.0010 ^{DLA} | <0.00050 | <0.00050 | 0.00058 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.10 ^{DLA} | <0.10 ^{DLA} | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.55 | 3.23 | 3.47 | 1.89 | 1.83 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00038 | 0.00225 | 0.000562 | 0.00128 | 0.000173 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.59 | 7.06 | 6.76 | 6.05 | 5.65 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 65.0 | 141 | 84.2 | 16.4 | 14.0 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 11.2 | 8.75 | 7.18 | 0.819 | 0.727 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 235 | 385 | 247 | 10.9 | 14.3 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | 0.00011 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLA} | <0.00060 ^{DLA} | <0.00030 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00183 | 0.000917 | 0.00247 | 0.00113 | 0.00267 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 ^{DLA} | <0.0010 ^{DLA} | <0.00050 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0043 | <0.0020 ^{DLA} | 0.0015 | 0.0015 | 0.0112 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1916507-11 Water 23-APR-17 14:00 MW12-05-06 | L1916507-12 Water 23-APR-17 14:20 MW12-05-02 | L1916507-13 Water 23-APR-17 DUP | L1916507-14 Water 23-APR-17 14:50 MW12-05-07 |
|-------------------------|---|--|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | 0.0662 | 0.776 | 0.544 | 0.636 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00368 | 0.00021 | 0.00256 | 0.00224 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00054 | <0.0010 ^{DLA} | <0.00050 | <0.00050 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.10 ^{DLA} | <0.050 | 0.056 |
| | Potassium (K)-Dissolved (mg/L) | 1.78 | 3.61 | 1.95 | 1.70 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000190 | 0.00275 | 0.00171 | 0.00168 |
| | Silicon (Si)-Dissolved (mg/L) | 5.62 | 6.65 | 6.18 | 6.25 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 14.0 | 122 | 17.3 | 14.9 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.704 | 10.4 | 0.863 | 0.845 |
| | Sulfur (S)-Dissolved (mg/L) | 14.6 | 364 | 12.9 | 18.4 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00020 ^{DLA} | 0.00014 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00060 ^{DLA} | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | 0.00287 | 0.000262 | 0.00114 | 0.00267 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.0010 ^{DLA} | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0157 | <0.0020 ^{DLA} | 0.0018 | 0.0014 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|---|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1916507-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1916507-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1916507-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1916507-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1916507-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1916507-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1916507-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Nitrite (as N) | MS-B | L1916507-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |
| DLCI | Detection Limit Raised: Chromatographic Interference due to co-elution. |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |

Reference Information

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

| | |
|----|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |
|----|---|

Chain of Custody Numbers:

2017-04-24 B

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

DRAFT



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1916507-COFC

COC Number: 2017-04-24 B

| | | | | | | | | | |
|--|--|---|--|---|--|---|--|--|--|
| Report To Contact and company name below will appear on the final report | | | | Report For Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | |
| Company: Minto Explorations Ltd. | | Contact: Minto Environment - Coordinator | | Phone: 1-604-759-4659 | | Company address below will appear on the final report | | Date and Time Required for all E&P TATA: dd-mmm-yy hh:mm | |
| Street: 2100-510 West Georgia St. | | City/Province: Vancouver, British Columbia | | Postal Code: V6B 0M3 | | Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Analysis Request | |
| Company: Minto Explorations Ltd. | | Contact: Ruth Cayetano | | ALS Account # / Quote #: | | Job #: | | PO / AFE: 224161 (GW) | |
| LSD: | | ALS Lab Work Order # (lab use only): | | ALS Contact: | | Sampler: CH | | Number of Containers | |
| Sample Identification and/or Coordinates (This description will appear on the report) | | Date (dd-mmm-yy) | | Time (hh:mm) | | Sample Type | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | |
| MW09-03-01 | | 21-Apr-17 | | 14:14 | | Water | | Total Metals (TM) R | |
| MW09-03-02 | | 21-Apr-17 | | 17:07 | | Water | | Disolved Metals (DM) R | |
| DUP1 | | 21-Apr-17 | | | | Water | | Total Mercury, Hardness R | |
| MW12-07-01 | | 22-Apr-17 | | 14:12 | | Water | | Dissolved Mercury R | |
| MW12-07-02 | | 22-Apr-17 | | 14:17 | | Water | | Ammonia (Total Nutrients) R | |
| DUP2 | | 22-Apr-17 | | | | Water | | Dissolved Organic Carbon (DOC) R | |
| MW12-05-01 | | 23-Apr-17 | | 11:00 | | Water | | pH, Cond., TSS, TDS, Alkalinity, Anions R | |
| MW12-05-03 | | 23-Apr-17 | | 11:30 | | Water | | | |
| MW12-05-04 | | 23-Apr-17 | | 11:45 | | Water | | | |
| MW12-05-05 | | 23-Apr-17 | | 13:40 | | Water | | | |
| MW12-05-06 | | 23-Apr-17 | | 14:00 | | Water | | | |
| MW12-05-02 | | 23-Apr-17 | | 14:20 | | Water | | | |
| DUP | | 23-Apr-17 | | | | Water | | | |
| MW12-05-07 | | 23-Apr-17 | | 14:50 | | Water | | | |
| Drinking Water (DW) Samples (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | |
| Are samples taken from a Regulated DW System? | | <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Are samples for human drinking water use? | | <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | |
| Ice Packs <input type="checkbox"/> | | Ice Cubes <input type="checkbox"/> | | Cooling Initiated <input type="checkbox"/> | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | INITIAL COOLER TEMPERATURES °C: 5.0 | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | |
| Released by: Chris Harry | | Date: 2017-04-24 8:00 | | Time: Received by: JD. | | Date: April 24 / 17 | | Time: 13:30 | |

Short Holding Time
Rush Processing


www.alsglobal.com

| | | | | | | | | | | | | | | | | | | | | |
|--|---|--|-----------------------|--|--|--------------|-----------------|--|--|--|---|-------------|--|--------------|--|--|-------|--|-------|--|
| Report To Contact and company name below will appear on the final report | | | | | Report Form Confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | | | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | | | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | | | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | | | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | | | | Email 1 or Fax minto_environment@mintomine.com | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | | | | Email 2 | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | | | | Email 3 | | | | | | | | | | | | | | | |
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Invoice Distribution | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | | | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | Email 2 | | | | | | | | | | | | | | | |
| Project Information | | | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | |
| Job #: | | | | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | | | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | | | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order #: (lab use only) | | | | | ALS Contact: | | Sampler: CH | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | Number of Containers | | | | | | | | | | |
| | MW09-03-01 | | | | 21-Apr-17 | 14:14 | Water | | | | 4 | | | | | | | | | |
| | MW09-03-02 | | | | 21-Apr-17 | 17:07 | Water | | | | 4 | | | | | | | | | |
| | DUP1 | | | | 21-Apr-17 | | Water | | | | 4 | | | | | | | | | |
| | MW12-07-01 | | | | 22-Apr-17 | 14:12 | Water | | | | 4 | | | | | | | | | |
| | MW12-07-02 | | | | 22-Apr-17 | 14:17 | Water | | | | 4 | | | | | | | | | |
| | DUP2 | | | | 22-Apr-17 | | Water | | | | 4 | | | | | | | | | |
| | MW12-05-01 | | | | 23-Apr-17 | 11:00 | Water | | | | 4 | | | | | | | | | |
| | MW12-05-03 | | | | 23-Apr-17 | 11:30 | Water | | | | 4 | | | | | | | | | |
| | MW12-05-04 | | | | 23-Apr-17 | 11:45 | Water | | | | 4 | | | | | | | | | |
| | MW12-05-05 | | | | 23-Apr-17 | 13:40 | Water | | | | 4 | | | | | | | | | |
| | MW12-05-06 | | | | 23-Apr-17 | 14:00 | Water | | | | 4 | | | | | | | | | |
| | MW12-05-02 | | | | 23-Apr-17 | 14:20 | Water | | | | 4 | | | | | | | | | |
| | DUP | | | | 23-Apr-17 | | Water | | | | 4 | | | | | | | | | |
| | MW12-05-07 | | | | 23-Apr-17 | 14:50 | Water | | | | 4 | | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | |
| | | | | | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | |
| Released by: Chris Harry | | | Date: 2017-04-24 8:00 | | Time: | | Received by: JD | | | Date: April 24 / 17 | | Time: 13:30 | | Received by: | | | Date: | | Time: | |

Short Holding Time
Rush Processing

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FORM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 30-MAR-17
Report Date: 10-APR-17 16:35 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1907261
Project P.O. #: 224161 (GW)
Job Reference:
C of C Numbers: 2017-03-30 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | | | | |
|-----------------------------|---|---|----------------------|--|--|
| | L1907261-1 WATER 30-MAR-17 08:40 MW12-07-01 | L1907261-2 WATER 30-MAR-17 09:10 MW12-07-02 | | | |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 1170 | 1430 | | |
| | Hardness (as CaCO3) (mg/L) | 523 | 665 | | |
| | pH (pH) | 8.04 | 8.05 | | |
| | Total Suspended Solids (mg/L) | 6.2 | 5.7 | | |
| | Total Dissolved Solids (mg/L) | 921 | 1160 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 577 | 106 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 577 | 106 | | |
| | Ammonia, Total (as N) (mg/L) | 0.229 | 0.0594 | | |
| | Chloride (Cl) (mg/L) | <2.5 ^{DLDS} | <2.5 ^{DLDS} | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.293 | 0.313 | | |
| | Nitrate (as N) (mg/L) | 0.091 | 0.092 | | |
| | Nitrite (as N) (mg/L) | 0.202 | 0.221 | | |
| | Sulfate (SO4) (mg/L) | 49.8 | 731 | | |
| | Anion Sum (meq/L) | 12.6 | 17.4 | | |
| | Cation Sum (meq/L) | 14.6 | 16.7 | | |
| | Cation - Anion Balance (%) | 7.1 | -2.0 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0058 | 0.0038 | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00018 | 0.00017 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00053 | 0.00170 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.107 | 0.0138 | | |
| | Beryllium (Be)-Dissolved (mg/L) | 0.000049 | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | 0.470 | 0.256 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000073 | 0.0000865 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 179 | 213 | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00086 | <0.00010 | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00139 | 0.00060 | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.038 | 0.151 | | |
| | Lead (Pb)-Dissolved (mg/L) | 0.000090 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0261 | 0.0292 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 18.6 | 32.3 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.122 | 0.109 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1907261-1 | L1907261-2 | | |
|-------------------------|----------------------------------|--------------|------------|------------|--|--|
| | | Description | WATER | WATER | | |
| | | Sampled Date | 30-MAR-17 | 30-MAR-17 | | |
| | | Sampled Time | 08:40 | 09:10 | | |
| | | Client ID | MW12-07-01 | MW12-07-02 | | |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000373 | 0.0188 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00227 | <0.00050 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 3.05 | 3.00 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00132 | 0.000100 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 9.82 | 6.29 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 92.5 | 77.6 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 7.25 | 10.5 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 45.2 | 280 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00033 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000174 | 0.00171 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00189 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0040 | 0.0027 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Aluminum (Al)-Dissolved | MS-B | L1907261-1, -2 |
| Matrix Spike | Arsenic (As)-Dissolved | MS-B | L1907261-1, -2 |
| Matrix Spike | Cadmium (Cd)-Dissolved | MS-B | L1907261-1, -2 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1907261-1, -2 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L1907261-1, -2 |
| Matrix Spike | Iron (Fe)-Dissolved | MS-B | L1907261-1, -2 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1907261-1, -2 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1907261-1, -2 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1907261-1, -2 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1907261-1, -2 |
| Matrix Spike | Zinc (Zn)-Dissolved | MS-B | L1907261-1, -2 |
| Matrix Spike | Nitrate (as N) | MS-B | L1907261-1, -2 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| <p>This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.</p> | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| <p>Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).</p> | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| <p>Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| <p>This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.</p> | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| <p>Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.</p> | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| <p>Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.</p> | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| <p>Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.</p> | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| <p>Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.</p> <p>Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:</p> <p style="margin-left: 20px;">Ion Balance (%) = [Cation Sum - Anion Sum] / [Cation Sum + Anion Sum]</p> | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |

Reference Information

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

| | | | |
|---|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-VA | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-03-30 B

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| Report To | | Report Format | | | Analysis Request | | | | | | | | | | | |
|---|---|--|------------------|---------------------|--|-----------------------|---|-------------------|--|--------------------------------|--|--|---|--|--|----------------------|
| Contact and company name below will appear on the final report | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | |
| Contact: | Minto Environment - Coordinator | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | EMERGENCY | | | | | | | | | | | |
| Phone: | 1-604-759-4659 | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | |
| Company address below will appear on the final report | | Email 1 or Fax minto_environment@mintonline.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 2 | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 3 | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | | | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintonline.com | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Sampler: | | CH/EB | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals (TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, Alkalinity, Anions | | | | | Number of Containers |
| MW12-07-01 | | 30-Mar-17 | 8:40 | Water | | R | | R | R | | R | | | | | 4 |
| MW12-07-02 | | 30-Mar-17 | 9:10 | Water | | R | | R | R | | R | | | | | 4 |
| <div style="border: 2px solid black; padding: 10px; display: inline-block;"> Short Holding Time Rush Processing </div> | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | Cooling Initiated <input checked="" type="checkbox"/> | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | INITIAL COOLER TEMPERATURES °C | | FINAL COOLER TEMPERATURES °C | | 2.0 | | 8 | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | |
| Released by: Chris Harry | Date: 2017-03-30 9:00 | Time: | Received by: EHF | Date: 30 March 2017 | Time: 15:03 | Received by: JH | Date: 03/31/17 | Time: 15:50 | | | | | | | | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 15-MAR-17
Report Date: 24-MAR-17 16:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1901640
Project P.O. #: 224161 (GW)
Job Reference:
C of C Numbers: 2017-03-15B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1901640-1 | L1901640-2 | L1901640-3 |
|--------------------------------------|---|---------------------------------------|--------------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 12-MAR-17 | 14-MAR-17 | 14-MAR-17 |
| | | Sampled Time | 17:30 | 15:55 | 16:15 |
| | | Client ID | MW11-04A | MW09-03-01 | MW09-03-02 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 293 | 313 | 321 |
| | Hardness (as CaCO3) (mg/L) | | 145 | 144 | 151 |
| | pH (pH) | | 11.11 | 8.14 | 8.04 |
| | Total Suspended Solids (mg/L) | | 234 | 5.0 | <3.0 |
| | Total Dissolved Solids (mg/L) | | 148 ^{RRV} | 202 | 196 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | <1.0 | 145 | 150 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | 101 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | 30.7 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 132 | 145 | 150 |
| | Ammonia, Total (as N) (mg/L) | | 0.0191 | 0.0380 | 0.0116 |
| | Chloride (Cl) (mg/L) | | <0.50 | <0.50 | <0.50 |
| | Nitrate (as N) (mg/L) | | 1.10 | <0.0050 | 2.02 |
| | Nitrite (as N) (mg/L) | | 0.0085 | 0.116 | 0.286 |
| | Sulfate (SO4) (mg/L) | | 5.49 | 20.2 | 10.4 |
| | Anion Sum (meq/L) | | 2.82 | 3.33 | 3.37 |
| | Cation Sum (meq/L) | | 3.22 | 3.32 | 3.36 |
| | Cation - Anion Balance (%) | | 6.6 | -0.2 | -0.2 |
| | Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD |
| Dissolved Metals Filtration Location | | | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | | | 0.572 | 0.0026 | 0.0036 |
| Antimony (Sb)-Dissolved (mg/L) | | | 0.00157 | 0.00012 | 0.00022 |
| Arsenic (As)-Dissolved (mg/L) | | | 0.00238 | 0.00078 | 0.00014 |
| Barium (Ba)-Dissolved (mg/L) | | | 0.194 | 0.0710 | 0.0368 |
| Beryllium (Be)-Dissolved (mg/L) | | | <0.000020 | <0.000020 | <0.000020 |
| Bismuth (Bi)-Dissolved (mg/L) | | | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Dissolved (mg/L) | | | <0.010 | 0.125 | 0.298 |
| Cadmium (Cd)-Dissolved (mg/L) | | | 0.0000063 | <0.0000050 | 0.0000414 |
| Calcium (Ca)-Dissolved (mg/L) | | | 58.1 | 39.0 | 49.6 |
| Chromium (Cr)-Dissolved (mg/L) | | | 0.00188 | <0.00010 | 0.00019 |
| Cobalt (Co)-Dissolved (mg/L) | | | <0.00010 | <0.00010 | 0.00040 |
| Copper (Cu)-Dissolved (mg/L) | | | 0.0362 | 0.00040 | 0.00214 |
| Iron (Fe)-Dissolved (mg/L) | | | <0.010 | 0.242 | 0.019 |
| Lead (Pb)-Dissolved (mg/L) | | | <0.000050 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved (mg/L) | | | 0.0174 | 0.0033 | <0.0010 |
| Magnesium (Mg)-Dissolved (mg/L) | | | <0.10 | 11.4 | 6.64 |
| Manganese (Mn)-Dissolved (mg/L) | | | 0.00027 | 0.0842 | 0.113 |
| Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1901640-1 | L1901640-2 | L1901640-3 | | |
|-------------------------|----------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 12-MAR-17 | 14-MAR-17 | 14-MAR-17 | | |
| | | Sampled Time | 17:30 | 15:55 | 16:15 | | |
| | | Client ID | MW11-04A | MW09-03-01 | MW09-03-02 | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00226 | 0.00448 | 0.00807 | | |
| | Nickel (Ni)-Dissolved (mg/L) | | <0.00050 | 0.00107 | 0.00064 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | | 3.63 | 2.17 | 2.47 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.00250 | <0.000050 | 0.000193 | | |
| | Silicon (Si)-Dissolved (mg/L) | | 5.14 | 5.30 | 5.27 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 3.73 | 8.39 | 6.26 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.234 | 0.960 | 0.320 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 1.91 | 6.58 | 3.76 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | | <0.000010 | 0.000940 | 0.00266 | | |
| | Vanadium (V)-Dissolved (mg/L) | | 0.0100 | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0016 | 0.0057 | 0.0446 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---|---|-----------|-----------------------------|
| Qualifiers for Individual Parameters Listed: | | | |
| Qualifier | Description | | |
| RRV | Reported Result Verified By Repeat Analysis | | |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| <p>This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.</p> | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| <p>Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| <p>This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.</p> | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| <p>Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.</p> | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| <p>Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.</p> | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| <p>Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.</p> | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| <p>Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.</p> <p>Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:</p> <p style="margin-left: 20px;">Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]</p> | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| <p>Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| <p>This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.</p> | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| <p>This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.</p> | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-03-15B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1901640-COFC

COC Number: 2017-03-15 B

Page of

www.alsglobal.com

| | | | | | | | | | | | | | | | | | | |
|--|---|---|---|--|---|--|---|--|------------------------------------|---------------------------|------------------------------------|--|--|--|--|--|--|----------------------|
| Report To Contact and company name below will appear on the final report | | Report For | | | confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: | <input checked="" type="checkbox"/> PDF | <input type="checkbox"/> EXCEL | <input checked="" type="checkbox"/> EDD (DIGITAL) | Regular [R] | | <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | EMERGENCY | | 1 Business day [E1] | | <input type="checkbox"/> | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report | <input checked="" type="checkbox"/> YES | <input type="checkbox"/> NO | | 4 day [P4] | <input type="checkbox"/> | | 3 day [P3] | <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] | <input type="checkbox"/> | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked. | | | | 2 day [P2] | <input type="checkbox"/> | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: | <input checked="" type="checkbox"/> EMAIL | <input type="checkbox"/> MAIL | <input type="checkbox"/> FAX | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax | minto_environment@mintomine.com | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | Analysis Request | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: | <input checked="" type="checkbox"/> EMAIL | <input type="checkbox"/> MAIL | <input type="checkbox"/> FAX | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax | ap@mintomine.com | | | P | F/P | P | F/P | P | F/P | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Shane Stack | Sampler: | SR/SB | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | Total Metals(TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | | | | | | Number of Containers |
| | MW11-04A | 12-Mar-17 | 17:30 | Water | | | R | | R | R | | R | | | | | | 4 |
| | MW09-03-01 | 14-Mar-17 | 15:55 | Water | | | R | | R | R | | R | | | | | | 4 |
| | MW09-03-02 | 14-Mar-17 | 16:15 | Water | | | R | | R | R | | R | | | | | | 4 |
| <div style="border: 2px solid black; padding: 10px; display: inline-block;"> <p>Short Holding Time</p> <p>Rush Processing</p> </div> | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | Ice Packs <input type="checkbox"/> | | Ice Cubes <input type="checkbox"/> | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | Cooling Initiated <input type="checkbox"/> | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | INITIAL COOLER TEMPERATURES °C | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | |
| | | | | | 1.0. | | 4.44 | | 3.3 | | 5.77 | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | |
| Released by: Shaun Roberts | Date: 2017-03-15 | Time: 11:00 | Received by: <i>VD.</i> | Date: <i>March 15/17</i> | Time: <i>14:50</i> | Received by: <i>JC</i> | Date: <i>MAR 16 2017</i> | Time: <i>14:35</i> | | | | | | | | | | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 22-FEB-17
Report Date: 03-MAR-17 16:51 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1893584
Project P.O. #: 224161 (GW)
Job Reference:
C of C Numbers: 2017-02-22 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1893584-1 Water 18-FEB-17 10:15 MW12-06-02 | L1893584-2 Water 18-FEB-17 10:45 MW12-06-04 | L1893584-3 Water 18-FEB-17 11:25 MW12-06-06 | L1893584-4 Water 20-FEB-17 13:50 MW12-05-01 | L1893584-5 Water 20-FEB-17 14:15 MW12-05-02 | |
|---|---|---|---|---|---|--------------------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 983 | 991 | 845 | 2080 | 2110 |
| | Hardness (as CaCO3) (mg/L) | 467 | 498 | 408 | 933 | 1020 |
| | pH (pH) | 8.04 | 8.11 | 8.13 | 8.03 | 8.18 |
| | Total Suspended Solids (mg/L) | 61.3 | 8.1 | 7.6 | <3.0 | 4.4 |
| | TDS (Calculated) (mg/L) | 637 | 635 | 522 | 1760 | 1730 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 361 | 414 | 325 | 145 | 181 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 361 | 414 | 325 | 145 | 181 |
| | Ammonia, Total (as N) (mg/L) | 0.0261 | 0.0080 | <0.0050 | 0.0110 | 0.0121 |
| | Chloride (Cl) (mg/L) | <2.5 ^{DLDS} | <2.5 ^{DLDS} | 5.4 | 12.6 | 11.1 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.519 | 1.08 | 1.27 | 0.068 | 0.053 |
| | Nitrate (as N) (mg/L) | 0.106 | 0.202 | 1.05 | <0.050 ^{DLDS} | <0.050 ^{DLDS} |
| | Nitrite (as N) (mg/L) | 0.413 | 0.875 | 0.221 | 0.068 | 0.0531 |
| | Sulfate (SO4) (mg/L) | 214 | 182 | 153 | 1170 | 1110 |
| | Anion Sum (meq/L) | 11.7 | 12.1 | 9.91 | 27.5 | 27.0 |
| | Cation Sum (meq/L) | 11.0 | 11.6 | 9.53 | 24.8 | 26.0 |
| | Cation - Anion Balance (%) | -3.0 | -2.3 | -2.0 | -5.2 | -1.9 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0015 | 0.0021 | 0.0016 | 0.0036 | 0.0043 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00025 | 0.00022 | 0.00013 | 0.00032 | 0.00025 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00364 | 0.00258 | 0.00016 | 0.00079 | 0.00029 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0234 | 0.0172 | 0.0138 | 0.0410 | 0.109 |
| | Beryllium (Be)-Dissolved (mg/L) | 0.000039 | 0.000027 | <0.000020 | <0.000040 ^{DLA} | <0.000040 ^{DLA} |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.00010 ^{DLA} |
| | Boron (B)-Dissolved (mg/L) | 0.252 | 0.435 | 0.156 | 0.111 | 0.106 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | 0.0000423 | <0.000010 ^{DLA} | <0.000010 ^{DLA} |
| | Calcium (Ca)-Dissolved (mg/L) | 131 | 104 | 80.2 | 311 | 319 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00022 | 0.00045 ^{DLA} | 0.00030 ^{DLA} |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00020 ^{DLA} | <0.00020 ^{DLA} |
| | Copper (Cu)-Dissolved (mg/L) | 0.0202 | 0.00030 | 0.00059 | <0.00040 ^{DLA} | 0.00060 |
| | Iron (Fe)-Dissolved (mg/L) | 0.743 | 0.442 | <0.010 | 0.026 | 0.042 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.00010 ^{DLA} |
| | Lithium (Li)-Dissolved (mg/L) | 0.0108 | 0.0067 | 0.0051 | 0.0084 | 0.0059 |
| | Magnesium (Mg)-Dissolved (mg/L) | 33.9 | 57.6 | 50.5 | 37.8 | 54.7 |
| Manganese (Mn)-Dissolved (mg/L) | 0.0266 | 0.0432 | 0.0360 | 0.137 | 0.789 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1893584-6 | L1893584-7 | L1893584-8 | L1893584-9 | L1893584-10 |
|---|---|---------------------------------------|------------|------------|------------|-------------|
| | | Water | Water | Water | Water | Water |
| | | 20-FEB-17 | 20-FEB-17 | 20-FEB-17 | 20-FEB-17 | 20-FEB-17 |
| | | 14:40 | 15:00 | 15:20 | 15:40 | 16:00 |
| | | MW12-05-03 | MW12-05-04 | MW12-05-05 | MW12-05-06 | MW12-05-07 |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 1670 | 506 | 479 | 475 | 500 |
| | Hardness (as CaCO3) (mg/L) | 771 | 225 | 216 | 214 | 239 |
| | pH (pH) | 8.12 | 8.24 | 8.15 | 8.18 | 8.26 |
| | Total Suspended Solids (mg/L) | 3.0 | <3.0 | <3.0 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | 1270 | 279 | 264 | 265 | 278 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 255 | 242 | 212 | 212 | 247 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 255 | 242 | 212 | 212 | 247 |
| | Ammonia, Total (as N) (mg/L) | 0.0150 | 0.0194 | 0.0082 | <0.0050 | 0.0154 |
| | Chloride (Cl) (mg/L) | 7.9 | 5.32 | 5.12 | 5.13 | 4.84 |
| | Nitrate and Nitrite (as N) (mg/L) | <0.051 | 0.0677 | 0.393 | 0.497 | 0.0267 |
| | Nitrate (as N) (mg/L) | <0.050 ^{DLDS} | <0.0050 | 0.332 | 0.463 | 0.0090 |
| | Nitrite (as N) (mg/L) | 0.049 | 0.0677 | 0.0606 | 0.0344 | 0.0177 |
| | Sulfate (SO4) (mg/L) | 749 | 34.6 | 43.5 | 44.4 | 29.0 |
| | Anion Sum (meq/L) | 20.9 | 5.70 | 5.31 | 5.35 | 5.67 |
| | Cation Sum (meq/L) | 19.4 | 5.35 | 5.02 | 4.97 | 5.48 |
| | Cation - Anion Balance (%) | -3.8 | -3.2 | -2.8 | -3.6 | -1.7 |
| | Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | | 0.0025 | 0.0034 | 0.0025 | 0.0042 | 0.0025 |
| Antimony (Sb)-Dissolved (mg/L) | | <0.00020 ^{DLA} | 0.00019 | 0.00019 | 0.00032 | 0.00022 |
| Arsenic (As)-Dissolved (mg/L) | | 0.00029 | 0.00014 | 0.00015 | 0.00014 | 0.00024 |
| Barium (Ba)-Dissolved (mg/L) | | 0.0441 | 0.0661 | 0.0675 | 0.0598 | 0.469 |
| Beryllium (Be)-Dissolved (mg/L) | | <0.000040 ^{DLA} | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| Bismuth (Bi)-Dissolved (mg/L) | | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Dissolved (mg/L) | | 0.088 | 0.081 | 0.064 | 0.040 | 0.035 |
| Cadmium (Cd)-Dissolved (mg/L) | | 0.000014 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| Calcium (Ca)-Dissolved (mg/L) | | 196 | 46.7 | 43.6 | 44.0 | 51.9 |
| Chromium (Cr)-Dissolved (mg/L) | | <0.00020 ^{DLA} | <0.00010 | <0.00010 | 0.00015 | 0.00036 |
| Cobalt (Co)-Dissolved (mg/L) | | <0.00020 ^{DLA} | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Copper (Cu)-Dissolved (mg/L) | | 0.00579 | <0.00020 | 0.00082 | 0.00197 | 0.00025 |
| Iron (Fe)-Dissolved (mg/L) | | 0.042 | 0.012 | <0.010 | <0.010 | 0.089 |
| Lead (Pb)-Dissolved (mg/L) | | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved (mg/L) | | 0.0034 | 0.0033 | 0.0036 | 0.0037 | 0.0032 |
| Magnesium (Mg)-Dissolved (mg/L) | | 68.3 | 26.2 | 25.9 | 25.4 | 26.6 |
| Manganese (Mn)-Dissolved (mg/L) | | 2.07 | 0.555 | 0.142 | 0.0639 | 0.617 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1893584-11 | | | |
|-----------------------------|--|----------------------|--|--|--|
| | | Water | | | |
| | | 18-FEB-17 | | | |
| | | DUP | | | |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 988 | | | |
| | Hardness (as CaCO3) (mg/L) | 496 | | | |
| | pH (pH) | 8.17 | | | |
| | Total Suspended Solids (mg/L) | 6.6 | | | |
| | TDS (Calculated) (mg/L) | 635 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 418 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 418 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0068 | | | |
| | Chloride (Cl) (mg/L) | <2.5 ^{DLDS} | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 1.16 | | | |
| | Nitrate (as N) (mg/L) | 0.220 | | | |
| | Nitrite (as N) (mg/L) | 0.940 | | | |
| | Sulfate (SO4) (mg/L) | 180 | | | |
| | Anion Sum (meq/L) | 12.2 | | | |
| | Cation Sum (meq/L) | 11.5 | | | |
| | Cation - Anion Balance (%) | -2.7 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0014 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00017 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00267 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0169 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | 0.000031 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.490 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 105 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.00020 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.389 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0070 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 56.6 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0444 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

03-MAR-17 16:51 (MT)

Version: FINAL

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1893584-1 | L1893584-2 | L1893584-3 | L1893584-4 | L1893584-5 |
|-------------------------|----------------------------------|--------------|--------------|------------|--------------------------|--------------------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 18-FEB-17 | 10:15 | MW12-06-02 | 18-FEB-17 | 18-FEB-17 | 18-FEB-17 | 20-FEB-17 | 20-FEB-17 |
| | | | | | 10:15 | 10:45 | 11:25 | 13:50 | 14:15 |
| | | | | | MW12-06-02 | MW12-06-04 | MW12-06-06 | MW12-05-01 | MW12-05-02 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00695 | 0.00783 | 0.00569 | 0.00031 | 0.00039 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00235 | <0.00050 | <0.00050 | <0.0010 ^{DLA} | <0.0010 ^{DLA} | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.10 ^{DLA} | <0.10 ^{DLA} | | | |
| | Potassium (K)-Dissolved (mg/L) | 3.78 | 3.80 | 3.47 | 3.84 | 4.07 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000721 | 0.000569 | 0.000487 | 0.00034 | <0.00010 ^{DLA} | | | |
| | Silicon (Si)-Dissolved (mg/L) | 10.6 | 9.20 | 7.20 | 7.45 | 7.20 | | | |
| | Silver (Ag)-Dissolved (mg/L) | 0.000011 | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000020 ^{DLA} | | | |
| | Sodium (Na)-Dissolved (mg/L) | 35.5 | 35.2 | 29.4 | 140 | 125 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 10.1 | 3.07 | 1.58 | 8.56 | 11.2 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 72.6 | 63.8 | 54.6 | 412 | 406 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} | 0.000020 ^{DLA} | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00020 ^{DLA} | <0.00020 ^{DLA} | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00060 ^{DLA} | <0.00060 ^{DLA} | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00277 | 0.00603 | 0.00494 | 0.00110 | 0.000569 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.0010 ^{DLA} | <0.0010 ^{DLA} | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0016 | 0.0402 | 0.0488 | <0.0020 ^{DLA} | 0.0024 ^{DLA} | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00060 ^{DLA} | <0.00060 ^{DLA} | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1893584-6 | L1893584-7 | L1893584-8 | L1893584-9 | L1893584-10 |
|-------------------------|----------------------------------|--------------------------|--------------|------------|------------|------------|------------|------------|-------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 20-FEB-17 | 14:40 | MW12-05-03 | 20-FEB-17 | 20-FEB-17 | 20-FEB-17 | 20-FEB-17 | 20-FEB-17 |
| | | | | | 15:00 | 15:00 | 15:20 | 15:40 | 16:00 |
| | | | | | MW12-05-03 | MW12-05-04 | MW12-05-05 | MW12-05-06 | MW12-05-07 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00076 | 0.00406 | 0.00365 | 0.00347 | 0.00221 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.0010 ^{DLA} | <0.00050 | 0.00065 | 0.00066 | 0.00057 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.10 ^{DLA} | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 3.86 | 2.21 | 2.16 | 2.13 | 1.97 | | | |
| | Selenium (Se)-Dissolved (mg/L) | <0.00010 ^{DLA} | 0.000172 | 0.000172 | 0.000150 | 0.000129 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 7.47 | 6.58 | 6.42 | 6.35 | 6.78 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 87.6 | 18.0 | 15.0 | 14.6 | 14.4 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 7.04 | 0.892 | 0.683 | 0.682 | 0.729 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 256 | 12.2 | 15.1 | 15.6 | 10.6 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00039 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLA} | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00255 | 0.00149 | 0.00295 | 0.00319 | 0.00280 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 ^{DLA} | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0026 | <0.0010 | 0.0457 | 0.0613 | 0.0025 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00060 ^{DLA} | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1893584-11 | | | |
|-------------------------|--|-------------|--|--|--|
| | | Water | | | |
| | | 18-FEB-17 | | | |
| | | DUP | | | |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00845 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 3.77 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000258 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 9.17 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 34.7 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 3.03 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 63.0 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00626 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0667 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---|---|-----------|-----------------------------|
| Qualifiers for Individual Parameters Listed: | | | |
| Qualifier | Description | | |
| DLA | Detection Limit adjusted for required dilution | | |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. | | |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| $\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$ | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |

Reference Information

| | | | |
|---|-------|---------------------------------------|---------------------------|
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-02-22 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| | | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|---|---|-----------------|--------------|--|-------------|---|---|--------------|------------------------------|-------|--|-------|--|--|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | 4 day [P4] <input type="checkbox"/> | | | | | EMERGENCY | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | 2 day [P2] <input type="checkbox"/> | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | CS Monday through | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | |
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | Analysis Request | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | | P F/P P F/P P F/P | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | Total Metals(TM) | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | Total Mercury, Hardness | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: PO# | | | Dissolved Mercury | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: Routing Code: | | | Ammonia (Total Nutrients) | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | Requisitioner: | | | Dissolved Organic Carbon (DOC) | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | pH, Cond., TSS, TDS, Alkalinity, Anions | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | | Sampler: SR/SB | | | Number of Containers | | | | | | | | | | | | |
| ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | | Time (hh:mm) | | Sample Type | | | | | | | | | | | |
| 1 | | MW12-06-02 | | | 18-Feb-17 | | 10:15 | | Water | | 4 | | | | | | | | | |
| 2 | | MW12-06-04 | | | 18-Feb-17 | | 10:45 | | Water | | 4 | | | | | | | | | |
| 3 | | MW12-06-06 | | | 18-Feb-17 | | 11:25 | | Water | | 4 | | | | | | | | | |
| 4 | | MW12-05-01 | | | 20-Feb-17 | | 13:50 | | Water | | 4 | | | | | | | | | |
| 5 | | MW12-05-02 | | | 20-Feb-17 | | 14:15 | | Water | | 4 | | | | | | | | | |
| 6 | | MW12-05-03 | | | 20-Feb-17 | | 14:40 | | Water | | 4 | | | | | | | | | |
| 7 | | MW12-05-04 | | | 20-Feb-17 | | 15:00 | | Water | | 4 | | | | | | | | | |
| 8 | | MW12-05-05 | | | 20-Feb-17 | | 15:20 | | Water | | 4 | | | | | | | | | |
| 9 | | MW12-05-06 | | | 20-Feb-17 | | 15:40 | | Water | | 4 | | | | | | | | | |
| 10 | | MW12-05-07 | | | 20-Feb-17 | | 16:00 | | Water | | 4 | | | | | | | | | |
| 11 | | DUP | | | 18-Feb-17 | | | | Water | | 4 | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | | | | 2.0°C | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2016-02-22 | | Time: 11:00 | | Received by: VD | | Date: Feb 22/17 | | Time: 12:55P | | Received by: | | Date: | | Time: | | | | |

Short Holding Time
Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 20-FEB-17
Report Date: 01-MAR-17 20:15 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1892400
Project P.O. #: 224161 (GW)
Job Reference:
C of C Numbers: 2016-02-18 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1892400-1 Water 16-FEB-17 14:40 MW12-07-01 | L1892400-2 Water 16-FEB-17 15:05 MW12-07-02 | | |
|-----------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 1190 | 1430 | | |
| | Hardness (as CaCO3) (mg/L) | 542 | 673 | | |
| | pH (pH) | 7.70 | 7.83 | | |
| | Total Suspended Solids (mg/L) | <3.0 | 3.6 | | |
| | TDS (Calculated) (mg/L) | 708 | 1080 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 566 | 110 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 566 | 110 | | |
| | Ammonia, Total (as N) (mg/L) | 0.525 | 0.0322 | | |
| | Chloride (Cl) (mg/L) | <2.5 ^{DLDS} | <2.5 ^{DLDS} | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.825 | 1.16 | | |
| | Nitrate (as N) (mg/L) | 0.250 | 0.162 | | |
| | Nitrite (as N) (mg/L) | 0.575 | 1.00 | | |
| | Sulfate (SO4) (mg/L) | 69.1 | 687 | | |
| | Anion Sum (meq/L) | 12.8 | 16.6 | | |
| | Cation Sum (meq/L) | 14.8 | 16.8 | | |
| | Cation - Anion Balance (%) | 7.2 | 0.5 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0020 | 0.0027 | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00023 | 0.00022 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00074 | 0.00160 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0880 | 0.0139 | | |
| | Beryllium (Be)-Dissolved (mg/L) | 0.000042 | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | 0.638 | 0.317 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000125 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 185 | 215 | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00047 | 0.00013 | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.00020 | 0.00094 | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.022 | 0.108 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0260 | 0.0289 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 19.8 | 33.1 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.115 | 0.110 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1892400-1 Water 16-FEB-17 14:40 MW12-07-01 | L1892400-2 Water 16-FEB-17 15:05 MW12-07-02 | | |
|-------------------------|--|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000550 | 0.0189 | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | <0.00050 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 2.94 | 3.04 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00204 | 0.000205 | | |
| | Silicon (Si)-Dissolved (mg/L) | 9.50 | 6.27 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 88.5 | 74.5 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 7.63 | 10.9 | | |
| | Sulfur (S)-Dissolved (mg/L) | 58.0 | 250 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000179 | 0.00169 | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00175 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0023 | 0.0031 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---|---|-----------|-----------------------------|
| Qualifiers for Individual Parameters Listed: | | | |
| Qualifier | Description | | |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. | | |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| $\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$ | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2016-02-18 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 17-FEB-17
Report Date: 01-MAR-17 17:46 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1892186
Project P.O. #: NOT SUBMITTED
Job Reference: 224161 (GW)
C of C Numbers: 2016-02-16 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1892186-1 | L1892186-2 | | |
|---------------------------------|---|--------------|------------|------------|--|--|
| | | Description | Water | Water | | |
| | | Sampled Date | 15-FEB-17 | 15-FEB-17 | | |
| | | Sampled Time | 14:50 | 15:30 | | |
| | | Client ID | MW09-03-01 | MW09-03-02 | | |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 316 | 318 | | |
| | Hardness (as CaCO3) (mg/L) | | 153 | 163 | | |
| | pH (pH) | | 8.18 | 8.16 | | |
| | Total Suspended Solids (mg/L) | | 4.5 | 9.7 | | |
| | TDS (Calculated) (mg/L) | | 177 | 187 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 150 | 160 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 150 | 160 | | |
| | Ammonia, Total (as N) (mg/L) | | 0.0420 | 0.0122 | | |
| | Chloride (Cl) (mg/L) | | <0.50 | <0.50 | | |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.290 | 2.40 | | |
| | Nitrate (as N) (mg/L) | | 0.0172 | 1.99 | | |
| | Nitrite (as N) (mg/L) | | 0.273 | 0.406 | | |
| | Sulfate (SO4) (mg/L) | | 20.9 | 10.2 | | |
| | Anion Sum (meq/L) | | 3.45 | 3.58 | | |
| | Cation Sum (meq/L) | | 3.52 | 3.62 | | |
| | Cation - Anion Balance (%) | | 1.1 | 0.5 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0033 | 0.0026 | | |
| | Antimony (Sb)-Dissolved (mg/L) | | 0.00035 | 0.00044 | | |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00079 | 0.00021 | | |
| | Barium (Ba)-Dissolved (mg/L) | | 0.0695 | 0.0323 | | |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | | 0.286 | 0.490 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | | <0.0000050 | 0.0000679 | | |
| | Calcium (Ca)-Dissolved (mg/L) | | 42.5 | 54.3 | | |
| | Chromium (Cr)-Dissolved (mg/L) | | <0.00010 | 0.00026 | | |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | 0.00031 | | |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00068 | 0.00279 | | |
| | Iron (Fe)-Dissolved (mg/L) | | 0.103 | 0.016 | | |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | | 0.0039 | 0.0013 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | | 11.5 | 6.66 | | |
| Manganese (Mn)-Dissolved (mg/L) | | 0.0861 | 0.0882 | | | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1892186-1 | L1892186-2 | | | |
|-------------------------|----------------------------------|--------------|------------|------------|--|--|--|
| | | Description | Water | Water | | | |
| | | Sampled Date | 15-FEB-17 | 15-FEB-17 | | | |
| | | Sampled Time | 14:50 | 15:30 | | | |
| | | Client ID | MW09-03-01 | MW09-03-02 | | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00509 | 0.00732 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00110 | 0.00066 | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.20 | 2.38 | | | | |
| | Selenium (Se)-Dissolved (mg/L) | <0.000050 | 0.000163 | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.24 | 5.06 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 8.92 | 6.74 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.992 | 0.342 | | | | |
| | Sulfur (S)-Dissolved (mg/L) | 7.06 | 3.32 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00030 | 0.00025 | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000935 | 0.00255 | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0172 | 0.0727 | | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | | | |

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|-----------|-----------|-----------------------------|
|---------------------|-----------|-----------|-----------------------------|

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |

Reference Information

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2016-02-16 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L1892186-COFC

| | | | | | | | | | | | | | | | | | | | | | | |
|--|---|------------------|--|---|-------------------------|---------------|-------------------|-----------------------|--|-------------------|---------------------------|--|---|-------|--|-------|--|--|--|--|--|----------------------|
| Report To Contact and company name below will appear on the final report | | | | Report Format / Distribution | | | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | | | <input checked="" type="checkbox"/> Standard TAT (if received by 3 pm - business days - no surcharges apply) | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | | | Priority (Business Days) 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> | | | EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | |
| Phone: | 1-604-759-4659 | | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | Date and Time Required for all E&P TATs: _____ | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | | | Email 1 or Fax minto_environment@mintomine.com | | | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | | | Email 2 | | | | | Analysis Request | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | | | Email 3 | | | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Invoice Distribution | | | | | | | | | | | | | | | | | | |
| | | | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | |
| | | | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | | | Email 2 | | | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | |
| Job #: | | | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | |
| PO / AFE: 224161 (GW) | | | | Requisitioner: | | | | | | | | | | | | | | | | | | |
| LSD: | | | | Location: | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | ALS Contact: | | Sampler: | | SR | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | Total Metals (TM) | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | | | | | | | | | Number of Containers |
| | MW09-03-01 | | | 15-Feb-17 | 14:50 | Water | R | R | R | R | R | R | R | | | | | | | | | 4 |
| | MW09-03-02 | | | 15-Feb-17 | 15:30 | Water | R | R | R | R | R | R | R | | | | | | | | | 4 |
| | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | INITIAL COOLER TEMPERATURES °C: 2.0 FINAL COOLER TEMPERATURES °C: _____ | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-02-16 | | Time: 10:00 | Received by: <i>EHR</i> | | Date: 17 Feb 2017 | | | Time: 13:34 | | Received by: | | Date: | | Time: | | | | | | |

Short Holding Time
Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 01-FEB-17
Report Date: 10-FEB-17 19:10 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1885861
Project P.O. #: 224161 (GW)
Job Reference:
C of C Numbers: 2017-01-31 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1885861-1 | L1885861-2 | | | |
|---------------------------------|---|--------------|----------------------|----------------------|--|--|--|
| | | Description | Water | Water | | | |
| | | Sampled Date | 30-JAN-17 | 30-JAN-17 | | | |
| | | Sampled Time | 16:05 | 16:20 | | | |
| | | Client ID | MW12-07-01 | MW12-07-02 | | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 1200 | 1400 | | | |
| | Hardness (as CaCO3) (mg/L) | | 531 | 658 | | | |
| | pH (pH) | | 7.59 | 7.79 | | | |
| | Total Suspended Solids (mg/L) | | 3.9 | 3.6 | | | |
| | TDS (Calculated) (mg/L) | | 717 | 1110 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 570 | 110 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 570 | 110 | | | |
| | Ammonia, Total (as N) (mg/L) | | 0.459 | 0.0407 | | | |
| | Chloride (Cl) (mg/L) | | <2.5 ^{DLDS} | <2.5 ^{DLDS} | | | |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.520 | 0.710 | | | |
| | Nitrate (as N) (mg/L) | | 0.158 | 0.212 | | | |
| | Nitrite (as N) (mg/L) | | 0.363 | 0.499 | | | |
| | Sulfate (SO4) (mg/L) | | 80.0 | 727 | | | |
| | Anion Sum (meq/L) | | 13.1 | 17.4 | | | |
| | Cation Sum (meq/L) | | 14.6 | 16.1 | | | |
| | Cation - Anion Balance (%) | | 5.6 | -3.8 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | | | |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0026 | 0.0019 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | | 0.00038 | 0.00019 | | | |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00065 | 0.00159 | | | |
| | Barium (Ba)-Dissolved (mg/L) | | 0.0942 | 0.0143 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | | 0.000045 | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | | 0.557 | 0.349 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | | 0.0000154 | 0.0000056 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | | 179 | 215 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | | 0.00042 | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00023 | <0.00020 | | | |
| | Iron (Fe)-Dissolved (mg/L) | | 0.023 | 0.145 | | | |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | | 0.0268 | 0.0291 | | | |
| Magnesium (Mg)-Dissolved (mg/L) | | 20.5 | 29.4 | | | | |
| Manganese (Mn)-Dissolved (mg/L) | | 0.134 | 0.109 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1885861-1 | L1885861-2 | | |
|-------------------------|----------------------------------|--------------|--------------------------|------------|--|--|
| | | Description | Water | Water | | |
| | | Sampled Date | 30-JAN-17 | 30-JAN-17 | | |
| | | Sampled Time | 16:05 | 16:20 | | |
| | | Client ID | MW12-07-01 | MW12-07-02 | | |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.000010 ^{DLM} | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.000596 | 0.0191 | | |
| | Nickel (Ni)-Dissolved (mg/L) | | <0.00050 | <0.00050 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | | 2.97 | 2.69 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.00147 | 0.000155 | | |
| | Silicon (Si)-Dissolved (mg/L) | | 10.2 | 6.10 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 90.0 | 66.2 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 7.66 | 11.0 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 72.4 | 256 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.000187 | 0.00176 | | |
| | Vanadium (V)-Dissolved (mg/L) | | 0.00189 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0027 | 0.0035 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1885861-1, -2 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1885861-1, -2 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1885861-1, -2 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1885861-1, -2 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1885861-1, -2 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1885861-1, -2 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et | | | |

Reference Information

al.

| | | | |
|---|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-01-31 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| | | | | | |
|--|---------------------------------|--|--|---|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | Select Service Level below - Please confirm all E&P TATs with your AM - surcharges will apply | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | PROBITY (Business Days) 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> | |
| Phone: | 1-804-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | Date and Time Required for all E&P TATs: [dropdown] | |
| City/Province: | Vancouver, British Columbia | Email 2 | | For tests that can not be performed according to the service level selected, you will be contacted. | |
| Postal Code: | V6B 0M3 | Email 3 | | | |
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | Analysis Request | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | |
| Contact: | Ruth Cayetano | Email 2 | | | |

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Oil and Gas Required Fields (client use) | | | | | | | | | | Number of Containers | | | | | | | | |
|-----------------------------|---|------------------|--------------|-------------|--|-----|-------------------|---------------|----------------|-----------|--------------|----------|----|-------------------|----------------------|-----------------------|-------------------------|-------------------|---------------------------|--------------------------------|---|---|---|
| | | | | | AFE/Cost Center: | PC# | Major/Minor Code: | Routing Code: | Requisitioner: | Location: | ALS Contact: | Sampler: | CH | Total Metals (TM) | | Dissolved Metals (DM) | Total Mercury, Hardness | Dissolved Mercury | Ammonia (Total Nutrients) | Dissolved Organic Carbon (DOC) | pH, Cond., TSS, TDS, Alkalinity, Anions | | |
| MW12-07-01 | | 30-Jan-17 | 16:05 | Water | | | | | | | | | | | | | | | | | | 4 | |
| MW12-07-02 | | 30-Jan-17 | 16:20 | Water | | | | | | | | | | | | | | | | | | | 4 |

| | | | | | | | | | | | | | | | | | |
|--|--|---|--|--|--|--|--|--|------------------------------|---|--|--------------|--|-------|--|-------|--|
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Frozen <input type="checkbox"/> | | SIF Observations Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Ice Packs <input type="checkbox"/> | | Ice Cubes <input type="checkbox"/> | | Custody seal intact Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> | | | | | | | |
| | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | |
| | | | | | | INITIAL COOLER TEMPERATURES °C | | | FINAL COOLER TEMPERATURES °C | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-01-31 8:45 | | Time: | | Received by: | | Date: | | Time: | | Received by: | | Date: | | Time: | |

Appendix D – Seepage Monitoring Program Laboratory Results

Memo

| | | | |
|-----------------|--|--------------------|-------------------------|
| To: | Deborah Flemming, Ryan Herbert | Client: | Minto Explorations Ltd. |
| From: | Soren Jensen, Kaitlyn Kooy | Project No: | 1CM002.024 |
| Cc: | Dylan MacGregor (SRK) | Date: | March 28, 2018 |
| Subject: | 2017 Water Balance and Water Quality Model Summary for the Minto Mine Site | | |

1 Introduction and Background

This memorandum provides a summary of the 2017 water balance and water quality model updates for the Minto Mine site. The update covers the period January 1, 2017 through December 31, 2017.

The water balance update includes a review and summary of precipitation, flow and water inventory data for the Mine site. The water quality update includes a comparison of water quality data collected in 2017 to water quality model predictions for Phase VII of the Mine development, which were recently updated as part of a revised Reclamation and Closure Plan. Water quality predictions for the Main Pit Tailings Management Facility (MPTMF) and the Water Storage Pond (WSP) are provided for 2017, 2018 and for the post-closure period when predicted concentrations are the same from year to year (steady state concentrations).

2 Water Balance Update

2.1 Precipitation

Table 1 shows a summary of monthly precipitation measured at the Mine site between October 2016 and December 2017 along with precipitation data from the regional station at Carmacks, YT (Climate ID: 2100301)¹, which is located 77 km Southwest of the Minto Mine. In the past, the meteorological station at Pelly Ranch (Climate ID 2100880)¹ located 25 km north of Minto was used as a regional reference station. However, the published data record from Pelly Ranch ends in March 2015 so the Carmacks Station was used instead.

Approximately 210 mm of precipitation was measured at the Mine site in the 2017 hydrological year, which was lower than total precipitation measured in 2015 (243 mm) and 2016 (242 mm). Total annual precipitation of 210 mm roughly corresponds to a 1 in 50 to a 1 in 100 dry year.

¹ Data obtained from Meteorological Service of Canada, Environment Canada.

Table 1: Precipitation Records for the Minto Mine Site and Carmacks

| | | Campbell Scientific Station (Minto Mine) | | |
|--|-------|--|--------------|---|
| Year | Month | Tipping Bucket Gauge | Geonor Gauge | Carmacks Ranch ^A (Climate ID 2100301) |
| | | mm/month | mm/month | mm/month |
| 2016 | Oct | 6.7 | 9.8 | 8.4 |
| 2016 | Nov | 24.2 | 13.6 | 14.4 |
| 2016 | Dec | 7.4 | 14.1 | 17.5 |
| 2017 | Jan | 1.3 | 8.0 | 13.9 |
| 2017 | Feb | 0.0 | 6.6 | 4.3 |
| 2017 | Mar | 3.8 | 7.5 | 13.1 |
| 2017 | Apr | 7.0 | 9.4 | 8.7 |
| 2017 | May | 22.0 | 17.5 | 13.1 |
| 2017 | Jun | 40.0 | 13.2 | 76.6 |
| 2017 | Jul | 42.3 | 44.7 | 92.3 |
| 2017 | Aug | 20.4 | 20.9 | 24.4 |
| 2017 | Sept | 37.4 | 38.8 | 39.9 |
| 2017 | Oct | 4.7 | 17.9 | 27.3 |
| 2017 | Nov | 7.9 | 7.9 | 14.4 |
| 2017 | Dec | 4.7 | 4.7 | 6.1 |
| SUM Hydrological Year, Nov. 2016 to Oct. 2017 | | 210.5 | 212.2 | 345.5 |

Source: Minto Site Data: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\Minto Water Balance\2017 Met Station Data Summary.xlsx

Notes:

A: Data obtained from Meteorological Service of Canada, Environment Canada.

Minto's Campbell Scientific meteorological station measures total precipitation using a Geonor gauge and a tipping bucket rain gauge. From October through May, the tipping bucket is equipped with a snowfall conversion adaptor, which allows it to measure snowfall as snow water equivalent. The Geonor precipitation gauge collects precipitation in a bucket and records precipitation by measuring the weight of the bucket. In the winter months, the bucket is partially filled with an antifreeze solution that melts any snow collected. Figure 1 shows monthly precipitation recorded by the two gauges as well as total precipitation recorded at Carmacks.

Precipitation measured by the tipping bucket gauge and Geonor gauge were in good agreement on the total annual precipitation measurements (see Table 1) so the measured annual precipitation was assumed to be reliable for use in the annual summary. However, considerable discrepancy was noted in monthly precipitation measurements between January and June (Figure 1). Agreement is better in the second half of the year. Precipitation measured at Carmacks was much higher in June and July than at the Minto Mine.

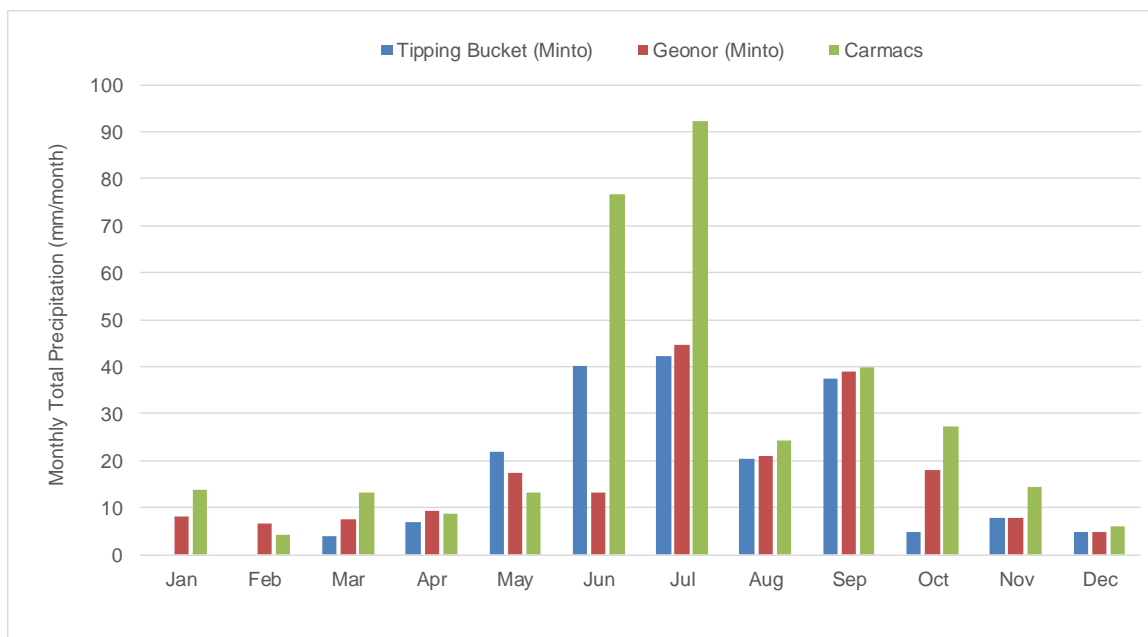


Figure 1: 2017 Monthly Total Precipitation Measurements at Minto and at Carmacks

2.2 Snow Course Data

Snow course surveys were completed at the three established snow survey stations at the Mine site in 2017. Table 2 shows a summary of the snow survey data (i.e. an average of the results from the three stations) from 2009 to 2017. The depth and water equivalent of the snow pack provides an indication of the volume of surface runoff that must be managed the following freshet. In March, April and May 2017, approximately 210,000 m³ of surface runoff was collected from catchments at the Mine site upstream of the Water Storage Dam. This volume corresponds to roughly 20 mm of runoff, which was slightly less than the estimated 25 mm of runoff observed in 2016.

Table 2: Summary of Snow Survey Data for the Minto Mine Site

| Year | February | March | April |
|------|-----------------------|-----------------------|-----------------------|
| | Water Equivalent (mm) | Water Equivalent (mm) | Water Equivalent (mm) |
| 2009 | 92.7 | 110.0 | 150.7 |
| 2010 | 107.7 | 120.7 | 56.0 |
| 2011 | 106.0 | 141.7 | 111.7 |
| 2012 | 111.0 | 127.0 | 132.7 |
| 2013 | 91.3 | 106.0 | 62.7 |
| 2014 | 84.3 | 99.7 | 67.3 |
| 2015 | 90.3 | 76.6 | 67.8 |
| 2016 | 80.3 | 80.7 | n/a |
| 2017 | 79.0 | 72.7 | 59.3 |

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2017_Water_Balance_Update\MintoSnowMaster_2017.xlsx

2.3 Water Management

Water that is suitable for release into Minto Creek is conveyed to the Water Storage Pond (WSP), while water collected from active mine areas is routed to the Main Pit Tailings Management Facility (MPTMF) or the Area 2 Pit Tailings Management Facility (A2PTMF). Since November 2012, the MPTMF has also been used for subaqueous deposition of tailings. Deposition of mine water and tailings (subaqueous) to the A2PTMF commenced in April 2015.

Other water management features on the Mine site include:

- W15 sump: collects surface runoff and seepage from:
 - The Southwest Waste Dump;
 - Part of the Main Waste Dump; and
 - Adjacent undisturbed catchments.

In 2017, water collected at W15 was routed to the Main Pit TMF from April until late May and when water quality met discharge criteria, W15 was re-routed to the WSP. Approximately 50% of the catchment that report to W15 is covered by waste rock.

- W35 sump: collects surface runoff from the minimally disturbed southern catchments. Water collected at W35 in 2017 was piped to the Main Pit TMF from April until early May, then to the WSP from May until July once water quality met release criteria. Water quality was closely monitored and W35 sump water was re-routed to the Main Pit periodically throughout the summer. Construction of the re-alignment of the South Diversion Ditch (SDD) in July necessitated the routing of W35 water to the Main Pit TMF for the rest of the year.
- W62 sump (formerly known as W36 or W37 sump): collects surface runoff and seepage from the mill valley, including contributions from the Dry Stack Tailings Storage Facility. Water collected at the W62 sump is pumped to the MPTMF.
- South Diversion Ditch: diverts water from (W35 Sump) minimally disturbed southern catchments to the WSP (can also be routed to the MPTMF).
- WSP: reservoir for water that meets discharge criteria and is destined for discharge to Minto Creek.

2.4 2017 Water Balance

Table 3 summarizes the monthly water and tailings inventory in Minto's MPTMF and A2PTMF as well as water inventory in the WSP. In 2017, the water inventory in the MPTMF was reduced by approximately 22,000 m³, while the water inventory in A2PTMF increased by roughly 501,000 m³. The increase in water inventory in the A2PTMF roughly corresponds to the volume of pore water in the sub-aqueously deposited tailings in 2017. Therefore, the free water volume in the pits should be unchanged from last year. The WSP water inventory increased by about 6,000 m³ between January 1 and December 31, 2017.

Table 4 shows a summary of the 2017 water balance for the Mine site. The total surface runoff collected on site was estimated to be 565,000 m³ based on the change in the water inventory and the known volume of water released to Minto Creek. Including an estimated inflow of 30,000 m³ of groundwater, the total site-wide yield was estimated at about 595,000 m³ for the year. The total catchment upstream of the Water Storage Dam measures approximately 1,040 ha. Therefore, 595,000 m³ of runoff from 1,040 ha gives a unit yield of approximately 57 mm/year.

The water and load balance model used for forecasting surface runoff volumes uses a site-wide annual average runoff coefficient, which has been derived based on previous years' water balance results. The runoff coefficient is estimated based on the total annual precipitation as follows:

- For dry years with less than 190 mm total precipitation: runoff coefficient = 0.15.
- For average to wet years with more than 309 mm total precipitation: runoff coefficient = 0.30.
- Runoff coefficients for years with total precipitation between 190 mm and 309 mm: interpolated values between 0.15 and 0.30.

In 2017 (hydraulic year) the estimated total precipitation was 210 mm (Table 1), which corresponds to a modelled runoff coefficient of 0.18. The site-wide runoff coefficient, based on the 2017 water balance (measured flows, water inventory and total precipitation), is:

$$\text{Annual Yield} / \text{Total Annual Precipitation} = \text{Runoff Coefficient} \rightarrow 57 \text{ mm} / 210 \text{ mm} = \mathbf{0.27}$$

The calculated value for the annual site-wide runoff coefficient is higher than the runoff coefficient estimated by the water balance model. However, the site-wide runoff coefficient is similar to the coefficient calculated in previous, slightly wetter years. Therefore, the method used by the water balance model to estimate runoff in dry years is likely too conservative (i.e. conservatively dry).

Table 3: 2017 Water Inventory and Release to Minto Creek

| Month/ Year | MPTMF Volume Occupied (Water + Tailings) ^A m ³ | Change in MPTMF Water Inventory m ³ /month | Tailings Solids Deposition in MPTMF BCM/month | A2PTMF Volume Occupied (Water + Tailings) ^A m ³ | Change in A2PTMF Water Inventory m ³ /month | Tailings Solids Deposition in A2PTMF BCM/month | WSP Volume ^A m ³ | Change in WSP Water Inventory m ³ /month |
|----------------|---|---|---|--|--|--|--|---|
| Jan-17 | 3,924,000 | 41,000 | 0 | 2,077,000 | -2,000 | 45,000 | 67,000 | -4,000 |
| Feb-17 | 3,965,000 | 48,000 | 0 | 2,120,000 | 5,000 | 40,000 | 63,000 | -5,000 |
| Mar-17 | 4,013,000 | 32,000 | 0 | 2,164,000 | 20,000 | 48,000 | 58,000 | -3,000 |
| Apr-17 | 4,046,000 | -140,000 | 0 | 2,231,000 | 147,000 | 43,000 | 55,000 | 18,000 |
| May-17 | 3,906,000 | 68,000 | 0 | 2,421,000 | 43,000 | 47,000 | 73,000 | 5,000 |
| Jun-17 | 3,974,000 | 71,000 | 0 | 2,511,000 | -29,000 | 47,000 | 78,000 | 6,000 |
| Jul-17 | 4,045,000 | 17,000 | 0 | 2,529,000 | 24,000 | 43,000 | 84,000 | -5,000 |
| Aug-17 | 4,061,000 | 63,000 | 0 | 2,596,000 | -17,000 | 40,000 | 79,000 | -7,000 |
| Sep-17 | 4,124,000 | -8,000 | 0 | 2,618,000 | 98,000 | 41,000 | 72,000 | 6,000 |
| Oct-17 | 4,116,000 | -162,000 | 0 | 2,757,000 | 162,000 | 45,000 | 77,000 | 0 |
| Nov-17 | 3,954,000 | -100,000 | 0 | 2,964,000 | 89,000 | 39,000 | 77,000 | -4,000 |
| Dec-17 | 3,854,000 | 49,000 | 0 | 3,092,000 | -37,000 | 42,000 | 74,000 | -2,000 |
| Jan-18 | 3,903,000 | | 0 | 3,098,000 | | | 72,000 | |
| SUM | | -22,000 | 0 | | 501,000 | 524,000 | | 6,000 |

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2017_Water_Balance_Update\2017 Water Balance Update REV00 KNK.xlsx

Notes:

A – on the first day of the month.

Table 4: Water Balance Summary of the Minto Mine Site, 2017 (Jan to Dec)

| | Units | Main Pit TMF | Area 2 Pit TMF | WSP |
|---|----------------------|-----------------|-------------------|-------|
| Volume Change 2017 (water + tailings) | m ³ | -22,000 | 1,021,000 | 6,000 |
| Tailings Deposited, total | BCM | - | 524,000 | - |
| Water Volume Change 2017 | m ³ | -22,000 | 501,000 | 6,000 |
| Estimated Groundwater Inflow | m ³ | - | 30,000 | - |
| Total Water Inventory Increase in 2017 | m³ | | 515,000 | |
| Total Water Discharged to Minto Creek | m ³ | | 80,000 | |
| Total Site-Wide Yield in 2017 | m³ | | 595,000 | |

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2017_Water_Balance_Update\2017 Water Balance Update REV00 KNK.xlsx

3 Water Quality Model Update

3.1 Solid Phase Geochemistry

The neutralization potential ratio (NPR) and copper content of waste rock and tailings were reviewed in order to identify any new trends in the solid phase geochemistry that may have developed since the last source term update. Significant changes in the solid phase geochemistry would indicate a need for further analysis of the waste rock and tailings to generate new source terms that reflect the observed changes in the geochemistry.

The NPR and copper content of waste rock and tailings are shown in Figure 2 to Figure 5. The NPR of tailings solids appear to show a decreasing trend in 2017 and copper concentrations an increasing trend. However, measured NPR was greater than 3 for all samples, which indicates that the tailings are not potentially acid generating and the lower NPRs are therefore not expected to affect source terms. Copper concentrations increased only to the levels measured in 2015. This range of copper concentrations has already been accounted for in the existing source terms. No significant changes in geochemistry were observed in the properties of the waste rock in 2017 compared to similar materials produced in prior years. Therefore, no further evaluation of 2017 solid phase geochemistry was warranted.

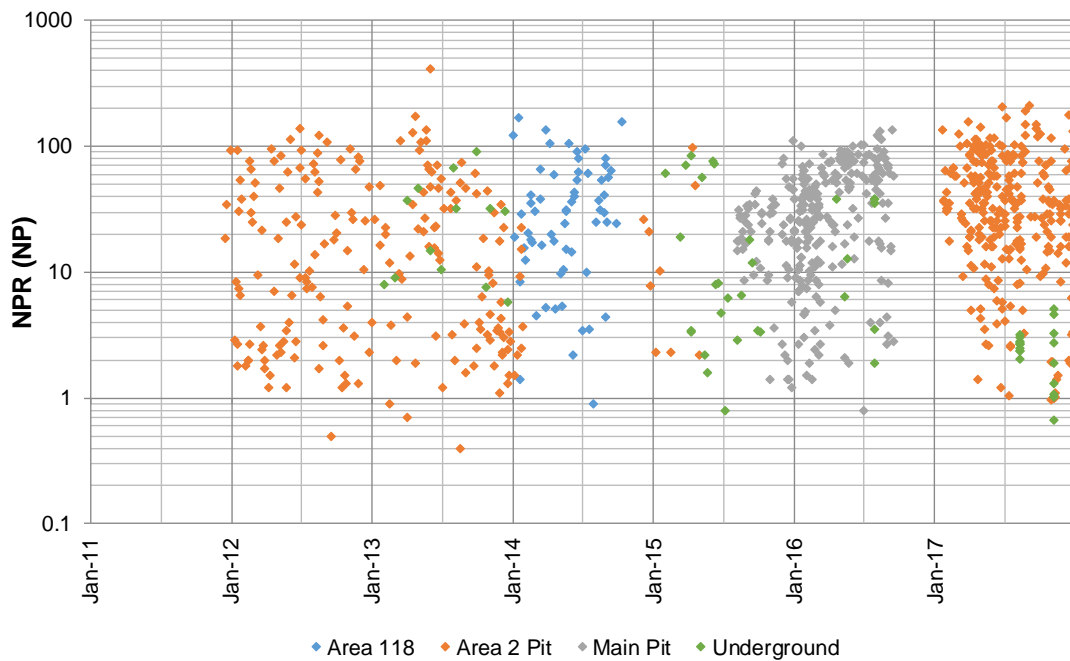


Figure 2: Waste Rock Neutralization Potential Ratio over Time

X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\080_Deliverables\2017_Water_Bal_Update_Ann_Rep\ABACharts_Cu_NPR_2017_1CM002.024_REV00_KNK.xlsx

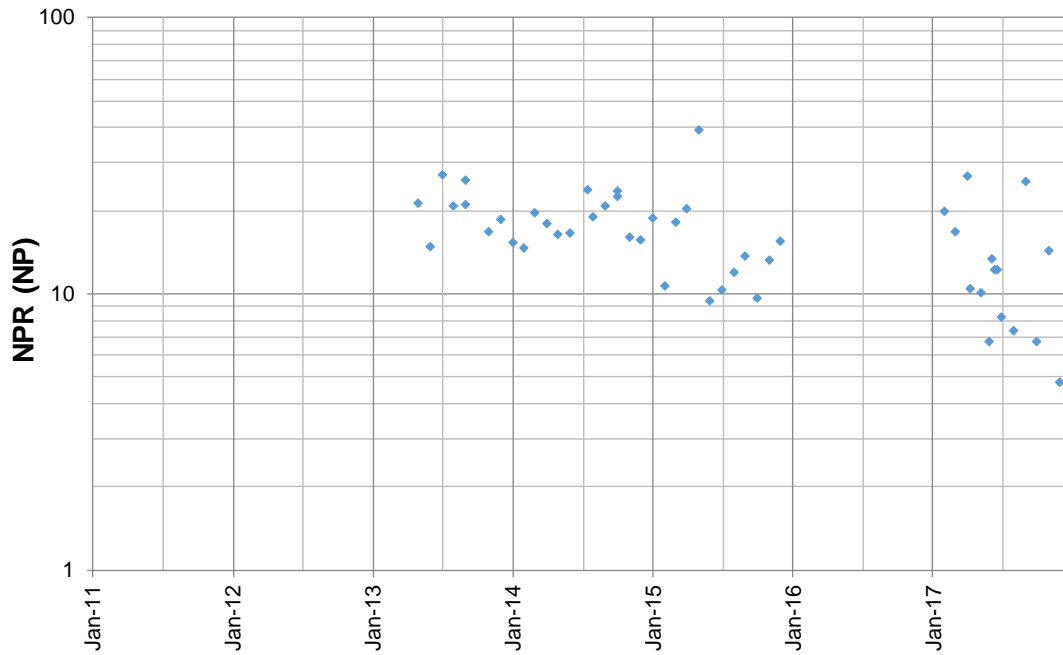


Figure 3: Tailings Neutralization Potential Ratio over Time

X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\080_Deliverables\2017_Water_Bal_Update_Ann_Rep\ABASharts_Cu_NPR_2017_1CM002.024_REV00_KNK.xlsx

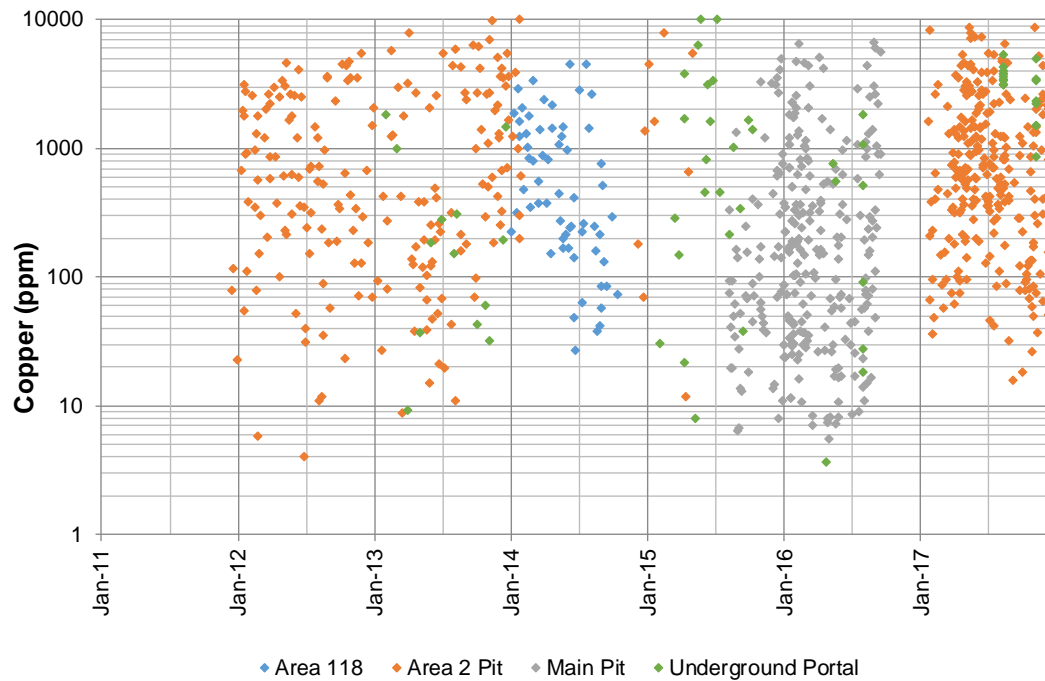


Figure 4: Waste Rock Copper Concentration over Time

X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\080_Deliverables\2017_Water_Bal_Update_Ann_Rep\ABASharts_Cu_NPR_2017_1CM002.024_REV00_KNK.xlsx

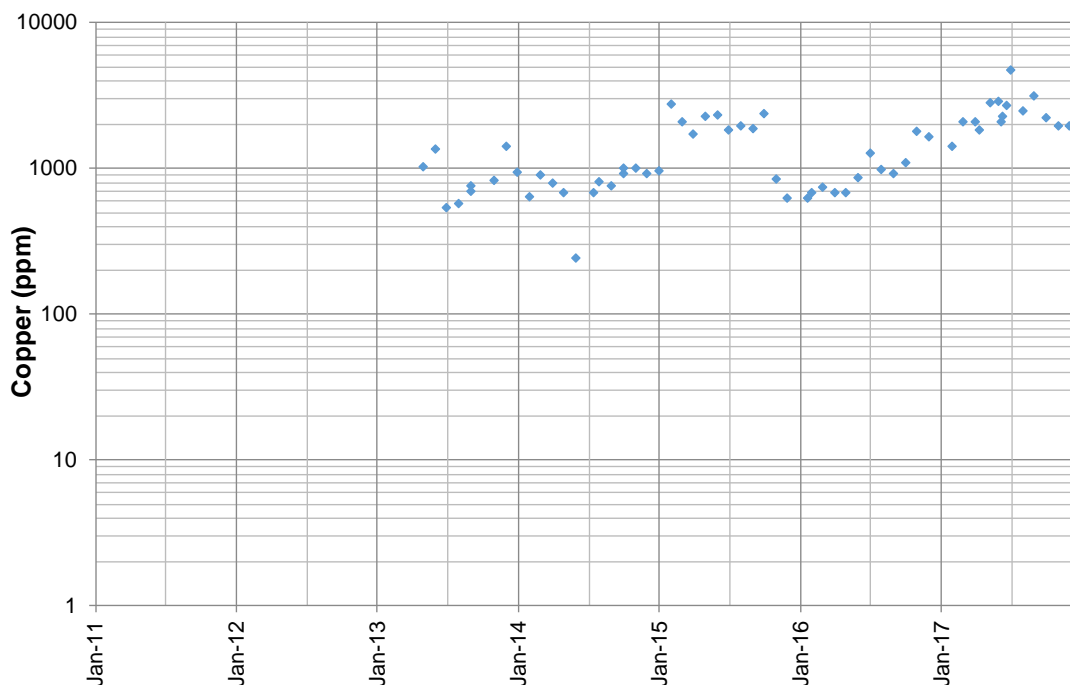


Figure 5: Tailings copper concentration over time

X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\080_Deliverables\2017_Water_Bal_Update_Ann_Rep\
ABACharts_Cu_NPR_2017_1CM002.024_REV00_KNK.xlsx

3.2 Comparison of Measured Water Quality Data to Source Terms

3.2.1 Source Terms – Dry Stack Tailings Storage Facility

The Dry Stack Tailings Storage Facility (DSTSF) source terms used in the water and load balance model for the Minto were developed based on the observed water chemistry of samples collected at station W8 and W8A. This station was chosen because it had the highest concentrations of copper, cadmium, selenium, and sulfate during the period of record. The following points describe the source terms:

- Best Estimate source term: 50th percentile dissolved concentrations from W8A;
- Reasonable Worst Case source term: 95th percentile dissolved concentrations from W8A.

The Best Estimate and Reasonable Worst Case source terms were updated to include data to 2017 for comparison to the existing source terms. It was found that the updated source terms did not differ from the source terms used in the latest model revision, which included data up to and including 2016. Therefore, for consistency the original DSTSF source terms was be used in this 2017 update of the water balance and water quality model.

3.2.2 Source Terms – Waste Rock

The Main Waste Dump and the Southwest Waste Dump source terms used in the water and load balance model were defined based on observed water chemistry at station W15, which collects runoff from the Southwest Waste Dump. The latest model revision assigned Best Estimate waste

rock source term as the 50th percentile dissolved concentrations at W15 until the end of 2016 and the Reasonable Worst Case waste rock source term was the 95th percentile dissolved concentrations. Water quality data collected at W15 in 2017 followed the same trends as the historical data. Therefore, the original source term was used for the updated predictions presented here.

3.2.3 Source Term – Tailings Slurry

In 2017, sulfate concentrations in the Area 2 and Main Pit water increased at a greater rate than in previous years. After investigating possible causes, it was concluded that variability in sulfate loadings from tailings slurry was the most likely cause of the concentration increases.

In order to properly represent the variability in the mill effluent water quality in the water and load balance model, the tailings slurry source term was divided into two parts: sulfide ore tailings source term and oxide ore (referred to as POX) tailings source term. Typically, just sulfide ore or a blend of sulfide ore and POX ore are processed in the mill. Elevated concentrations of sulfate in the mill effluent coincided with processing of POX. Accordingly, the tailings slurry source terms for sulfide ore and POX ore were developed based on measured sulfate concentrations in the tailings thickener when sulfide ore and POX ore were milled.

The loading rates associated with POX processing are highly variable. To maintain conservatism in the model predictions, the Expected Case and Worst Case POX ore slurry source term that represents the highest sulfate loading rates was used for all model scenarios.

3.3 Water Quality Model Results

Table 5 and 6 show revised model outputs from the updated water and load balance model for water quality in the Water Storage Pond (WSP) for 2017, 2018, and post-closure (best estimate and worst case) along with concentrations measured in 2017. Table 7 and 8 show revised model predictions of water quality in the MPTMF for 2017, 2018 and post-closure. Predictions for 2018 and post-closure were selected to provide representative short-term and long-term indications of water quality trends. Predictions are for average precipitation conditions. The Water Use Licence (QZ14-031) effluent limits are also listed in the tables. Model runs started on 1 January 2016 and ended on 1 January 2045, at which point concentrations in the model roughly have reached steady state.

The MPTMF was historically the primary water reservoir on site. In the model, the free water in the MPTMF and A2PTMF are more or less considered to belong to the same reservoir due to the high rate of flow between the two reservoirs. Reclaim water is drawn from the MPTMF and excess free water in the A2PTMF is pumped back to the MPTMF.

Therefore, a comparison of measured MPTMF water quality with concentrations predicted for pit water for the Phase V/VI environmental assessment provides a good measure of actual vs. expected geochemical performance of the site. Water collected in the WSP includes clean (non-contact) runoff and effluent from Minto's water treatment plant.

Median measured concentrations in the WSP in 2017 were lower than or comparable to the revised model predictions using best estimate source terms (Table 5), except for dissolved

copper, for which the measured median concentration was 27 µg/L compared to expected median concentrations of approximately 18 µg/L. Dissolved copper concentrations in the WSP shows a decreasing trend between 2011 and 2015 followed by an increasing trend between 2015 and 2017 (Figure 6). The increase in copper concentrations in the WSP in 2017 was due to a reduction in the volume of treated MPTMF water that was pumped to the WSP. MPTMF water is treated using reverse osmosis, which removes nearly all dissolved copper.

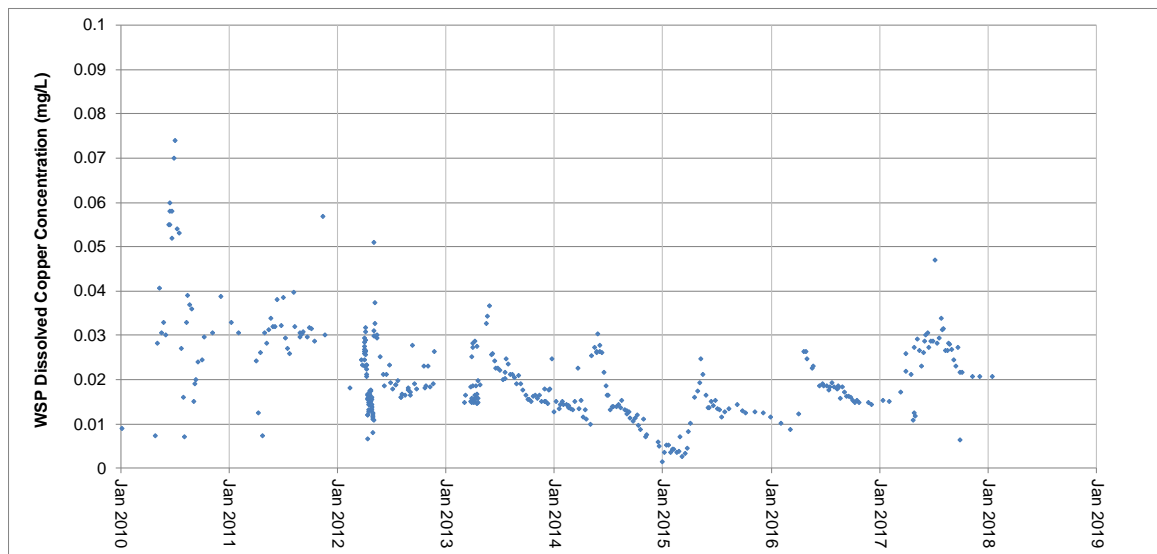


Figure 6 Dissolved Copper Concentrations in WSP (Station W16)

The overall favorable agreement in the results tables below indicates that the revised source terms are appropriate for describing the existing geochemical performance and the actual water management practices on site. Best estimate source terms are intended to provide an indication of the general trend in water quality parameter concentrations, but are not intended to capture maximum or outlier concentration values. Therefore, the median values of best estimate model predictions are compared to measured median values.

Revised model predictions using reasonable worst case source terms are generally higher than comparable median and maximum measured values for the WSP, except for copper (Table 6).

Revised model predictions for water quality in the MPTMF (and by extension the A2PTMF) using the best estimate source terms are in reasonable agreement with median measured concentrations in 2017 (Table 7) except for dissolved cadmium and nitrite. Median measured cadmium concentrations are approximately a factor of 2 greater than expected concentration but still well below the concentrations predicted based on reasonable worst case source terms (Table 8). Nitrite is relatively unstable and is produced and consumed by biological activity in the pit water. An investigation of the matter indicated that it may be the activity of heterotrophic microorganisms in the MPTMF water that is responsible for producing the elevated nitrite concentrations.

Water quality model predictions using reasonable worst-case source terms are higher than measured median and maximum concentrations, with the exception of nitrite (Table 8).

Table 5: WSP Water Quality Model Predictions and Measured Concentrations in 2017, Best Estimate

| | WUL Effluent Limits (QZ14-031) | WSP Measured Water Quality (Station W16) | Modelling Predictions of Quality in WSP (Station W16) | | | |
|------------------------|---------------------------------------|--|--|----------|--------------|--------------|
| | | | 2017 | 2017 | 2018 | Post-Closure |
| Year | | 2017 | 2017 | 2018 | Post-Closure | |
| | | Median | Median | Median | Median | |
| Ammonia mg/L | 0.75 | 0.055 | 0.095 | 0.09 | 0.23 | |
| N-NO ₂ mg/L | 0.18 | 0.029 | 0.066 | 0.057 | 0.059 | |
| N-NO ₃ mg/L | 27.3 | 2 | 4.5 | 4.8 | 1.2 | |
| Ag-Dissolved mg/L | 0.0003 | 0.00001 | 0.000023 | 0.000023 | 0.000049 | |
| Al-Dissolved mg/L | 0.3 | 0.0062 | 0.062 | 0.058 | 0.28 | |
| As-Dissolved mg/L | 0.015 | 0.00039 | 0.00078 | 0.00078 | 0.0021 | |
| Cd-Dissolved mg/L | 0.0014a | 0.0000099 | 0.000031 | 0.000029 | 0.000022 | |
| Cr-Dissolved mg/L | 0.003 | 0.00011 | 0.0012 | 0.0012 | 0.0019 | |
| Cu-Dissolved mg/L | 0.06/0.039b | 0.027 | 0.018 | 0.017 | 0.013 | |
| Fe-Dissolved mg/L | 3.3 | 0.069 | 0.54 | 0.55 | 0.59 | |
| Pb-Dissolved mg/L | 0.012 | 0.00005 | 0.00026 | 0.00026 | 0.00042 | |
| Mo-Dissolved mg/L | 0.219 | 0.0027 | 0.0026 | 0.0027 | 0.0097 | |
| Ni-Dissolved mg/L | 0.33 | 0.0008 | 0.0019 | 0.0018 | 0.0024 | |
| Se-Dissolved mg/L | 0.006 | 0.00073 | 0.0013 | 0.0014 | 0.002 | |
| Zn-Dissolved mg/L | 0.09 | 0.0011 | 0.007 | 0.0068 | 0.0035 | |

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\All_Model_Results_for_WQ_Model_Comparison_for_2015_An_Report_SRJ_Rev00.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

- a) at 50 mg/L hardness.
- b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 6: WSP Water Quality Model Predictions and Measured Concentrations in 2017, Reasonable Worst Case

| Year | WUL Effluent Limits (QZ14-031) | WSP Measured Water Quality (Station W16) | | Modelling Predictions of Quality in WSP (Station W16) | | | | | |
|-------------------|--------------------------------|--|----------|---|----------|----------|----------|--------------|---------|
| | | 2017 | | 2017 | | 2018 | | Post-Closure | |
| | | Median | Max | Median | Max | Median | Max | Median | Max |
| Ammonia mg/L | 0.75 | 0.055 | 0.16 | 0.26 | 0.32 | 0.25 | 0.29 | 0.83 | 1.6 |
| N-NO2 mg/L | 0.18 | 0.029 | 0.12 | 0.2 | 0.22 | 0.18 | 0.22 | 0.12 | 0.23 |
| N-NO3 mg/L | 27.3 | 2 | 4.9 | 12 | 19 | 13 | 16 | 3.3 | 6.4 |
| Ag-Dissolved mg/L | 0.0003 | 0.00001 | 0.00001 | 0.000023 | 0.000027 | 0.000023 | 0.000025 | 0.000088 | 0.00021 |
| Al-Dissolved mg/L | 0.3 | 0.0062 | 0.034 | 0.12 | 0.15 | 0.11 | 0.14 | 0.55 | 1.2 |
| As-Dissolved mg/L | 0.015 | 0.00039 | 0.00048 | 0.0011 | 0.0013 | 0.0011 | 0.0012 | 0.0047 | 0.011 |
| Cd-Dissolved mg/L | 0.0014a | 9.9E-06 | 0.000049 | 0.000091 | 0.00011 | 0.000088 | 0.0001 | 0.000096 | 0.00024 |
| Cr-Dissolved mg/L | 0.003 | 0.00011 | 0.00022 | 0.0013 | 0.0015 | 0.0013 | 0.0014 | 0.0036 | 0.0086 |
| Cu-Dissolved mg/L | 0.06/0.039b | 0.027 | 0.047 | 0.031 | 0.038 | 0.03 | 0.035 | 0.02 | 0.057 |
| Fe-Dissolved mg/L | 3.3 | 0.069 | 0.14 | 1.1 | 1.4 | 1.1 | 1.2 | 1.4 | 3.9 |
| Pb-Dissolved mg/L | 0.012 | 0.00005 | 0.000096 | 0.00027 | 0.00031 | 0.00028 | 0.00029 | 0.0018 | 0.004 |
| Mo-Dissolved mg/L | 0.219 | 0.0027 | 0.0048 | 0.0052 | 0.0069 | 0.0054 | 0.0061 | 0.03 | 0.071 |
| Ni-Dissolved mg/L | 0.33 | 0.0008 | 0.0013 | 0.0029 | 0.0033 | 0.0029 | 0.0031 | 0.0054 | 0.015 |
| Se-Dissolved mg/L | 0.006 | 0.00073 | 0.0015 | 0.0029 | 0.0043 | 0.0031 | 0.0038 | 0.0044 | 0.0084 |
| Zn-Dissolved mg/L | 0.09 | 0.0011 | 0.011 | 0.0098 | 0.01 | 0.0092 | 0.01 | 0.0083 | 0.023 |

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\All_Model_Results_for_WQ_Model_Comparison_for_2015_An_Report_SRJ_Rev00.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

- a) at 50 mg/L hardness.
- b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 7: MPTMF Water Quality Model Predictions and Measured Concentrations in 2017, Best Estimate

| | | WUL Effluent Limits (QZ14-031) | MPTMF Measured Water Quality (Station W12) | Modelling Predictions of Quality in MPTMF (Station W12) | | |
|--------------|------|---|---|--|----------|----------|
| Year | | | | 2017 | 2017 | 2018 |
| | | | Median | Median | Median | Median |
| Ammonia | mg/L | 0.75 | 4 | 5.2 | 4.4 | 0.079 |
| N-NO2 | mg/L | 0.18 | 3.7 | 2 | 1.5 | 0.017 |
| N-NO3 | mg/L | 27.3 | 14 | 38 | 33 | 0.38 |
| Ag-Dissolved | Mg/L | 0.0003 | 0.00002 | 0.000063 | 0.000063 | 0.000057 |
| Al-Dissolved | mg/L | 0.3 | 0.0055 | 0.37 | 0.37 | 0.26 |
| As-Dissolved | mg/L | 0.015 | 0.00044 | 0.0026 | 0.0026 | 0.0021 |
| Cd-Dissolved | mg/L | 0.0014a | 0.00016 | 0.000084 | 0.000087 | 0.00006 |
| Cr-Dissolved | mg/L | 0.003 | 0.0002 | 0.0021 | 0.0022 | 0.0023 |
| Cu-Dissolved | mg/L | 0.06/0.039b | 0.039 | 0.032 | 0.037 | 0.035 |
| Fe-Dissolved | mg/L | 3.3 | 0.02 | 0.39 | 0.48 | 0.71 |
| Pb-Dissolved | mg/L | 0.012 | 0.0001 | 0.00052 | 0.00053 | 0.00051 |
| Mo-Dissolved | mg/L | 0.219 | 0.079 | 0.1 | 0.077 | 0.011 |
| Ni-Dissolved | mg/L | 0.33 | 0.0035 | 0.0035 | 0.0034 | 0.0028 |
| Se-Dissolved | mg/L | 0.006 | 0.013 | 0.019 | 0.016 | 0.0034 |
| Zn-Dissolved | mg/L | 0.09 | 0.0069 | 0.011 | 0.011 | 0.012 |

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\All_Model_Results_for_WQ_Model_Comparison_for_2015_An_Report_SRJ_Rev00.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

- a) at 50 mg/L hardness.
- b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 8: MPTMF Water Quality Model Predictions and Measured Concentrations in 2017, Reasonable Worst Case

| | | WUL Effluent Limits (QZ14-031) | MPTMF Measured Water Quality (Station W12) | | Modelling Predictions of Quality in MPTMF (Station W12) | | | | | |
|--------------|------|---|--|---------|--|---------|---------|---------|----------|---------|
| | | | | | 2017 | | 2017 | | 2018 | |
| Year | | | Median | Max | Median | Max | Median | Max | Median | Max |
| Ammonia | mg/L | 0.75 | 4 | 6.9 | 17 | 18 | 15 | 19 | 0.28 | 0.45 |
| N-NO2 | mg/L | 0.18 | 3.7 | 6.7 | 3.8 | 4.3 | 3.1 | 4 | 0.037 | 0.057 |
| N-NO3 | mg/L | 27.3 | 14 | 27 | 84 | 90 | 77 | 96 | 1.1 | 1.7 |
| Ag-Dissolved | Mg/L | 0.0003 | 0.00002 | 0.00005 | 0.00012 | 0.00013 | 0.00012 | 0.00013 | 0.000089 | 0.00012 |
| Al-Dissolved | mg/L | 0.3 | 0.0055 | 0.012 | 0.77 | 0.82 | 0.76 | 0.84 | 0.53 | 0.83 |
| As-Dissolved | mg/L | 0.015 | 0.00044 | 0.00054 | 0.0063 | 0.0066 | 0.0063 | 0.0066 | 0.0049 | 0.0063 |
| Cd-Dissolved | mg/L | 0.0014a | 0.00016 | 0.00021 | 0.00034 | 0.00035 | 0.00035 | 0.00036 | 0.00031 | 0.00037 |
| Cr-Dissolved | mg/L | 0.003 | 0.0002 | 0.0002 | 0.0049 | 0.0051 | 0.0049 | 0.0051 | 0.0038 | 0.0048 |
| Cu-Dissolved | mg/L | 0.06/0.039b | 0.039 | 0.074 | 0.081 | 0.083 | 0.09 | 0.093 | 0.077 | 0.098 |
| Fe-Dissolved | mg/L | 3.3 | 0.02 | 0.047 | 0.85 | 0.97 | 1.1 | 1.2 | 1.9 | 2.3 |
| Pb-Dissolved | mg/L | 0.012 | 0.0001 | 0.00021 | 0.0026 | 0.0027 | 0.0026 | 0.0028 | 0.0017 | 0.0025 |
| Mo-Dissolved | mg/L | 0.219 | 0.079 | 0.085 | 0.16 | 0.18 | 0.13 | 0.17 | 0.031 | 0.037 |
| Ni-Dissolved | mg/L | 0.33 | 0.0035 | 0.0046 | 0.0077 | 0.008 | 0.0077 | 0.008 | 0.0067 | 0.0074 |
| Se-Dissolved | mg/L | 0.006 | 0.013 | 0.015 | 0.028 | 0.031 | 0.025 | 0.031 | 0.008 | 0.01 |
| Zn-Dissolved | mg/L | 0.09 | 0.0069 | 0.009 | 0.033 | 0.034 | 0.033 | 0.035 | 0.03 | 0.036 |

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\All_Model_Results_for_WQ_Model_Comparison_for_2015_An_Report_SRJ_Rev00.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

- a) at 50 mg/L hardness.
- b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

4 Closing

The summary of the updated water balance and water quality model for the Minto Mine was prepared in support of annual reporting. SRK would be pleased to address any questions or comments.

Appendix E – 2017 Water Balance and Water Quality Model Summary for the Minto Mine

Memo

| | | | |
|-----------------|--|--------------------|-------------------------|
| To: | Deborah Flemming, Ryan Herbert | Client: | Minto Explorations Ltd. |
| From: | Soren Jensen, Kaitlyn Kooy | Project No: | 1CM002.024 |
| Cc: | Dylan MacGregor (SRK) | Date: | March 28, 2018 |
| Subject: | 2017 Water Balance and Water Quality Model Summary for the Minto Mine Site | | |

1 Introduction and Background

This memorandum provides a summary of the 2017 water balance and water quality model updates for the Minto Mine site. The update covers the period January 1, 2017 through December 31, 2017.

The water balance update includes a review and summary of precipitation, flow and water inventory data for the Mine site. The water quality update includes a comparison of water quality data collected in 2017 to water quality model predictions for Phase VII of the Mine development, which were recently updated as part of a revised Reclamation and Closure Plan. Water quality predictions for the Main Pit Tailings Management Facility (MPTMF) and the Water Storage Pond (WSP) are provided for 2017, 2018 and for the post-closure period when predicted concentrations are the same from year to year (steady state concentrations).

2 Water Balance Update

2.1 Precipitation

Table 1 shows a summary of monthly precipitation measured at the Mine site between October 2016 and December 2017 along with precipitation data from the regional station at Carmacks, YT (Climate ID: 2100301)¹, which is located 77 km Southwest of the Minto Mine. In the past, the meteorological station at Pelly Ranch (Climate ID 2100880)¹ located 25 km north of Minto was used as a regional reference station. However, the published data record from Pelly Ranch ends in March 2015 so the Carmacks Station was used instead.

Approximately 210 mm of precipitation was measured at the Mine site in the 2017 hydrological year, which was lower than total precipitation measured in 2015 (243 mm) and 2016 (242 mm). Total annual precipitation of 210 mm roughly corresponds to a 1 in 50 to a 1 in 100 dry year.

¹ Data obtained from Meteorological Service of Canada, Environment Canada.

Table 1: Precipitation Records for the Minto Mine Site and Carmacks

| | | Campbell Scientific Station (Minto Mine) | | |
|--|-------|--|--------------|---|
| Year | Month | Tipping Bucket Gauge | Geonor Gauge | Carmacks Ranch ^A (Climate ID 2100301) |
| | | mm/month | mm/month | mm/month |
| 2016 | Oct | 6.7 | 9.8 | 8.4 |
| 2016 | Nov | 24.2 | 13.6 | 14.4 |
| 2016 | Dec | 7.4 | 14.1 | 17.5 |
| 2017 | Jan | 1.3 | 8.0 | 13.9 |
| 2017 | Feb | 0.0 | 6.6 | 4.3 |
| 2017 | Mar | 3.8 | 7.5 | 13.1 |
| 2017 | Apr | 7.0 | 9.4 | 8.7 |
| 2017 | May | 22.0 | 17.5 | 13.1 |
| 2017 | Jun | 40.0 | 13.2 | 76.6 |
| 2017 | Jul | 42.3 | 44.7 | 92.3 |
| 2017 | Aug | 20.4 | 20.9 | 24.4 |
| 2017 | Sept | 37.4 | 38.8 | 39.9 |
| 2017 | Oct | 4.7 | 17.9 | 27.3 |
| 2017 | Nov | 7.9 | 7.9 | 14.4 |
| 2017 | Dec | 4.7 | 4.7 | 6.1 |
| SUM Hydrological Year, Nov. 2016 to Oct. 2017 | | 210.5 | 212.2 | 345.5 |

Source: Minto Site Data: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\Minto Water Balance\2017 Met Station Data Summary.xlsx

Notes:

A: Data obtained from Meteorological Service of Canada, Environment Canada.

Minto's Campbell Scientific meteorological station measures total precipitation using a Geonor gauge and a tipping bucket rain gauge. From October through May, the tipping bucket is equipped with a snowfall conversion adaptor, which allows it to measure snowfall as snow water equivalent. The Geonor precipitation gauge collects precipitation in a bucket and records precipitation by measuring the weight of the bucket. In the winter months, the bucket is partially filled with an antifreeze solution that melts any snow collected. Figure 1 shows monthly precipitation recorded by the two gauges as well as total precipitation recorded at Carmacks.

Precipitation measured by the tipping bucket gauge and Geonor gauge were in good agreement on the total annual precipitation measurements (see Table 1) so the measured annual precipitation was assumed to be reliable for use in the annual summary. However, considerable discrepancy was noted in monthly precipitation measurements between January and June (Figure 1). Agreement is better in the second half of the year. Precipitation measured at Carmacks was much higher in June and July than at the Minto Mine.

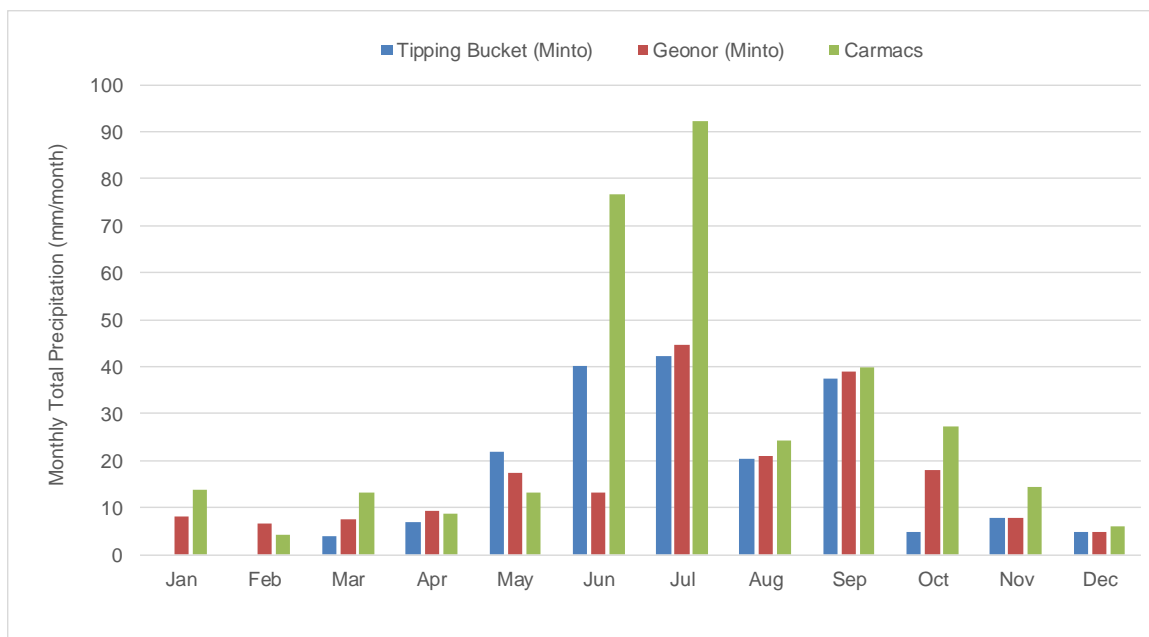


Figure 1: 2017 Monthly Total Precipitation Measurements at Minto and at Carmacks

2.2 Snow Course Data

Snow course surveys were completed at the three established snow survey stations at the Mine site in 2017. Table 2 shows a summary of the snow survey data (i.e. an average of the results from the three stations) from 2009 to 2017. The depth and water equivalent of the snow pack provides an indication of the volume of surface runoff that must be managed the following freshet. In March, April and May 2017, approximately 210,000 m³ of surface runoff was collected from catchments at the Mine site upstream of the Water Storage Dam. This volume corresponds to roughly 20 mm of runoff, which was slightly less than the estimated 25 mm of runoff observed in 2016.

Table 2: Summary of Snow Survey Data for the Minto Mine Site

| Year | February | March | April |
|------|-----------------------|-----------------------|-----------------------|
| | Water Equivalent (mm) | Water Equivalent (mm) | Water Equivalent (mm) |
| 2009 | 92.7 | 110.0 | 150.7 |
| 2010 | 107.7 | 120.7 | 56.0 |
| 2011 | 106.0 | 141.7 | 111.7 |
| 2012 | 111.0 | 127.0 | 132.7 |
| 2013 | 91.3 | 106.0 | 62.7 |
| 2014 | 84.3 | 99.7 | 67.3 |
| 2015 | 90.3 | 76.6 | 67.8 |
| 2016 | 80.3 | 80.7 | n/a |
| 2017 | 79.0 | 72.7 | 59.3 |

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2017_Water_Balance_Update\MintoSnowMaster_2017.xlsx

2.3 Water Management

Water that is suitable for release into Minto Creek is conveyed to the Water Storage Pond (WSP), while water collected from active mine areas is routed to the Main Pit Tailings Management Facility (MPTMF) or the Area 2 Pit Tailings Management Facility (A2PTMF). Since November 2012, the MPTMF has also been used for subaqueous deposition of tailings. Deposition of mine water and tailings (subaqueous) to the A2PTMF commenced in April 2015.

Other water management features on the Mine site include:

- W15 sump: collects surface runoff and seepage from:
 - The Southwest Waste Dump;
 - Part of the Main Waste Dump; and
 - Adjacent undisturbed catchments.

In 2017, water collected at W15 was routed to the Main Pit TMF from April until late May and when water quality met discharge criteria, W15 was re-routed to the WSP. Approximately 50% of the catchment that report to W15 is covered by waste rock.

- W35 sump: collects surface runoff from the minimally disturbed southern catchments. Water collected at W35 in 2017 was piped to the Main Pit TMF from April until early May, then to the WSP from May until July once water quality met release criteria. Water quality was closely monitored and W35 sump water was re-routed to the Main Pit periodically throughout the summer. Construction of the re-alignment of the South Diversion Ditch (SDD) in July necessitated the routing of W35 water to the Main Pit TMF for the rest of the year.
- W62 sump (formerly known as W36 or W37 sump): collects surface runoff and seepage from the mill valley, including contributions from the Dry Stack Tailings Storage Facility. Water collected at the W62 sump is pumped to the MPTMF.
- South Diversion Ditch: diverts water from (W35 Sump) minimally disturbed southern catchments to the WSP (can also be routed to the MPTMF).
- WSP: reservoir for water that meets discharge criteria and is destined for discharge to Minto Creek.

2.4 2017 Water Balance

Table 3 summarizes the monthly water and tailings inventory in Minto's MPTMF and A2PTMF as well as water inventory in the WSP. In 2017, the water inventory in the MPTMF was reduced by approximately 22,000 m³, while the water inventory in A2PTMF increased by roughly 501,000 m³. The increase in water inventory in the A2PTMF roughly corresponds to the volume of pore water in the sub-aqueously deposited tailings in 2017. Therefore, the free water volume in the pits should be unchanged from last year. The WSP water inventory increased by about 6,000 m³ between January 1 and December 31, 2017.

Table 4 shows a summary of the 2017 water balance for the Mine site. The total surface runoff collected on site was estimated to be 565,000 m³ based on the change in the water inventory and the known volume of water released to Minto Creek. Including an estimated inflow of 30,000 m³ of groundwater, the total site-wide yield was estimated at about 595,000 m³ for the year. The total catchment upstream of the Water Storage Dam measures approximately 1,040 ha. Therefore, 595,000 m³ of runoff from 1,040 ha gives a unit yield of approximately 57 mm/year.

The water and load balance model used for forecasting surface runoff volumes uses a site-wide annual average runoff coefficient, which has been derived based on previous years' water balance results. The runoff coefficient is estimated based on the total annual precipitation as follows:

- For dry years with less than 190 mm total precipitation: runoff coefficient = 0.15.
- For average to wet years with more than 309 mm total precipitation: runoff coefficient = 0.30.
- Runoff coefficients for years with total precipitation between 190 mm and 309 mm: interpolated values between 0.15 and 0.30.

In 2017 (hydraulic year) the estimated total precipitation was 210 mm (Table 1), which corresponds to a modelled runoff coefficient of 0.18. The site-wide runoff coefficient, based on the 2017 water balance (measured flows, water inventory and total precipitation), is:

$$\text{Annual Yield} / \text{Total Annual Precipitation} = \text{Runoff Coefficient} \rightarrow 57 \text{ mm} / 210 \text{ mm} = \mathbf{0.27}$$

The calculated value for the annual site-wide runoff coefficient is higher than the runoff coefficient estimated by the water balance model. However, the site-wide runoff coefficient is similar to the coefficient calculated in previous, slightly wetter years. Therefore, the method used by the water balance model to estimate runoff in dry years is likely too conservative (i.e. conservatively dry).

Table 3: 2017 Water Inventory and Release to Minto Creek

| Month/ Year | MPTMF Volume Occupied (Water + Tailings) ^A m ³ | Change in MPTMF Water Inventory m ³ /month | Tailings Solids Deposition in MPTMF BCM/month | A2PTMF Volume Occupied (Water + Tailings) ^A m ³ | Change in A2PTMF Water Inventory m ³ /month | Tailings Solids Deposition in A2PTMF BCM/month | WSP Volume ^A m ³ | Change in WSP Water Inventory m ³ /month |
|----------------|---|---|---|--|--|--|--|---|
| Jan-17 | 3,924,000 | 41,000 | 0 | 2,077,000 | -2,000 | 45,000 | 67,000 | -4,000 |
| Feb-17 | 3,965,000 | 48,000 | 0 | 2,120,000 | 5,000 | 40,000 | 63,000 | -5,000 |
| Mar-17 | 4,013,000 | 32,000 | 0 | 2,164,000 | 20,000 | 48,000 | 58,000 | -3,000 |
| Apr-17 | 4,046,000 | -140,000 | 0 | 2,231,000 | 147,000 | 43,000 | 55,000 | 18,000 |
| May-17 | 3,906,000 | 68,000 | 0 | 2,421,000 | 43,000 | 47,000 | 73,000 | 5,000 |
| Jun-17 | 3,974,000 | 71,000 | 0 | 2,511,000 | -29,000 | 47,000 | 78,000 | 6,000 |
| Jul-17 | 4,045,000 | 17,000 | 0 | 2,529,000 | 24,000 | 43,000 | 84,000 | -5,000 |
| Aug-17 | 4,061,000 | 63,000 | 0 | 2,596,000 | -17,000 | 40,000 | 79,000 | -7,000 |
| Sep-17 | 4,124,000 | -8,000 | 0 | 2,618,000 | 98,000 | 41,000 | 72,000 | 6,000 |
| Oct-17 | 4,116,000 | -162,000 | 0 | 2,757,000 | 162,000 | 45,000 | 77,000 | 0 |
| Nov-17 | 3,954,000 | -100,000 | 0 | 2,964,000 | 89,000 | 39,000 | 77,000 | -4,000 |
| Dec-17 | 3,854,000 | 49,000 | 0 | 3,092,000 | -37,000 | 42,000 | 74,000 | -2,000 |
| Jan-18 | 3,903,000 | | 0 | 3,098,000 | | | 72,000 | |
| SUM | | -22,000 | 0 | | 501,000 | 524,000 | | 6,000 |

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2017_Water_Balance_Update\2017 Water Balance Update REV00 KNK.xlsx

Notes:

A – on the first day of the month.

Table 4: Water Balance Summary of the Minto Mine Site, 2017 (Jan to Dec)

| | Units | Main Pit TMF | Area 2 Pit TMF | WSP |
|---|----------------------|-----------------|-------------------|-------|
| Volume Change 2017 (water + tailings) | m ³ | -22,000 | 1,021,000 | 6,000 |
| Tailings Deposited, total | BCM | - | 524,000 | - |
| Water Volume Change 2017 | m ³ | -22,000 | 501,000 | 6,000 |
| Estimated Groundwater Inflow | m ³ | - | 30,000 | - |
| Total Water Inventory Increase in 2017 | m³ | | 515,000 | |
| Total Water Discharged to Minto Creek | m ³ | | 80,000 | |
| Total Site-Wide Yield in 2017 | m³ | | 595,000 | |

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2017_Water_Balance_Update\2017 Water Balance Update REV00 KNK.xlsx

3 Water Quality Model Update

3.1 Solid Phase Geochemistry

The neutralization potential ratio (NPR) and copper content of waste rock and tailings were reviewed in order to identify any new trends in the solid phase geochemistry that may have developed since the last source term update. Significant changes in the solid phase geochemistry would indicate a need for further analysis of the waste rock and tailings to generate new source terms that reflect the observed changes in the geochemistry.

The NPR and copper content of waste rock and tailings are shown in Figure 2 to Figure 5. The NPR of tailings solids appear to show a decreasing trend in 2017 and copper concentrations an increasing trend. However, measured NPR was greater than 3 for all samples, which indicates that the tailings are not potentially acid generating and the lower NPRs are therefore not expected to affect source terms. Copper concentrations increased only to the levels measured in 2015. This range of copper concentrations has already been accounted for in the existing source terms. No significant changes in geochemistry were observed in the properties of the waste rock in 2017 compared to similar materials produced in prior years. Therefore, no further evaluation of 2017 solid phase geochemistry was warranted.

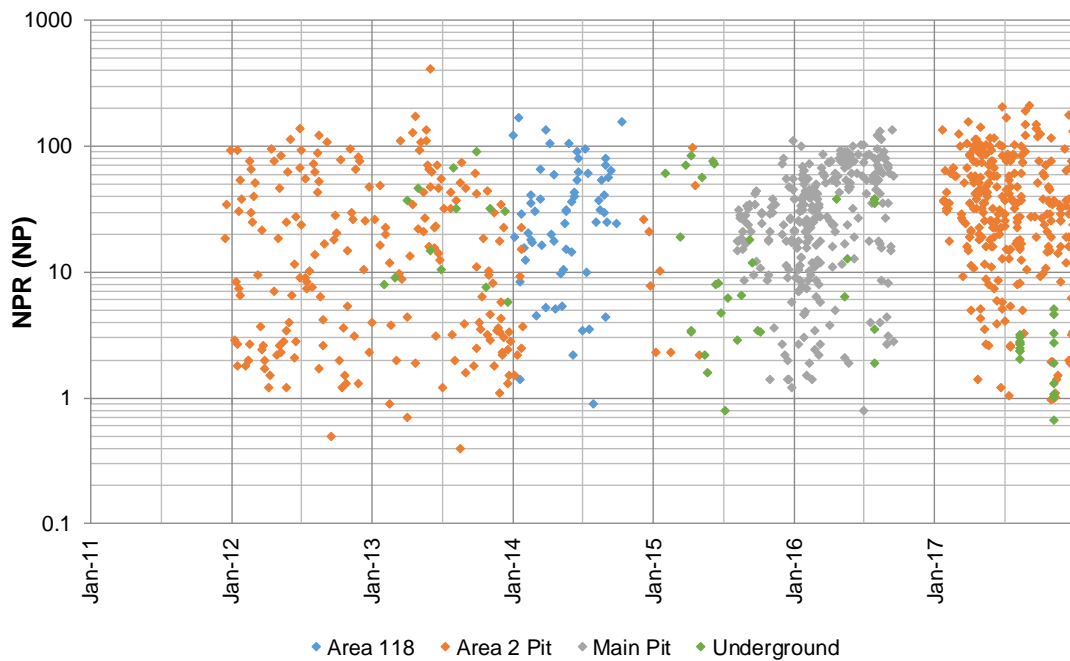


Figure 2: Waste Rock Neutralization Potential Ratio over Time

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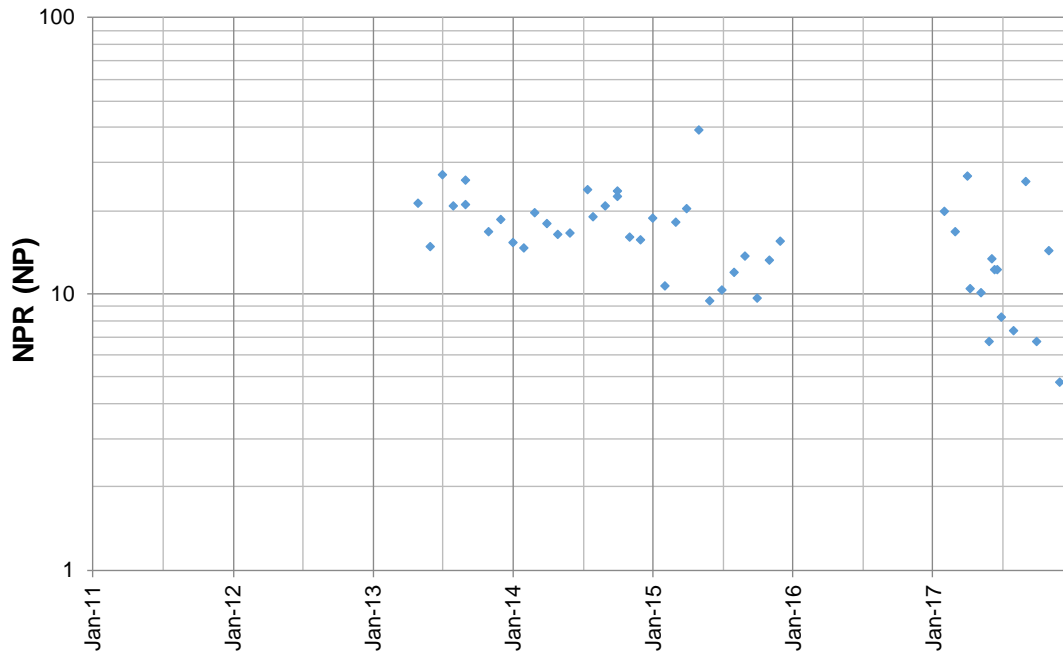


Figure 3: Tailings Neutralization Potential Ratio over Time

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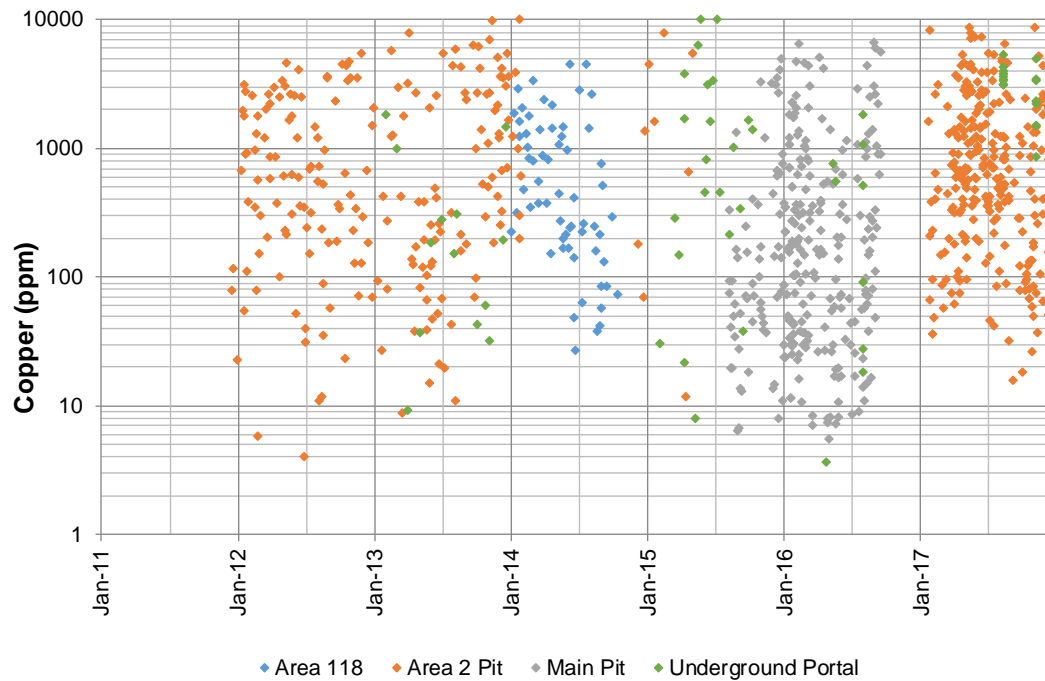


Figure 4: Waste Rock Copper Concentration over Time

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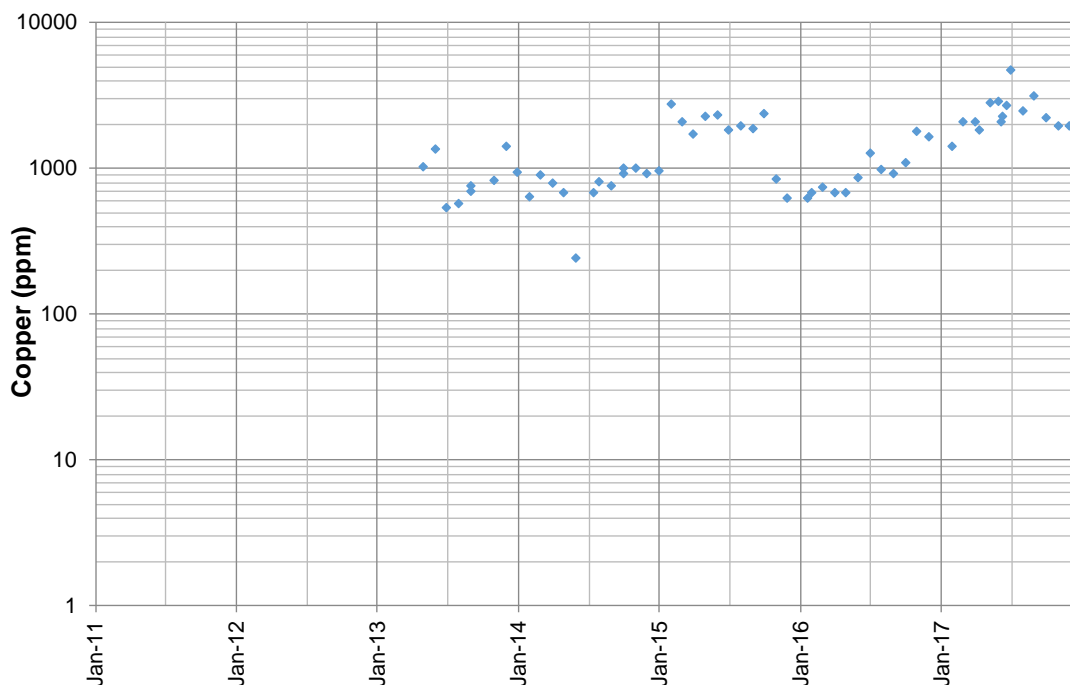


Figure 5: Tailings copper concentration over time

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ABACharts_Cu_NPR_2017_1CM002.024_REV00_KNK.xlsx

3.2 Comparison of Measured Water Quality Data to Source Terms

3.2.1 Source Terms – Dry Stack Tailings Storage Facility

The Dry Stack Tailings Storage Facility (DSTSF) source terms used in the water and load balance model for the Minto were developed based on the observed water chemistry of samples collected at station W8 and W8A. This station was chosen because it had the highest concentrations of copper, cadmium, selenium, and sulfate during the period of record. The following points describe the source terms:

- Best Estimate source term: 50th percentile dissolved concentrations from W8A;
- Reasonable Worst Case source term: 95th percentile dissolved concentrations from W8A.

The Best Estimate and Reasonable Worst Case source terms were updated to include data to 2017 for comparison to the existing source terms. It was found that the updated source terms did not differ from the source terms used in the latest model revision, which included data up to and including 2016. Therefore, for consistency the original DSTSF source terms was be used in this 2017 update of the water balance and water quality model.

3.2.2 Source Terms – Waste Rock

The Main Waste Dump and the Southwest Waste Dump source terms used in the water and load balance model were defined based on observed water chemistry at station W15, which collects runoff from the Southwest Waste Dump. The latest model revision assigned Best Estimate waste

rock source term as the 50th percentile dissolved concentrations at W15 until the end of 2016 and the Reasonable Worst Case waste rock source term was the 95th percentile dissolved concentrations. Water quality data collected at W15 in 2017 followed the same trends as the historical data. Therefore, the original source term was used for the updated predictions presented here.

3.2.3 Source Term – Tailings Slurry

In 2017, sulfate concentrations in the Area 2 and Main Pit water increased at a greater rate than in previous years. After investigating possible causes, it was concluded that variability in sulfate loadings from tailings slurry was the most likely cause of the concentration increases.

In order to properly represent the variability in the mill effluent water quality in the water and load balance model, the tailings slurry source term was divided into two parts: sulfide ore tailings source term and oxide ore (referred to as POX) tailings source term. Typically, just sulfide ore or a blend of sulfide ore and POX ore are processed in the mill. Elevated concentrations of sulfate in the mill effluent coincided with processing of POX. Accordingly, the tailings slurry source terms for sulfide ore and POX ore were developed based on measured sulfate concentrations in the tailings thickener when sulfide ore and POX ore were milled.

The loading rates associated with POX processing are highly variable. To maintain conservatism in the model predictions, the Expected Case and Worst Case POX ore slurry source term that represents the highest sulfate loading rates was used for all model scenarios.

3.3 Water Quality Model Results

Table 5 and 6 show revised model outputs from the updated water and load balance model for water quality in the Water Storage Pond (WSP) for 2017, 2018, and post-closure (best estimate and worst case) along with concentrations measured in 2017. Table 7 and 8 show revised model predictions of water quality in the MPTMF for 2017, 2018 and post-closure. Predictions for 2018 and post-closure were selected to provide representative short-term and long-term indications of water quality trends. Predictions are for average precipitation conditions. The Water Use Licence (QZ14-031) effluent limits are also listed in the tables. Model runs started on 1 January 2016 and ended on 1 January 2045, at which point concentrations in the model roughly have reached steady state.

The MPTMF was historically the primary water reservoir on site. In the model, the free water in the MPTMF and A2PTMF are more or less considered to belong to the same reservoir due to the high rate of flow between the two reservoirs. Reclaim water is drawn from the MPTMF and excess free water in the A2PTMF is pumped back to the MPTMF.

Therefore, a comparison of measured MPTMF water quality with concentrations predicted for pit water for the Phase V/VI environmental assessment provides a good measure of actual vs. expected geochemical performance of the site. Water collected in the WSP includes clean (non-contact) runoff and effluent from Minto's water treatment plant.

Median measured concentrations in the WSP in 2017 were lower than or comparable to the revised model predictions using best estimate source terms (Table 5), except for dissolved

copper, for which the measured median concentration was 27 µg/L compared to expected median concentrations of approximately 18 µg/L. Dissolved copper concentrations in the WSP shows a decreasing trend between 2011 and 2015 followed by an increasing trend between 2015 and 2017 (Figure 6). The increase in copper concentrations in the WSP in 2017 was due to a reduction in the volume of treated MPTMF water that was pumped to the WSP. MPTMF water is treated using reverse osmosis, which removes nearly all dissolved copper.

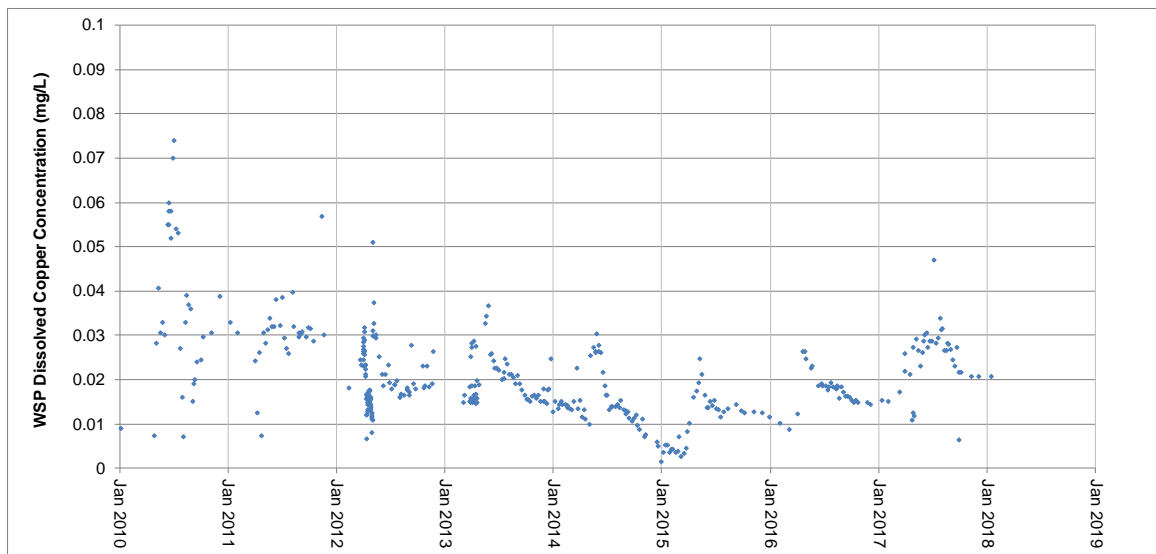


Figure 6 Dissolved Copper Concentrations in WSP (Station W16)

The overall favorable agreement in the results tables below indicates that the revised source terms are appropriate for describing the existing geochemical performance and the actual water management practices on site. Best estimate source terms are intended to provide an indication of the general trend in water quality parameter concentrations, but are not intended to capture maximum or outlier concentration values. Therefore, the median values of best estimate model predictions are compared to measured median values.

Revised model predictions using reasonable worst case source terms are generally higher than comparable median and maximum measured values for the WSP, except for copper (Table 6).

Revised model predictions for water quality in the MPTMF (and by extension the A2PTMF) using the best estimate source terms are in reasonable agreement with median measured concentrations in 2017 (Table 7) except for dissolved cadmium and nitrite. Median measured cadmium concentrations are approximately a factor of 2 greater than expected concentration but still well below the concentrations predicted based on reasonable worst case source terms (Table 8). Nitrite is relatively unstable and is produced and consumed by biological activity in the pit water. An investigation of the matter indicated that it may be the activity of heterotrophic microorganisms in the MPTMF water that is responsible for producing the elevated nitrite concentrations.

Water quality model predictions using reasonable worst-case source terms are higher than measured median and maximum concentrations, with the exception of nitrite (Table 8).

Table 5: WSP Water Quality Model Predictions and Measured Concentrations in 2017, Best Estimate

| | | WUL Effluent Limits (QZ14-031) | WSP Measured Water Quality (Station W16) | Modelling Predictions of Quality in WSP (Station W16) | | |
|-------------------|------|---------------------------------------|--|--|----------|--------------|
| Year | 2017 | | | 2017 | 2018 | Post-Closure |
| | | | Median | Median | Median | Median |
| Ammonia | mg/L | 0.75 | 0.055 | 0.095 | 0.09 | 0.23 |
| N-NO ₂ | mg/L | 0.18 | 0.029 | 0.066 | 0.057 | 0.059 |
| N-NO ₃ | mg/L | 27.3 | 2 | 4.5 | 4.8 | 1.2 |
| Ag-Dissolved | mg/L | 0.0003 | 0.00001 | 0.000023 | 0.000023 | 0.000049 |
| Al-Dissolved | mg/L | 0.3 | 0.0062 | 0.062 | 0.058 | 0.28 |
| As-Dissolved | mg/L | 0.015 | 0.00039 | 0.00078 | 0.00078 | 0.0021 |
| Cd-Dissolved | mg/L | 0.0014a | 0.0000099 | 0.000031 | 0.000029 | 0.000022 |
| Cr-Dissolved | mg/L | 0.003 | 0.00011 | 0.0012 | 0.0012 | 0.0019 |
| Cu-Dissolved | mg/L | 0.06/0.039b | 0.027 | 0.018 | 0.017 | 0.013 |
| Fe-Dissolved | mg/L | 3.3 | 0.069 | 0.54 | 0.55 | 0.59 |
| Pb-Dissolved | mg/L | 0.012 | 0.00005 | 0.00026 | 0.00026 | 0.00042 |
| Mo-Dissolved | mg/L | 0.219 | 0.0027 | 0.0026 | 0.0027 | 0.0097 |
| Ni-Dissolved | mg/L | 0.33 | 0.0008 | 0.0019 | 0.0018 | 0.0024 |
| Se-Dissolved | mg/L | 0.006 | 0.00073 | 0.0013 | 0.0014 | 0.002 |
| Zn-Dissolved | mg/L | 0.09 | 0.0011 | 0.007 | 0.0068 | 0.0035 |

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\All_Model_Results_for_WQ_Model_Comparison_for_2015_An_Report_SRJ_Rev00.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

- a) at 50 mg/L hardness.
- b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 6: WSP Water Quality Model Predictions and Measured Concentrations in 2017, Reasonable Worst Case

| | | WUL Effluent Limits (QZ14-031) | WSP Measured Water Quality (Station W16) | | Modelling Predictions of Quality in WSP (Station W16) | | | | | |
|--------------|------|---|---|----------|--|----------|----------|----------|----------|---------|
| | | | | | 2017 | | 2017 | | 2018 | |
| Year | | | Median | Max | Median | Max | Median | Max | Median | Max |
| Ammonia | mg/L | 0.75 | 0.055 | 0.16 | 0.26 | 0.32 | 0.25 | 0.29 | 0.83 | 1.6 |
| N-NO2 | mg/L | 0.18 | 0.029 | 0.12 | 0.2 | 0.22 | 0.18 | 0.22 | 0.12 | 0.23 |
| N-NO3 | mg/L | 27.3 | 2 | 4.9 | 12 | 19 | 13 | 16 | 3.3 | 6.4 |
| Ag-Dissolved | mg/L | 0.0003 | 0.00001 | 0.00001 | 0.000023 | 0.000027 | 0.000023 | 0.000025 | 0.000088 | 0.00021 |
| Al-Dissolved | mg/L | 0.3 | 0.0062 | 0.034 | 0.12 | 0.15 | 0.11 | 0.14 | 0.55 | 1.2 |
| As-Dissolved | mg/L | 0.015 | 0.00039 | 0.00048 | 0.0011 | 0.0013 | 0.0011 | 0.0012 | 0.0047 | 0.011 |
| Cd-Dissolved | mg/L | 0.0014a | 9.9E-06 | 0.000049 | 0.000091 | 0.00011 | 0.000088 | 0.0001 | 0.000096 | 0.00024 |
| Cr-Dissolved | mg/L | 0.003 | 0.00011 | 0.00022 | 0.0013 | 0.0015 | 0.0013 | 0.0014 | 0.0036 | 0.0086 |
| Cu-Dissolved | mg/L | 0.06/0.039b | 0.027 | 0.047 | 0.031 | 0.038 | 0.03 | 0.035 | 0.02 | 0.057 |
| Fe-Dissolved | mg/L | 3.3 | 0.069 | 0.14 | 1.1 | 1.4 | 1.1 | 1.2 | 1.4 | 3.9 |
| Pb-Dissolved | mg/L | 0.012 | 0.00005 | 0.000096 | 0.00027 | 0.00031 | 0.00028 | 0.00029 | 0.0018 | 0.004 |
| Mo-Dissolved | mg/L | 0.219 | 0.0027 | 0.0048 | 0.0052 | 0.0069 | 0.0054 | 0.0061 | 0.03 | 0.071 |
| Ni-Dissolved | mg/L | 0.33 | 0.0008 | 0.0013 | 0.0029 | 0.0033 | 0.0029 | 0.0031 | 0.0054 | 0.015 |
| Se-Dissolved | mg/L | 0.006 | 0.00073 | 0.0015 | 0.0029 | 0.0043 | 0.0031 | 0.0038 | 0.0044 | 0.0084 |
| Zn-Dissolved | mg/L | 0.09 | 0.0011 | 0.011 | 0.0098 | 0.01 | 0.0092 | 0.01 | 0.0083 | 0.023 |

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\All_Model_Results_for_WQ_Model_Comparison_for_2015_An_Report_SRJ_Rev00.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

- a) at 50 mg/L hardness.
- b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 7: MPTMF Water Quality Model Predictions and Measured Concentrations in 2017, Best Estimate

| | | WUL Effluent Limits (QZ14-031) | MPTMF Measured Water Quality (Station W12) | Modelling Predictions of Quality in MPTMF (Station W12) | | |
|--------------|------|---|---|--|----------|----------|
| Year | | | | 2017 | 2017 | 2018 |
| | | | Median | Median | Median | Median |
| Ammonia | mg/L | 0.75 | 4 | 5.2 | 4.4 | 0.079 |
| N-NO2 | mg/L | 0.18 | 3.7 | 2 | 1.5 | 0.017 |
| N-NO3 | mg/L | 27.3 | 14 | 38 | 33 | 0.38 |
| Ag-Dissolved | Mg/L | 0.0003 | 0.00002 | 0.000063 | 0.000063 | 0.000057 |
| Al-Dissolved | mg/L | 0.3 | 0.0055 | 0.37 | 0.37 | 0.26 |
| As-Dissolved | mg/L | 0.015 | 0.00044 | 0.0026 | 0.0026 | 0.0021 |
| Cd-Dissolved | mg/L | 0.0014a | 0.00016 | 0.000084 | 0.000087 | 0.00006 |
| Cr-Dissolved | mg/L | 0.003 | 0.0002 | 0.0021 | 0.0022 | 0.0023 |
| Cu-Dissolved | mg/L | 0.06/0.039b | 0.039 | 0.032 | 0.037 | 0.035 |
| Fe-Dissolved | mg/L | 3.3 | 0.02 | 0.39 | 0.48 | 0.71 |
| Pb-Dissolved | mg/L | 0.012 | 0.0001 | 0.00052 | 0.00053 | 0.00051 |
| Mo-Dissolved | mg/L | 0.219 | 0.079 | 0.1 | 0.077 | 0.011 |
| Ni-Dissolved | mg/L | 0.33 | 0.0035 | 0.0035 | 0.0034 | 0.0028 |
| Se-Dissolved | mg/L | 0.006 | 0.013 | 0.019 | 0.016 | 0.0034 |
| Zn-Dissolved | mg/L | 0.09 | 0.0069 | 0.011 | 0.011 | 0.012 |

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\All_Model_Results_for_WQ_Model_Comparison_for_2015_An_Report_SRJ_Rev00.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

- a) at 50 mg/L hardness.
- b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 8: MPTMF Water Quality Model Predictions and Measured Concentrations in 2017, Reasonable Worst Case

| | | WUL Effluent Limits (QZ14-031) | MPTMF Measured Water Quality (Station W12) | | Modelling Predictions of Quality in MPTMF (Station W12) | | | | | |
|--------------|------|---|--|---------|--|---------|---------|---------|----------|---------|
| | | | | | 2017 | | 2017 | | 2018 | |
| Year | | | Median | Max | Median | Max | Median | Max | Median | Max |
| Ammonia | mg/L | 0.75 | 4 | 6.9 | 17 | 18 | 15 | 19 | 0.28 | 0.45 |
| N-NO2 | mg/L | 0.18 | 3.7 | 6.7 | 3.8 | 4.3 | 3.1 | 4 | 0.037 | 0.057 |
| N-NO3 | mg/L | 27.3 | 14 | 27 | 84 | 90 | 77 | 96 | 1.1 | 1.7 |
| Ag-Dissolved | Mg/L | 0.0003 | 0.00002 | 0.00005 | 0.00012 | 0.00013 | 0.00012 | 0.00013 | 0.000089 | 0.00012 |
| Al-Dissolved | mg/L | 0.3 | 0.0055 | 0.012 | 0.77 | 0.82 | 0.76 | 0.84 | 0.53 | 0.83 |
| As-Dissolved | mg/L | 0.015 | 0.00044 | 0.00054 | 0.0063 | 0.0066 | 0.0063 | 0.0066 | 0.0049 | 0.0063 |
| Cd-Dissolved | mg/L | 0.0014a | 0.00016 | 0.00021 | 0.00034 | 0.00035 | 0.00035 | 0.00036 | 0.00031 | 0.00037 |
| Cr-Dissolved | mg/L | 0.003 | 0.0002 | 0.0002 | 0.0049 | 0.0051 | 0.0049 | 0.0051 | 0.0038 | 0.0048 |
| Cu-Dissolved | mg/L | 0.06/0.039b | 0.039 | 0.074 | 0.081 | 0.083 | 0.09 | 0.093 | 0.077 | 0.098 |
| Fe-Dissolved | mg/L | 3.3 | 0.02 | 0.047 | 0.85 | 0.97 | 1.1 | 1.2 | 1.9 | 2.3 |
| Pb-Dissolved | mg/L | 0.012 | 0.0001 | 0.00021 | 0.0026 | 0.0027 | 0.0026 | 0.0028 | 0.0017 | 0.0025 |
| Mo-Dissolved | mg/L | 0.219 | 0.079 | 0.085 | 0.16 | 0.18 | 0.13 | 0.17 | 0.031 | 0.037 |
| Ni-Dissolved | mg/L | 0.33 | 0.0035 | 0.0046 | 0.0077 | 0.008 | 0.0077 | 0.008 | 0.0067 | 0.0074 |
| Se-Dissolved | mg/L | 0.006 | 0.013 | 0.015 | 0.028 | 0.031 | 0.025 | 0.031 | 0.008 | 0.01 |
| Zn-Dissolved | mg/L | 0.09 | 0.0069 | 0.009 | 0.033 | 0.034 | 0.033 | 0.035 | 0.03 | 0.036 |

Source: SRK, X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\All_Model_Results_for_WQ_Model_Comparison_for_2015_An_Report_SRJ_Rev00.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

- a) at 50 mg/L hardness.
- b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

4 Closing

The summary of the updated water balance and water quality model for the Minto Mine was prepared in support of annual reporting. SRK would be pleased to address any questions or comments.

Appendix F – Minto and McGinty Creek 2017 Surface Hydrology Update

Hydrology

1. Introduction

In 2017, and as part of the EMSRP, Minto monitored hydrological conditions at water quality stations including the following: stations within the operational mine area; stations downstream from the mine operational area that are influenced by mine effluent discharge; and reference stations downstream from the mine operational area that are not exposed to effluent. Hydrological monitoring is performed using a variety of methods including: manual discrete discharge measurements with combinations of flow meters, continuous stage measurements through the deployment of Solinst Level Loggers and Barometric Loggers and monitoring of an engineered flume.

Minto maintained and monitored 7 hydrometric stations located on Minto Creek and McGinty Creek as listed below and shown in Figure 1.

- Minto Creek
 1. W3: Flume downstream of the Water Storage Pond (WSP);
 2. MC1: Located in Minto Canyon – mid-catchment;
 3. W1: Located approximately 1 km upstream of Yukon River – lower catchment; and
 4. W7: Tributary on the south side of Minto Creek.
- McGinty Creek
 5. MN-0.5: West Tributary of McGinty Creek
 6. MN-2.5: East Tributary of McGinty Creek
 7. MN-4.5: McGinty Creek near the Mouth

The following sections will present the methods used to measure flow at the hydrometric program, the summary of each station's hydrometric program and recommendations for future monitoring.

2. Methods

Minto personnel conduct regular discrete discharge measurements and maintenance at the stations listed below. Additionally, these stations are equipped with Solinst Level Logger and Barometric Logger for continuous measurements. Table 2-1 provides an overview of instrumentation available and discrete measurement frequency at these stations.

Table 2-1: Summary of Hydrometric Program

| Station | Watershed | Years Monitored | Frequency of Discrete Measurement | Instrumentation Available |
|---------|---------------|-----------------|-----------------------------------|---------------------------|
| W3 | Minto Creek | 2012-2017 | Weekly | Flume, Data Logger |
| MC1 | Minto Creek | 2012-2017 | Weekly | Staff Gauge, Data Logger |
| W1 | Minto Creek | 2012-2017 | Weekly | Staff Gauge, Data Logger |
| W7 | Minto Creek | 2013-2017 | Monthly | Staff Gauge, Data Logger |
| MN-0.5 | McGinty Creek | 2014-2017 | Monthly | Staff Gauge, Data Logger |
| MN-2.5 | McGinty Creek | 2014-2017 | Monthly | Staff Gauge, Data Logger |
| MN-4.5 | McGinty Creek | 2011-2017 | Monthly | Staff Gauge, Data Logger |

Stream-gauge data is collected and managed throughout the open water season by the Minto personnel. Velocities are measured using a Hach FH950 handheld electromagnetic flowmeter. Velocity and water depth measurements are converted to flows using the area-velocity relationship methods. All hydrometric data, calculated flows and the time-series of recorded water levels and temperature data from the loggers were processed by Minto personnel under SRK guidance.

Level logger data were compared to the staff gauge readings, logger records for water level may have shifted over the course of the season due to repositioning, and data were corrected to match staff gauge measurements.

Stage-discharge relationships (rating curves) were created with discrete flow measurements and staff gauge readings. For stations with level loggers, discharges were determined over the course of the 2017 hydrometric season to calculate mean monthly flows and total monthly runoff.

3. Minto Creek

3.1 Station W3 – Flume below the Water Storage Pond Dam

W3 is located about 500 meters downstream of the water storage pond dam and consist of a built flume. Solinst loggers record water levels and atmospheric pressure every 30 minutes, in addition water level at the flume are recorded daily for most of the year. In mid-November, the barologger’s battery ran out, by the time it was discovered 3 weeks of barometric pressure were lost. To compensate for this data, the barometric pressure at the Minto Weather Station were used, slightly skewing the results. A summary of the level and flow data recorded at W3 are presented in Figure 2 to 5. This data provided the necessary information to correct the recorded stage data and in turn generate a stage discharge relationship which is used to calculate the creek discharge, the stage-discharge relationship is presented in Figure 3.

Figure 2 presents the Solinst recorded water levels and water temperature for Minto Creek at W3 from January to December 2017.

W3 is directly influenced by discharge from the Water Storage Pond to Minto Creek. Figure 4 shows the 2017 hydrograph and discrete flow measurements conducted. A comparison of monthly flows at W3 and the discharge from the WSP is presented in Figure 5. As expected the flows recorded at W3 are slightly larger than the rate of discharge because of baseflow and runoff at W3. In mid-March, the station overflowed and froze, causing a lack of data for the following weeks leading into April. There is an incomplete dataset for records of flow at W3 from mid-March to the beginning of April. Overflow at the flume during the colder months, creates a pressure on the Levellogger that is not representative of the actual discharge occurring, months of November to March are difficult to obtain accurate water level readings.

Water was discharged from the WSP intermittently from April 30th to August 6th, 2017, the water level changed and flow fluctuations during the discharge period

Table 3-1 provides a summary of the average water temperature, flow and total flow volume in 2017. The higher temperatures recorded from November to March indicate the important influence of the heater at the flume on minimal flow or stagnant overflow discharge. Table 3-2 summarizes the historical mean monthly flows to previous years of the hydrometric program.

Table 3-1: W3 2017 Hydrometric Data and Temperature Summary

| Month | Period of Record (Day) | Mean Water Temperature (°C) | Mean Flow (m ³ /s) | Total Flow (m ³) |
|-------|------------------------|-----------------------------|-------------------------------|------------------------------|
| Jan | 31 | 3.68 | 0.0295 | 78810.5 |
| Feb | 28 | 3.25 | 0.0204 | 49470.7 |
| Mar | 31 | 3.86 | 0.0099 | 26557.6 |
| Apr | 30 | 2.12 | 0.0098 | 25514.7 |
| May | 31 | 2.44 | 0.0157 | 42273.6 |
| Jun | 30 | 7.57 | 0.0184 | 47711.3 |
| Jul | 31 | 7.70 | 0.0055 | 14633.8 |
| Aug | 31 | 7.05 | 0.0082 | 21871.8 |
| Sep | 30 | 3.48 | 0.0074 | 19241.1 |
| Oct | 31 | 1.12 | 0.0118 | 31711.7 |
| Nov | 30 | 3.11 | 0.0104 | 27061.8 |
| Dec | 31 | 4.51 | 0.0148 | 39510.0 |

Table 3-2: W3 Historical Mean Monthly Flow (m³/s)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------------------|-------|-------|-------|-------|-------|--------|--------|-------|-------|-------|-------|-------|
| 2012 ¹ | - | - | - | - | - | 0.005 | 0.005 | 0.006 | 0.005 | - | - | - |
| 2013 ¹ | - | - | - | - | - | 0.003 | 0.004 | 0.004 | 0.004 | - | - | - |
| 2014 ¹ | - | - | - | - | - | <0.001 | <0.001 | 0.002 | 0.003 | 0.003 | 0.006 | 0.004 |
| 2015 ¹ | 0.003 | 0.006 | 0.006 | 0.057 | 0.086 | 0.003 | 0.003 | 0.003 | 0.004 | 0.004 | 0.006 | 0.026 |
| 2016 ¹ | - | - | - | 0.022 | 0.052 | 0.003 | 0.003 | 0.004 | 0.004 | 0.004 | 0.003 | 0.004 |
| 2017 | 0.030 | 0.020 | 0.010 | 0.010 | 0.016 | 0.018 | 0.006 | 0.008 | 0.007 | 0.012 | 0.010 | 0.015 |

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

3.2 MC1 - Minto Creek Mid-Catchment

The hydrometric station MC1 on Minto Creek is located downstream of the W3 Flume and immediately upstream of the canyon along Minto Creek. The pressure transducer installed at this station recorded temperature and water levels at 15 minute intervals from May 2nd to October 19th (150 days). Figure 6 shows water level and temperature data for Minto Creek at MC1 from May 20th to October 16th, 2017. On May 19th, the level logger was discovered out of the water and replaced.

Over the course of the hydrometric program in 2017, numerous discrete discharge measurements were recorded in conjunction with water level readings recorded by both the pressure transducer and the staff gauge. This data provides the information necessary to generate a stage-discharge relationship which enables the computation of creek discharge for the recorded stage data. The stage-discharge relationship is presented in Figure 7.

The 2017 hydrograph and discrete measurements for MC1 are shown in Figure 8. In 2017, the maximum measured flow of 0.23 m³/s occurred on June 13th, 2017.

Table 3-3 provides a summary of the average water temperature, flow and total flow volume in 2017. The negative temperatures recorded in October indicate the start of the freeze-up period. Table 3-4 summarizes the historical mean monthly flows to previous years of the hydrometric program. During the August 11-14th period, the logger could have been partially out of the water as seen in negative pressure differences, hence the negative values recorded were purposefully removed for the data presentation in these tables.

Table 3-3: MC1 2017 Hydrometric Data and Temperature Summary

| Month | Period of Record (Day) | Mean Water Temperature (°C) | Mean Flow (m ³ /s) | Total Flow (m ³) |
|-------|------------------------|-----------------------------|-------------------------------|------------------------------|
| Jan | No Data | | | |
| Feb | No Data | | | |
| Mar | No Data | | | |
| Apr | No Data | | | |
| May | 12 | -1.146 | 0.102 | 106037 |
| Jun | 30 | 1.915 | 0.0743 | 192640 |
| Jul | 31 | 4.516 | 0.0176 | 47193 |
| Aug | 29 | 4.141 | 0.0103 | 25808 |
| Sep | 30 | 1.163 | 0.0283 | 73495 |
| Oct | 16 | -0.95 | 0.0293 | 39702 |
| Nov | No Data | | | |

Note: Shaded cells indicate incomplete months of data

Table 3-4: MC1 Historical Mean Monthly Flow (m³/s)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------------------|-----|-----|-----|-----|-------|-------|-------|-------|-------|-------|-----|-----|
| 2012 ¹ | - | - | - | - | 0.179 | 0.065 | 0.052 | 0.041 | 0.108 | - | - | - |
| 2013 ¹ | - | - | - | - | 0.358 | 0.085 | 0.103 | 0.44 | 0.089 | 0.064 | - | - |
| 2014 ¹ | - | - | - | - | 0.187 | 0.028 | 0.031 | 0.036 | 0.028 | 0.033 | - | - |
| 2015 ¹ | - | - | - | - | 0.862 | 0.014 | 0.028 | 0.042 | 0.035 | 0.031 | - | - |
| 2016 ¹ | - | - | - | - | - | 0.029 | 0.036 | 0.048 | 0.076 | - | - | - |
| 2017 | - | - | - | - | 0.102 | 0.074 | 0.018 | 0.010 | 0.028 | 0.029 | - | - |

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

3.3 W1 – Lower Minto Creek above Road Crossing

W1 station is located on the lower reach of Minto Creek before flowing into the Yukon River. In 2017, water level and temperature data were continuously measured and recorded every 15 minutes by the pressure transducer/data logger. Figure 9 shows Minto Creek at W1 water level and temperature data for the 167-day record from May 2 to October 16, 2017.

The stage-discharge relationship for W1 is presented in Figure 10. The 2017 hydrograph and discrete measurements for W1 are shown in Figure 11. In 2017, the maximum measured flow of 0.379 m³/s occurred on May 5th, 2017. Figure 12 shows W1 and MC1 flows. W1 is located downstream of MC1 and it is expected that flows would be larger because it has a much larger catchment area than MC1. W1 flows are lower than MC1 because it has been observed through the monitoring program that upstream of W1 is a losing reach. Water downstream of MC1 passes through a preferential pathway and by-passes W1.

Table 3-5 provides a summary of the average water temperature, flow and total flow volume in 2017. The negative temperatures recorded in October indicates the start of the freeze-up period. Table 3-6 summarizes the historical mean monthly flows to previous years of the hydrometric program. The history shows that freeze-up begins in October and that freshet typically occurs in April/May.

Table 3-5: W1 2017 Hydrometric Data and Temperature Summary

| Month | Period of Record (Day) | Mean Water Temperature (°C) | Mean Flow (m ³ /s) | Total Flow (m ³) |
|-------|------------------------|-----------------------------|-------------------------------|------------------------------|
| Jan | No Data | | | |
| Feb | No Data | | | |
| Mar | No Data | | | |
| Apr | No Data | | | |
| May | 29 | 0.152 | 0.085 | 217443 |
| Jun | 30 | 3.839 | 0.074 | 192228 |
| Jul | 31 | 7.128 | 0.014 | 35938 |
| Aug | 31 | 6.069 | 0.011 | 30709 |
| Sep | 30 | 3.092 | 0.017 | 43169 |
| Oct | 16 | -0.099 | 0.031 | 41302 |
| Nov | No Data | | | |
| Dec | No Data | | | |

Note: Shaded cells indicate incomplete months of data

Table 3-6: W1 Historical Mean Monthly Flow

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------------------|-----|-----|-----|-------|-------|-------|-------|-------|-------|-------|-----|-----|
| 2012 ¹ | - | - | - | - | 0.296 | 0.073 | 0.052 | 0.051 | 0.078 | 0.056 | - | - |
| 2013 ¹ | - | - | - | - | 0.485 | 0.064 | 0.065 | 0.044 | 0.85 | 0.059 | - | - |
| 2014 ¹ | - | - | - | - | 0.138 | 0.022 | 0.02 | 0.014 | 0.31 | 0.025 | - | - |
| 2015 ¹ | - | - | - | - | 0.117 | 0.01 | 0.01 | 0.03 | 0.24 | 0.02 | - | - |
| 2016 ¹ | - | - | - | 0.252 | 0.047 | 0.02 | 0.017 | 0.024 | 0.043 | 0.026 | - | - |
| 2017 | - | - | - | - | 0.085 | 0.074 | 0.014 | 0.011 | 0.017 | 0.031 | - | - |

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

In 2017, Minto personnel noticed the undercutts growing at the stream gauging transect, it is recommended to re-evaluate the location for discrete measurements in 2018.

3.4 W7 – Tributary of Minto Creek

A staff gauge was installed at this station in the summer of 2013. Before the installation of the staff gauge, this station was regularly monitored for surface water quality. The staff gauge was damaged during the winter 2014 and repaired for the hydrometric program running in 2015. In 2016, no stage measurements were continuously recorded but several discrete discharge measurements were conducted during the open water season. In early June 2017, a staff gauge and loggers were installed at this site, a continuous water level and temperature were recorded as presented in Figure 13. Table 3-7 provides a summary of the average water temperature, flow and total flow volume in 2017.

Table 3-8 presents the summary of historically measured flows at W7, based on discrete measurements. A rating curve was initiated in the 2017 hydrometric season, with limited data points the curve showed inconsistencies between discrete and pressure logger measurements, and was therefore not included in this year’s report; with more data being collected the curve will become more accurate over the years. The loggers were installed June 23rd and recorded water level and temperature every 30 minutes until October 3rd.

As this was a re-established station, it is recommended for 2018 to conduct stream gauging measurements more frequently to build a larger dataset and a more accurate rating curve.

Table 3-7: W7 2017 Hydrometric Data and Temperature Summary

| Month | Period of Record (Day) | Mean Water Temperature (°C) | Mean Flow (m ³ /s) | Total Flow (m ³) |
|-------|------------------------|-----------------------------|-------------------------------|------------------------------|
| Jan | No Data | | | |
| Feb | No Data | | | |
| Mar | No Data | | | |
| Apr | No Data | | | |
| May | No Data | | | |
| Jun | 7 | 4.07 | 0.002 | 1290 |
| Jul | 31 | 3.84 | 0.003 | 8625 |
| Aug | 31 | 3.55 | 0.002 | 6693 |
| Sep | 30 | 2.19 | 0.004 | 10648 |
| Oct | 3 | 0.017 | 0.004 | 953.9 |
| Nov | No Data | | | |
| Dec | No Data | | | |

Note: Shaded cells indicate incomplete months of data

Table 3-8: W7 Historical Mean Monthly Flow (m³/s)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------------------|-----|-----|-----|-----|-------|-------|-------|-------|-------|-------|-----|-----|
| 2013 ¹ | - | - | - | - | - | - | 0.013 | 0.031 | 0.019 | 0.006 | - | - |
| 2014 ¹ | - | - | - | - | 0.112 | - | - | - | - | - | - | - |
| 2015 ¹ | - | - | - | - | - | 0.006 | 0.004 | 0.011 | 0.011 | 0.029 | - | - |
| 2016 ¹ | - | - | - | - | - | 0.006 | 0.010 | 0.010 | 0.013 | 0.010 | - | - |
| 2017 | - | - | - | - | - | 0.002 | 0.003 | 0.003 | 0.004 | 0.004 | - | - |

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

4. McGinty Creek Hydrology

In 2017, hydrological monitoring on McGinty Creek was not conducted as per the schedule outlined in the EMSRP, it was noted late in the season that MN-1.5 was not monitored for continuous flow. Station MN-0.5 was monitored in place of MN-1.5 throughout the season. During the 2017 monitoring period, Minto Mine maintained and collected data from the following three hydrometric stations along McGinty Creek.

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

4.1 Station MN-0.5 – West Tributary of McGinty Creek

MN-0.5 station is located on the upper west stem of McGinty Creek. In 2017, water level and temperature data were continuously measured and recorded every 30 minutes by a pressure transducer/data logger. Figure 14 shows McGinty Creek at MN-0.5 water level and temperature data for the 117-day record from June 24 to October 21, 2016.

A stage-discharge relationship was established for MN-0.5 but it has limited flow data and corresponding staff gauge reading, hence it was not very accurate, the stage curve is presented in Figure 15. Additional flow measurements through the years will be required to establish a stage-discharge curve for the station with greater accuracy.

Table 4-1 provides a summary historical measured flows at MN-0.5. These flows are based on discrete measurements only.

Table 4-1: MN-0.5 Historical Mean Monthly Flow (m³/s)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------------------|-----|-----|-----|-----|-------|-------|-------|-------|-------|-------|-----|-----|
| 2014 ¹ | - | - | - | - | 0.045 | - | - | - | - | - | - | - |
| 2015 ¹ | - | - | - | - | 0.035 | 0.013 | 0.054 | 0.098 | 0.029 | 0.025 | - | - |
| 2016 ¹ | - | - | - | - | 0.28 | 0.016 | 0.01 | 0.016 | 0.035 | 0.018 | - | - |
| 2017 | - | - | - | - | - | 0.017 | 0.023 | 0.02 | 0.017 | 0.019 | - | - |

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

4.2 Station MN-1.5 – Upper East Tributary of McGinty Creek

As previously mentioned, MN-1.5 was not monitored continuously but Minto personnel conducted discrete flow measurement on a monthly frequency. Results are presented in Table 4-2; July measurement could not be conducted due to low flows. As required by the EMSRP, MN-1.5 will be monitored continuously for the 2018 hydrometric season.

Table 4-2: MN-1.5 2017 Recorded Discrete Flow Measurement (m³/s)

| | May | Jun | Jul | Aug | Sep |
|------|-------|-------|-----|--------|-------|
| Flow | 0.007 | 0.001 | - | 0.0004 | 0.001 |

4.2 Station MN-2.5 – East Tributary of McGinty Creek

MN-2.5 station is located on the lower stem of McGinty Creek. In 2017, water level and temperature data were continuously measured and recorded every 30 minutes by a pressure transducer/data logger. Figure 16 shows McGinty Creek at MN-2.5 water level and temperature data for the 149-day record from May 26 to October 21, 2017.

A stage-discharge relationship could not be established for MN-2.5 because of limited data flow and corresponding staff gauge reading.

Table 4-3 provides a summary of historical measured flows at MN-2.5. These flows are based on discrete measurements only.

Table 4-3: MN-2.5 Historical Mean Monthly Flow (m³/s)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------------------|-----|-----|-----|-------|-------|-------|-------|-------|-------|-------|-----|-----|
| 2014 ¹ | - | - | - | - | 0.032 | - | - | - | - | - | - | - |
| 2015 ¹ | - | - | - | - | 0.015 | 0.003 | 0.011 | 0.038 | 0.01 | 0.01 | - | - |
| 2016 ¹ | - | - | - | 0.034 | 0.008 | - | - | 0.009 | 0.014 | 0.003 | - | - |
| 2017 | - | - | - | - | - | 0.011 | 0.01 | 0.007 | 0.004 | 0.013 | - | - |

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

4.3 Station MN-4.5 - McGinty Creek near the Mouth

MN-4.5 station is located on the lower reach of McGinty Creek before flowing into the Yukon River. In 2017, water level and temperature data were continuously measured and recorded every 30 minutes by the pressure transducer/data logger. Figure 17 shows McGinty Creek at MN-4.5 water level and temperature data for the 140-day record from May 26 to October 12, 2017.

The stage-discharge relationship for MN-4.5 is presented in Figure 18. The 2017 hydrograph and discrete measurements for MN-4.5 are shown in Figure 19. In 2017, the maximum measured flow of 0.08 m³/s occurred on July 29, 2017.

Table 4-4 provides a summary of the average water temperature, flow and total flow volume in 2017. Table 4-5 summarizes the historical mean monthly flows to previous years of the hydrometric program.

Table 4-4: MN-4.5 2017 Hydrometric Data and Temperature Summary

| Month | Period of Record (Day) | Mean Water Temperature (°C) | Mean Flow (m ³ /s) | Total Flow (m ³) |
|-------|------------------------|-----------------------------|-------------------------------|------------------------------|
| Jan | No Data | | | |
| Feb | No Data | | | |
| Mar | No Data | | | |
| Apr | No Data | | | |
| May | 6 | 1.14 | 0.079 | 42847 |
| Jun | 30 | 2.81 | 0.12 | 310927 |
| Jul | 31 | 5.61 | 0.027 | 71968 |
| Aug | 31 | 5.75 | 0.003 | 10007 |
| Sep | 30 | 3.12 | 0.012 | 30138 |
| Oct | 12 | 0.31 | 0.079 | 114468 |
| Nov | No Data | | | |
| Dec | No Data | | | |

Note: Shaded cells indicate incomplete months of data

Table 4-5: MN-4.5 Historical Mean Monthly Flow (m³/s)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------------------|-----|-----|-----|-------|-------|-------|-------|-------|-------|-------|-----|-----|
| 2011 ¹ | - | - | - | - | 0.444 | 0.093 | 0.125 | 0.134 | 0.068 | 0.045 | - | - |
| 2012 ¹ | - | - | - | 0.212 | 0.023 | 0.18 | 0.082 | 0.053 | 0.109 | - | - | - |
| 2013 ¹ | - | - | - | - | - | 0.054 | 0.103 | 0.093 | 0.116 | - | - | - |
| 2014 ¹ | - | - | - | - | 0.23 | 0.041 | 0.037 | 0.026 | 0.046 | - | - | - |
| 2015 ¹ | - | - | - | - | - | 0.013 | 0.046 | 0.049 | 0.029 | 0.029 | - | - |
| 2016 ¹ | - | - | - | - | 0.017 | 0.015 | 0.026 | 0.028 | 0.028 | 0.01 | - | - |
| 2017 | - | - | - | - | 0.079 | 0.12 | 0.027 | 0.003 | 0.012 | 0.079 | - | - |

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

In 2017, Minto personnel noticed undercuts eroding on both sides on the stream gauging transect, it is recommended to re-evaluate the location of the transect for the 2018 hydrology season.

5. Hydrology QA/QC

Detailed procedures for hydrology monitoring at the Minto Mine are detailed in the *Minto Mine Surface Water Hydrology SOP*. In 2017, Minto implemented permanent discrete measurement locations at each station to ensure consistent results, on a few occasions due to changing stream bed conditions, locations were modified.

Figures

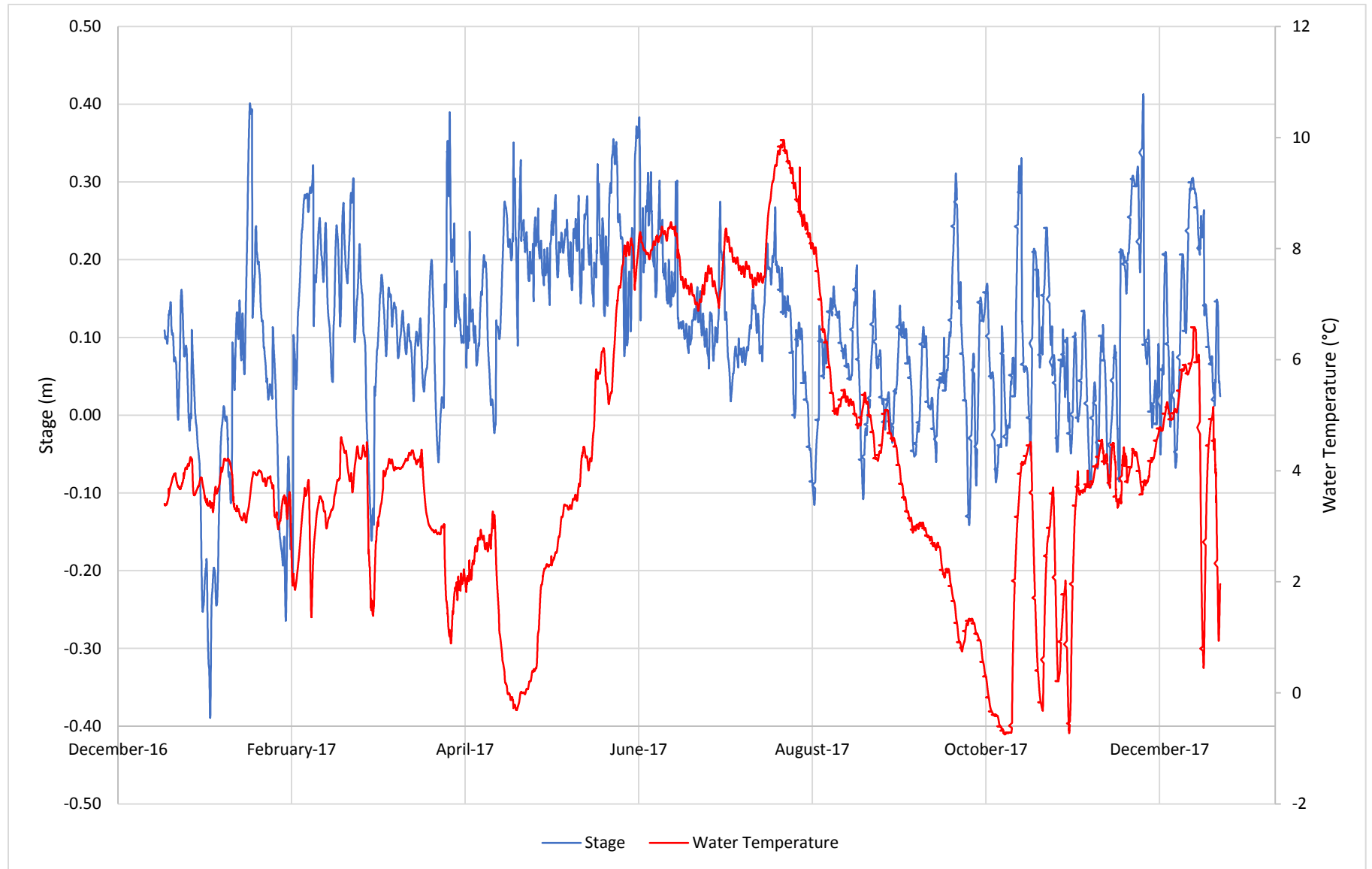


Figure 2. W3 Hydrograph Stage and Water Temperature

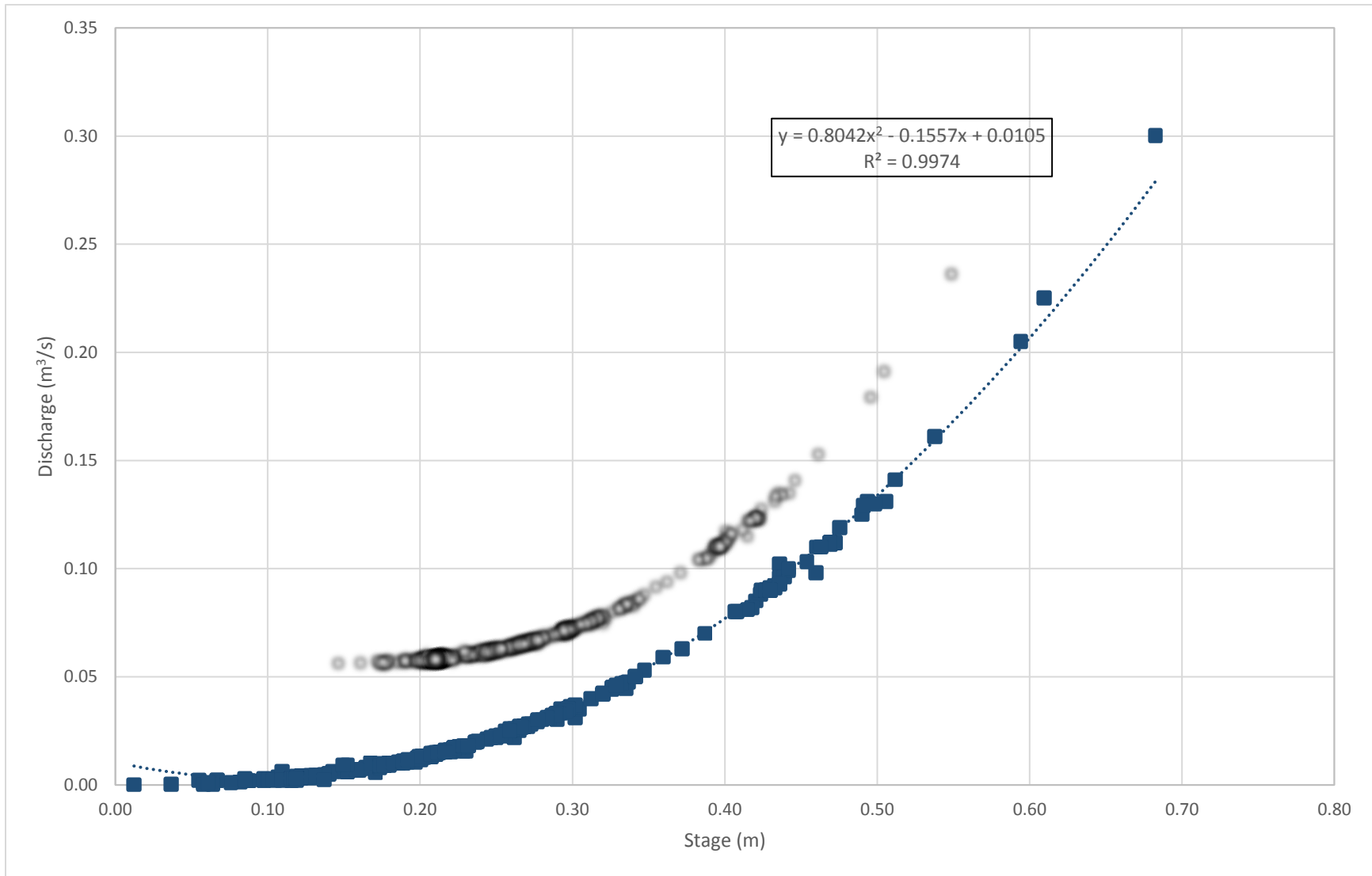


Figure 3: W3 Rating Curve

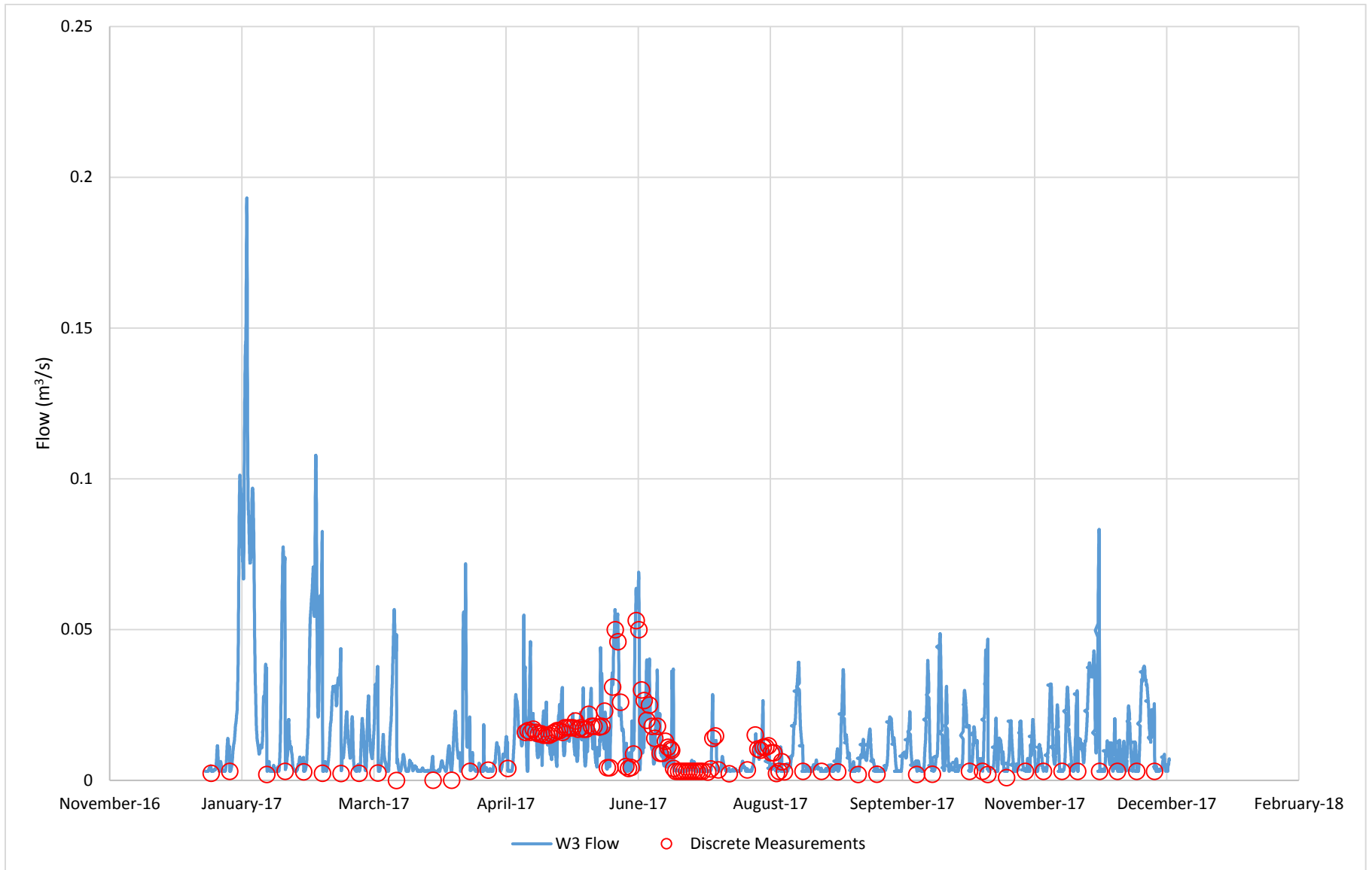


Figure 4. W3 Flow Hydrograph (with discrete measurements)

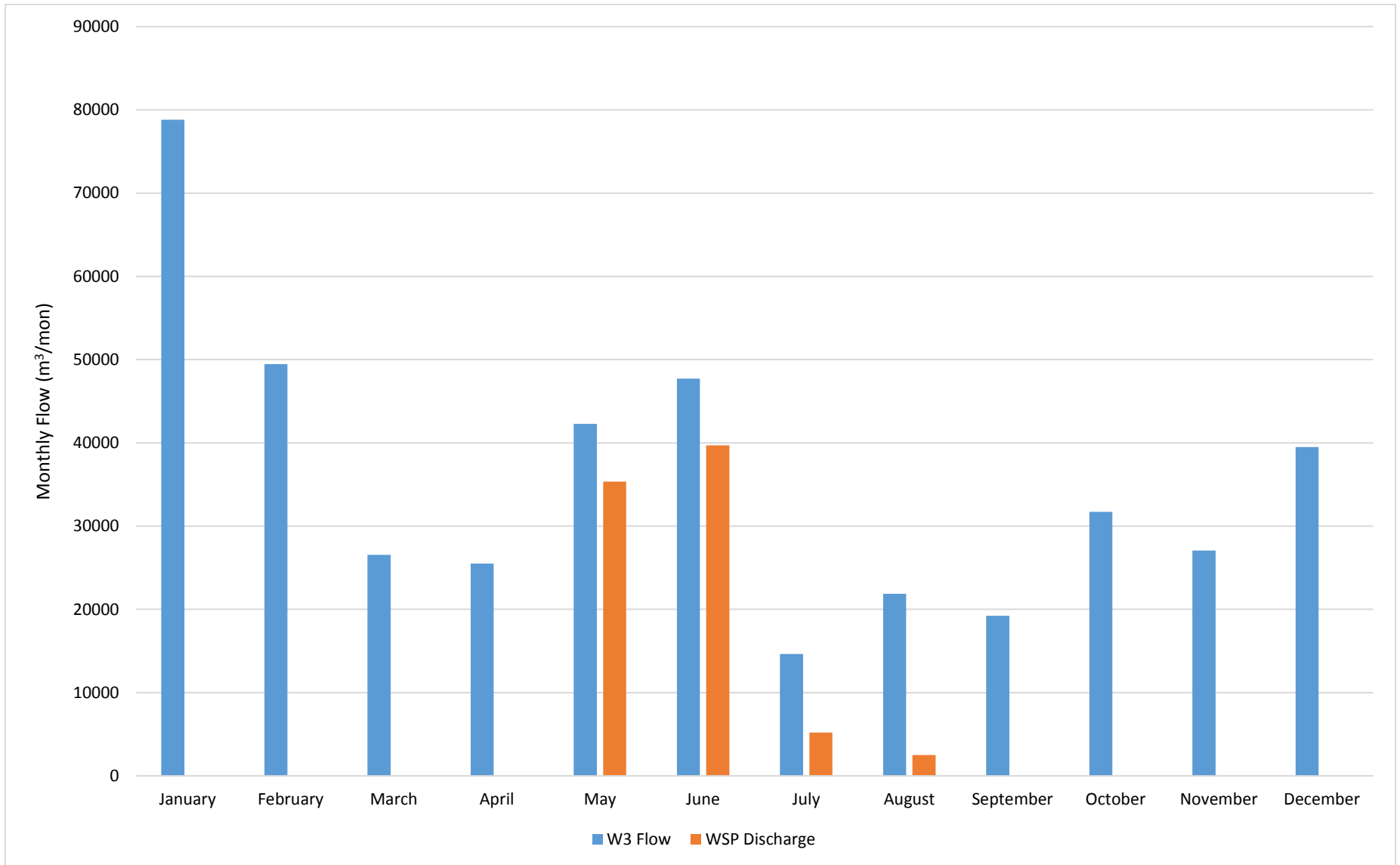


Figure 5. Monthly WSP Discharge and Flows at W3

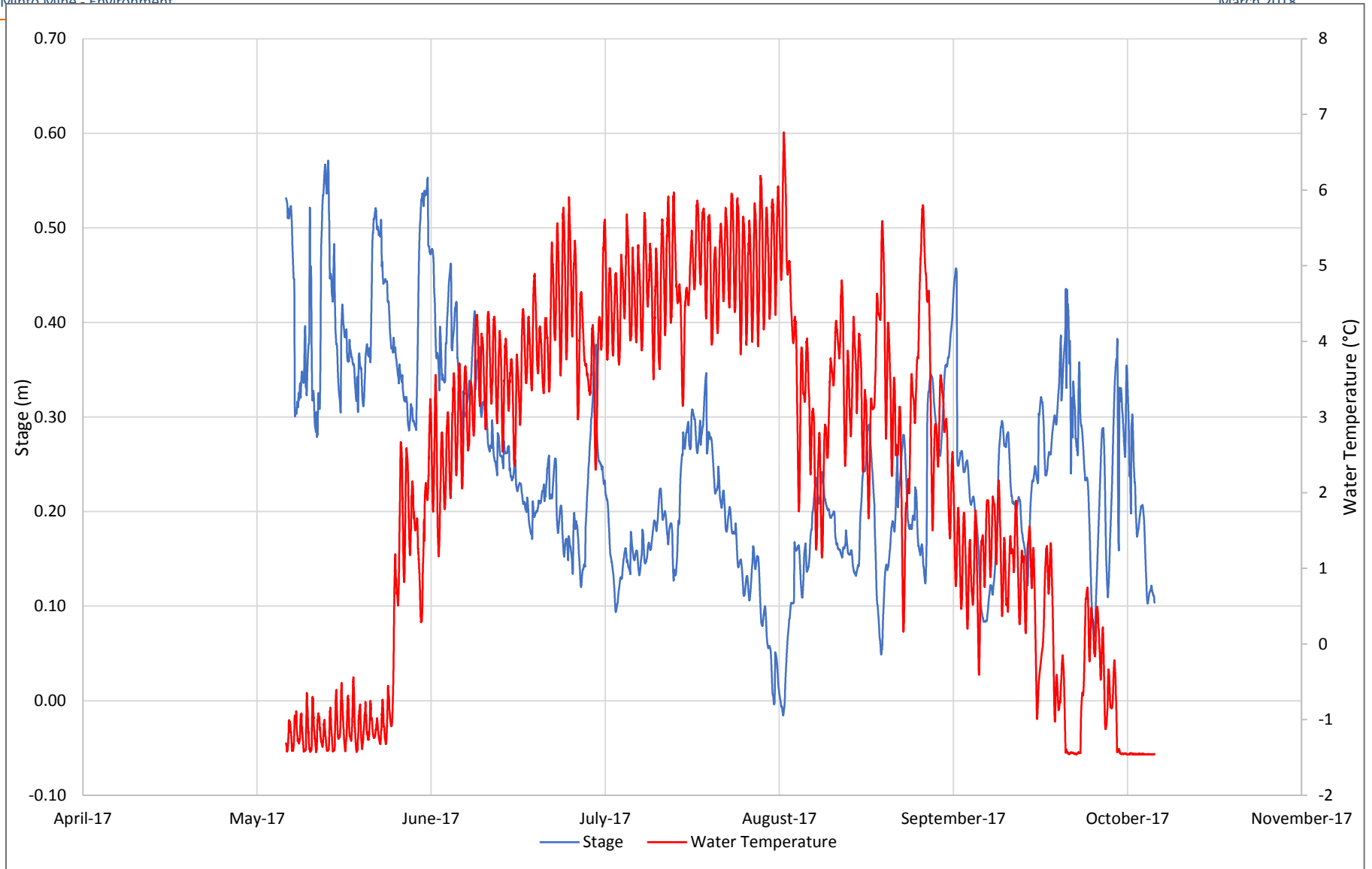


Figure 6: MC1 Stage and Temperature Hydrograph

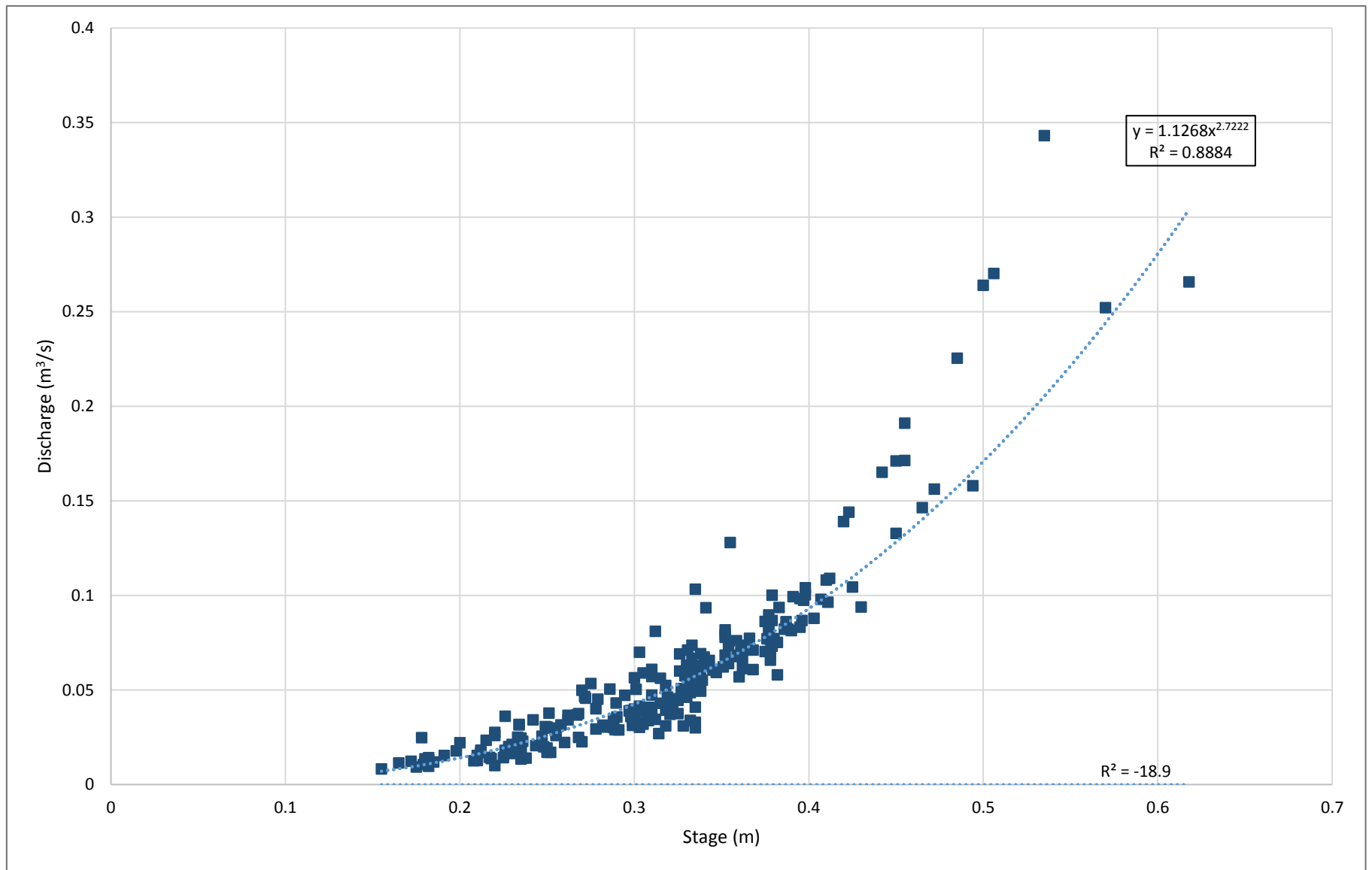


Figure 7: MC1 Rating Curve

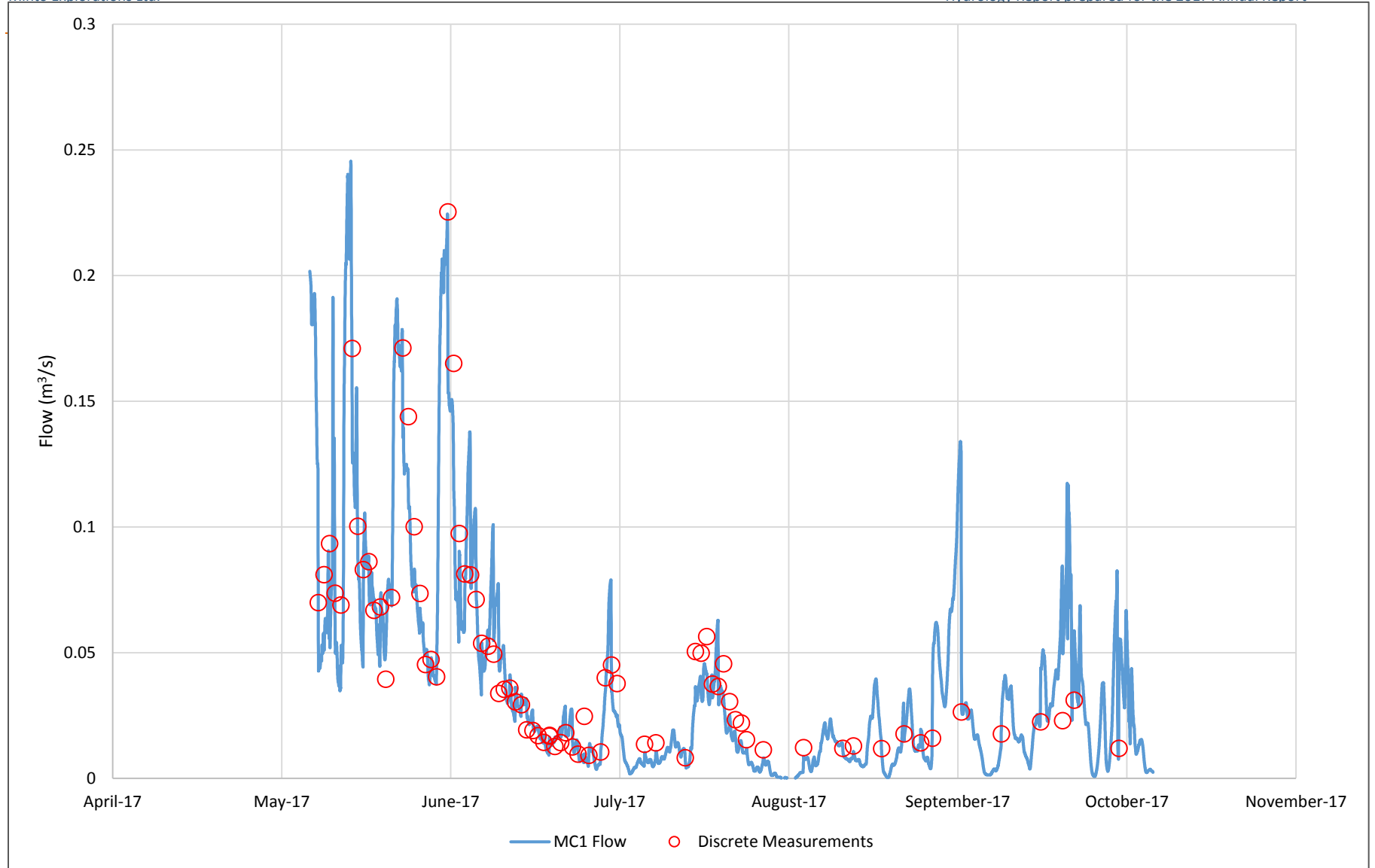


Figure 8: MC1 Flow Hydrograph

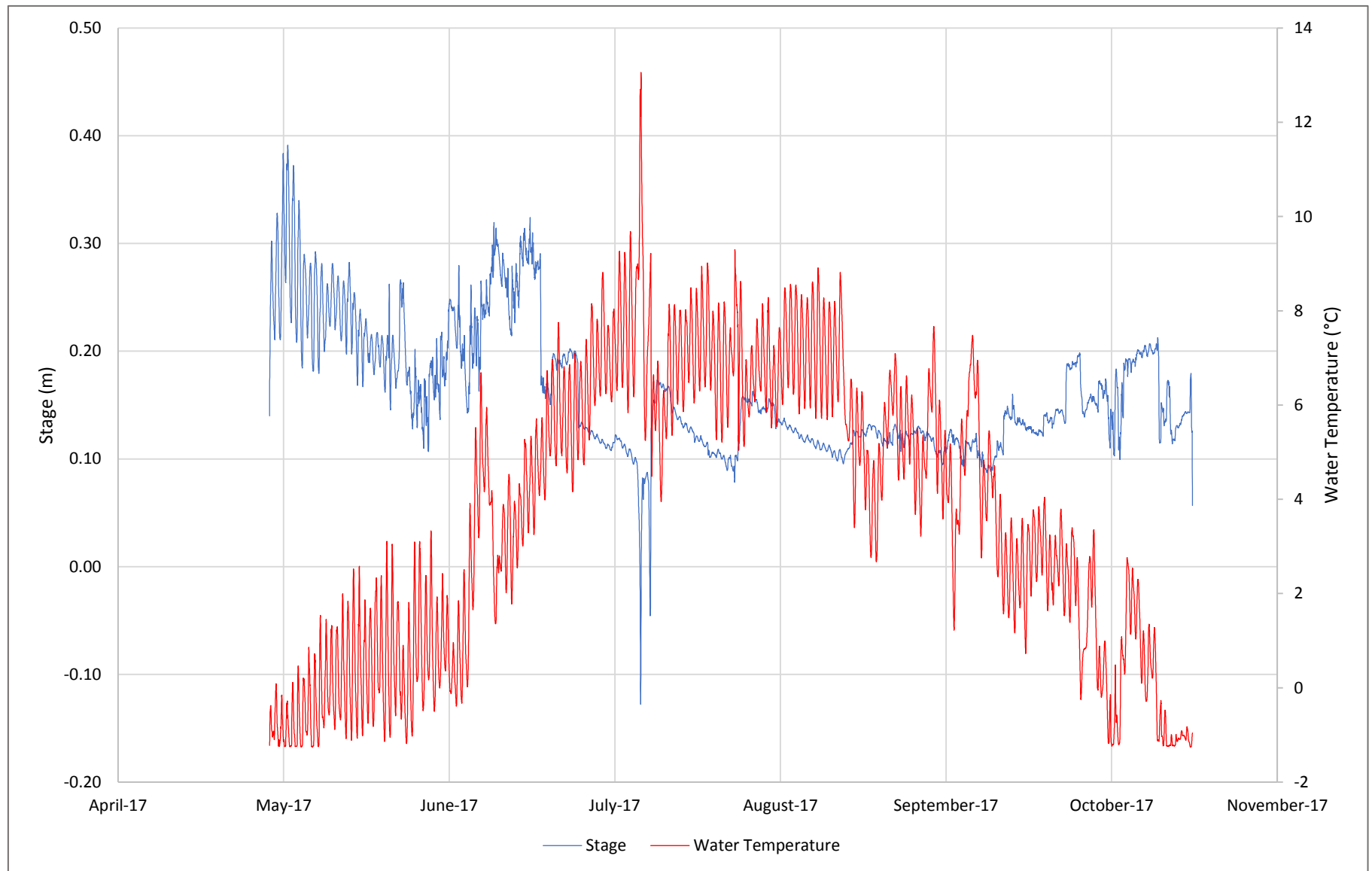


Figure 9: W1 Stage and Temperature Hydrograph

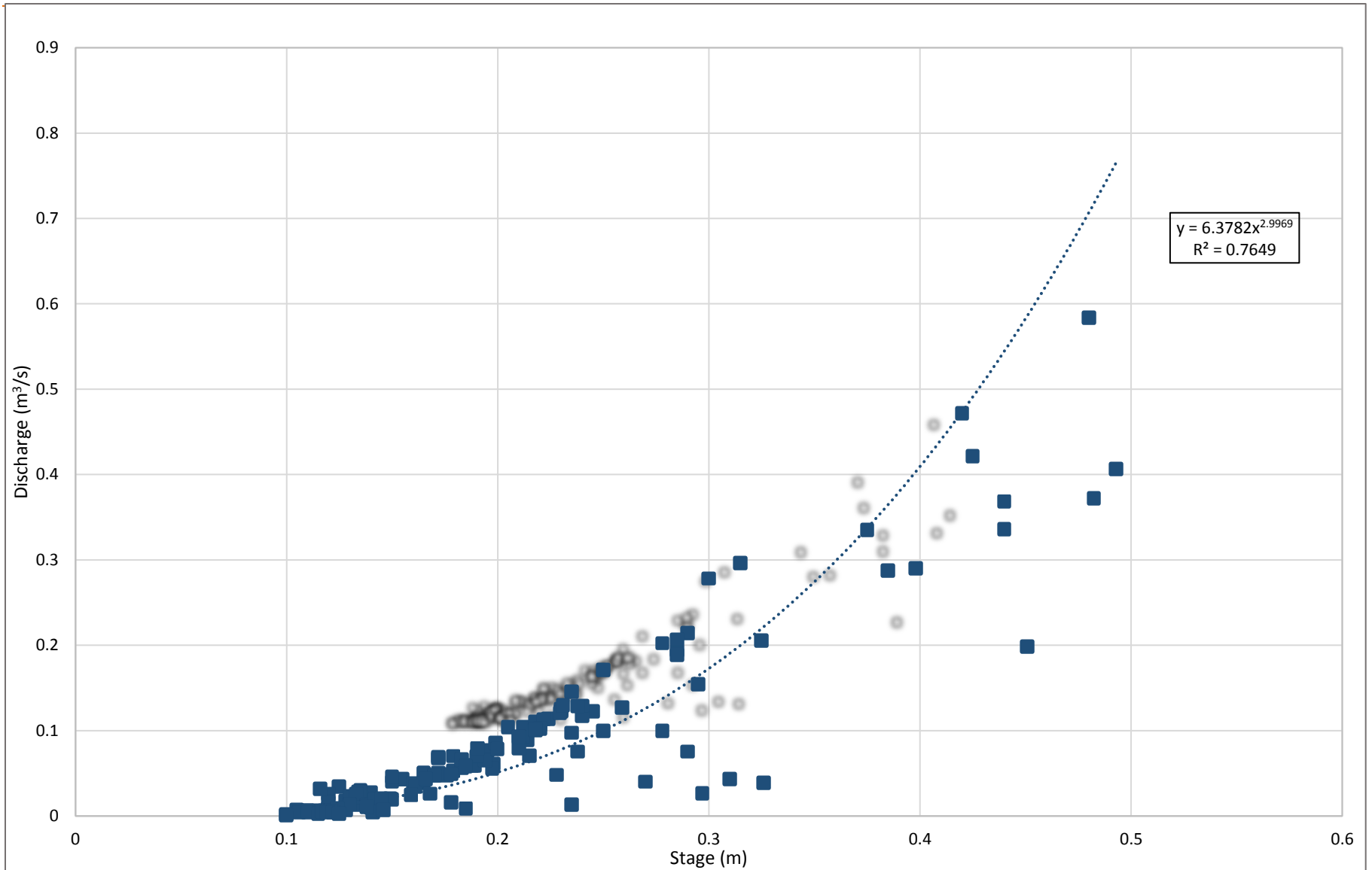


Figure 10: W1 Rating Curve

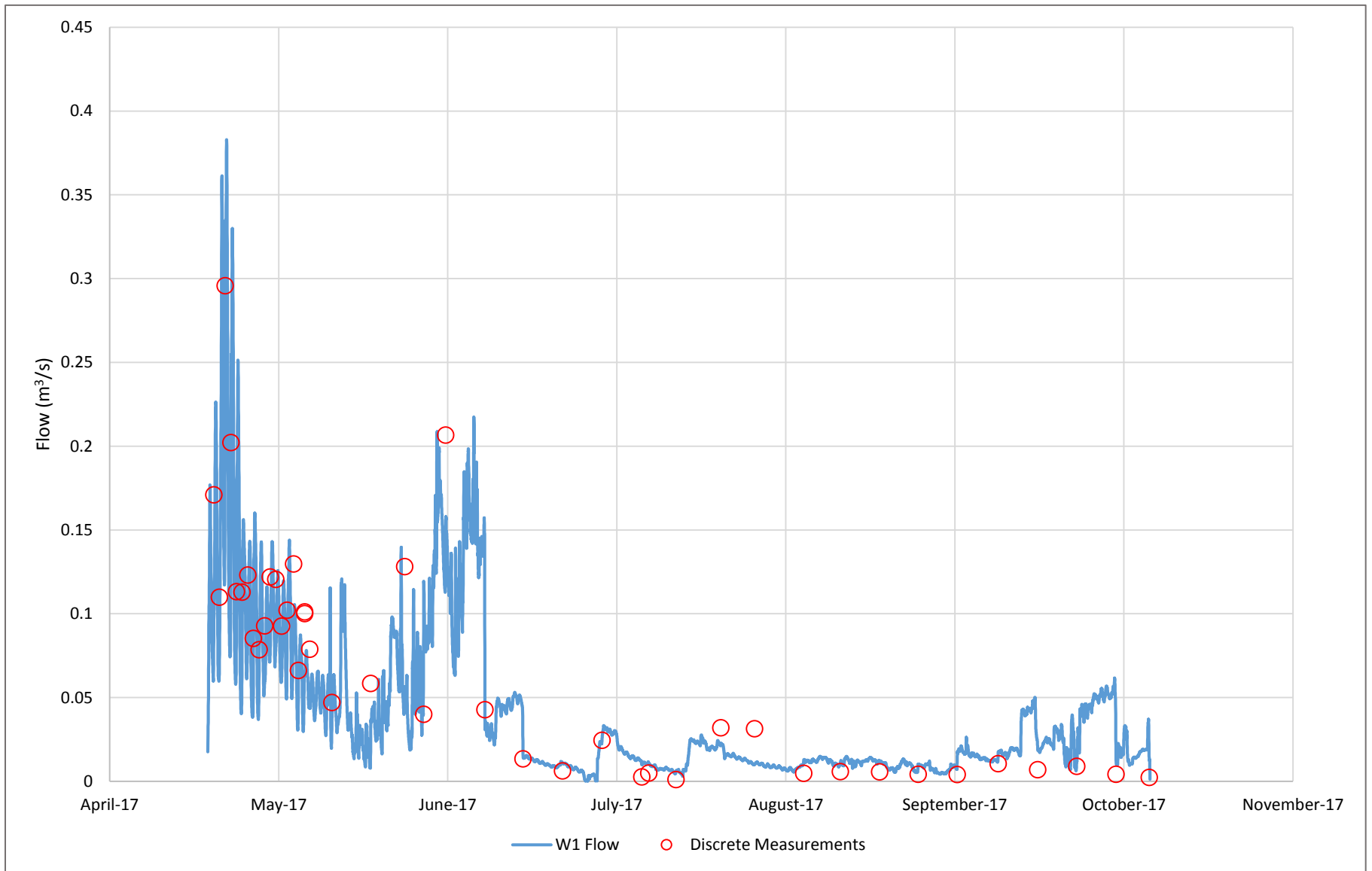


Figure 11: W1 Flow Hydrograph

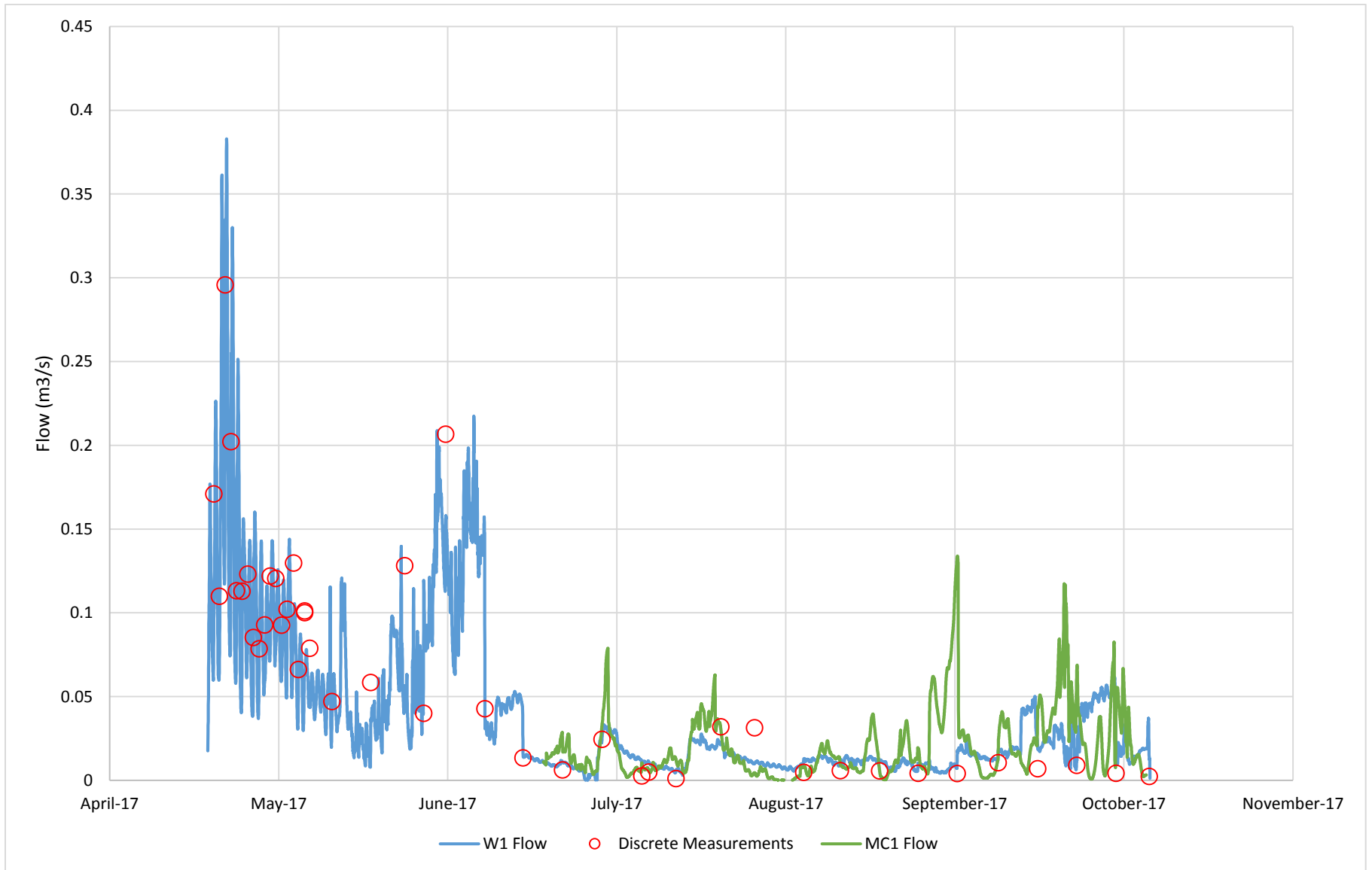


Figure 12: W1 Flow Hydrograph Comparison with MC1 Flow

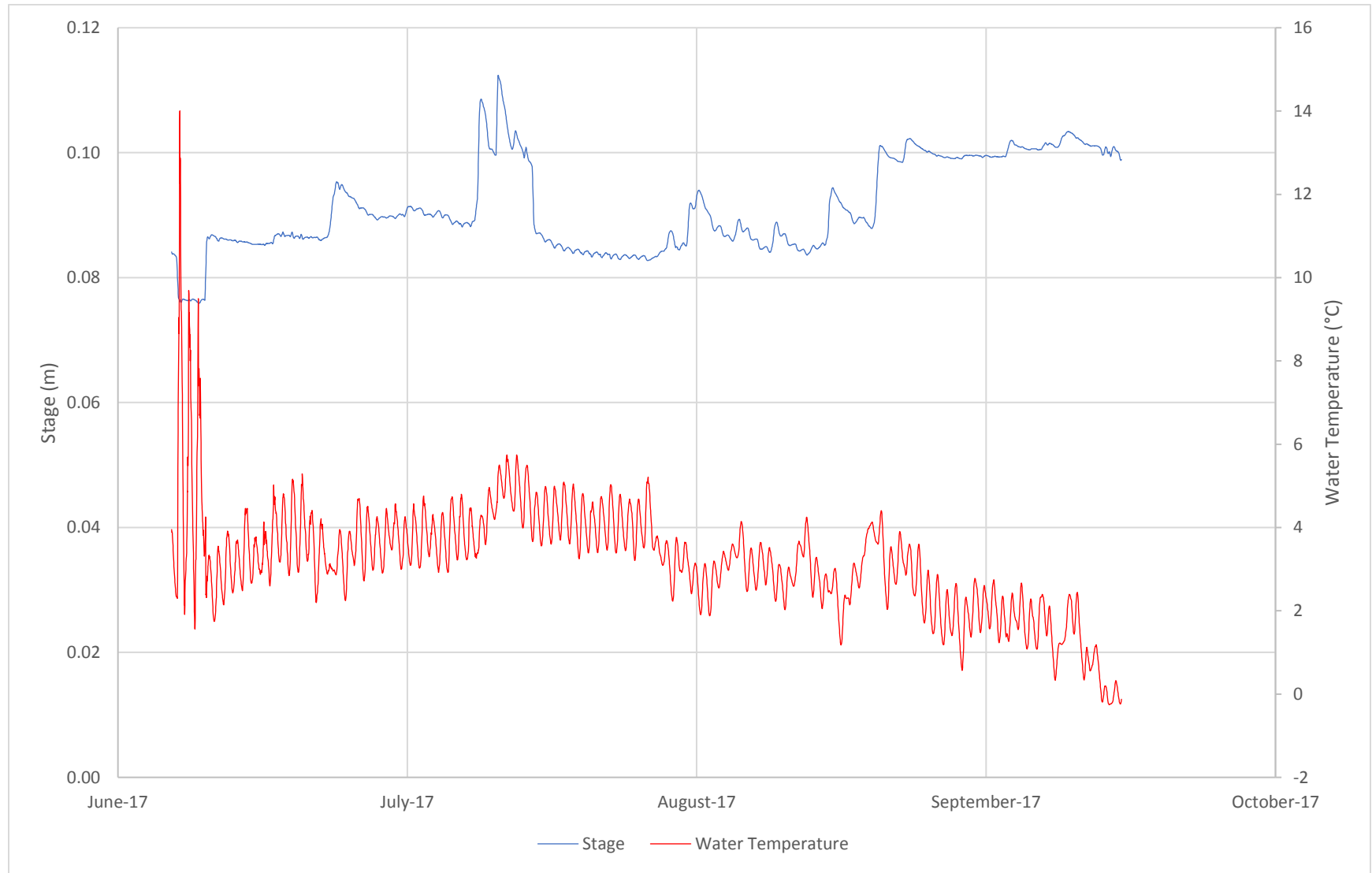


Figure 13: W7 Stage and Temperature Hydrograph

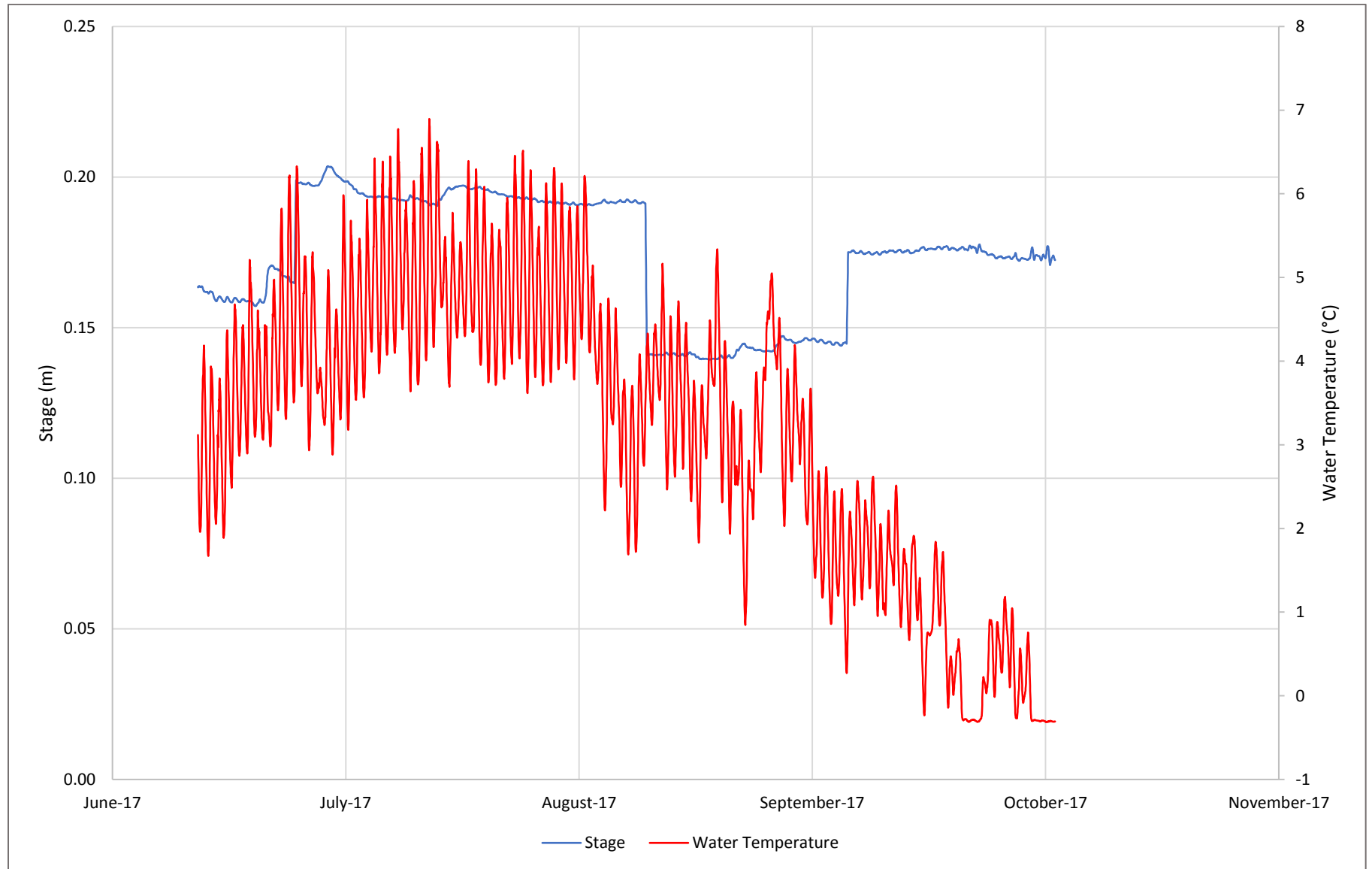


Figure 14: MN-0.5 Stage and Temperature Hydrograph

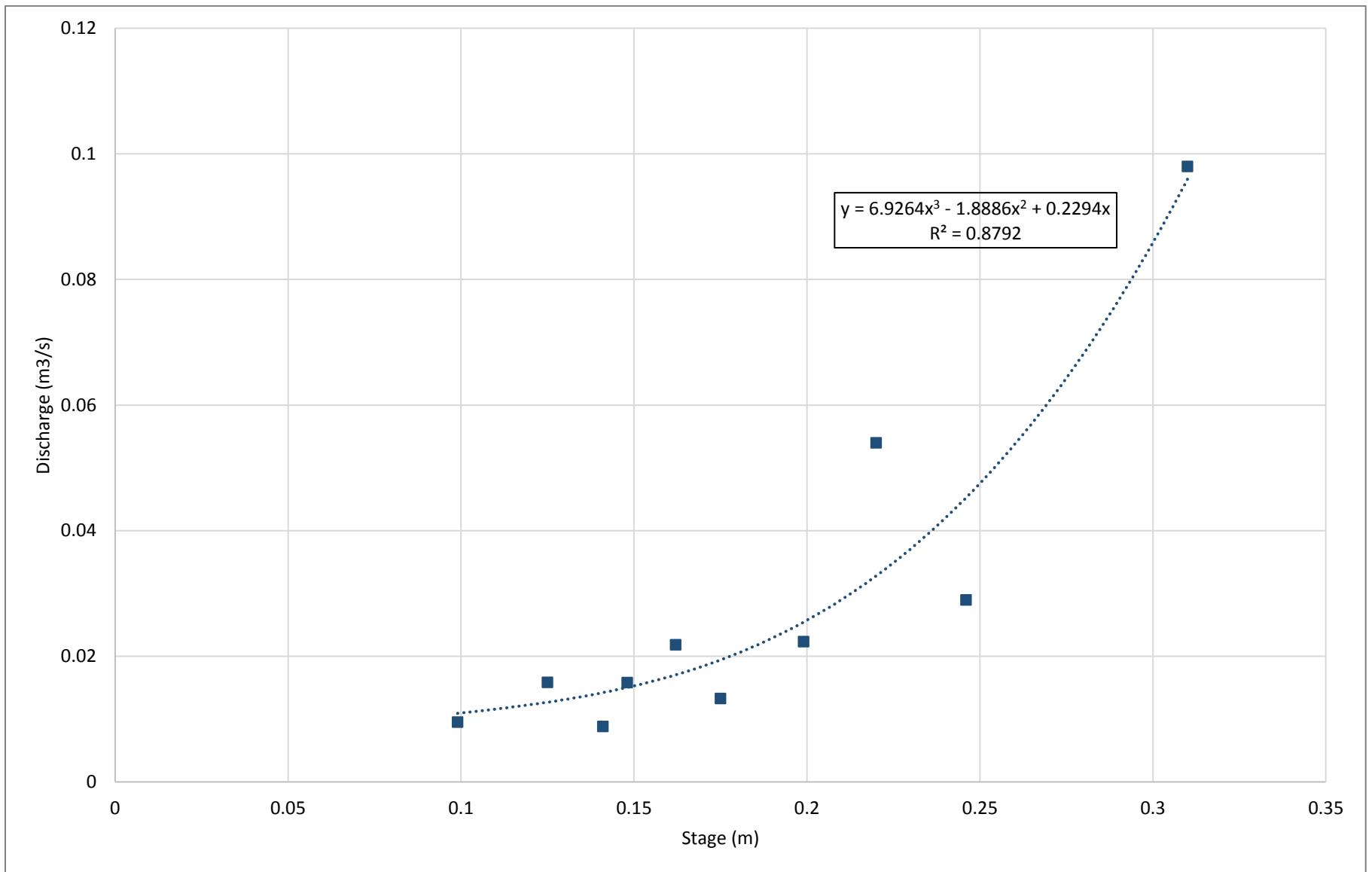


Figure 15: MN-0.5 Rating Curve

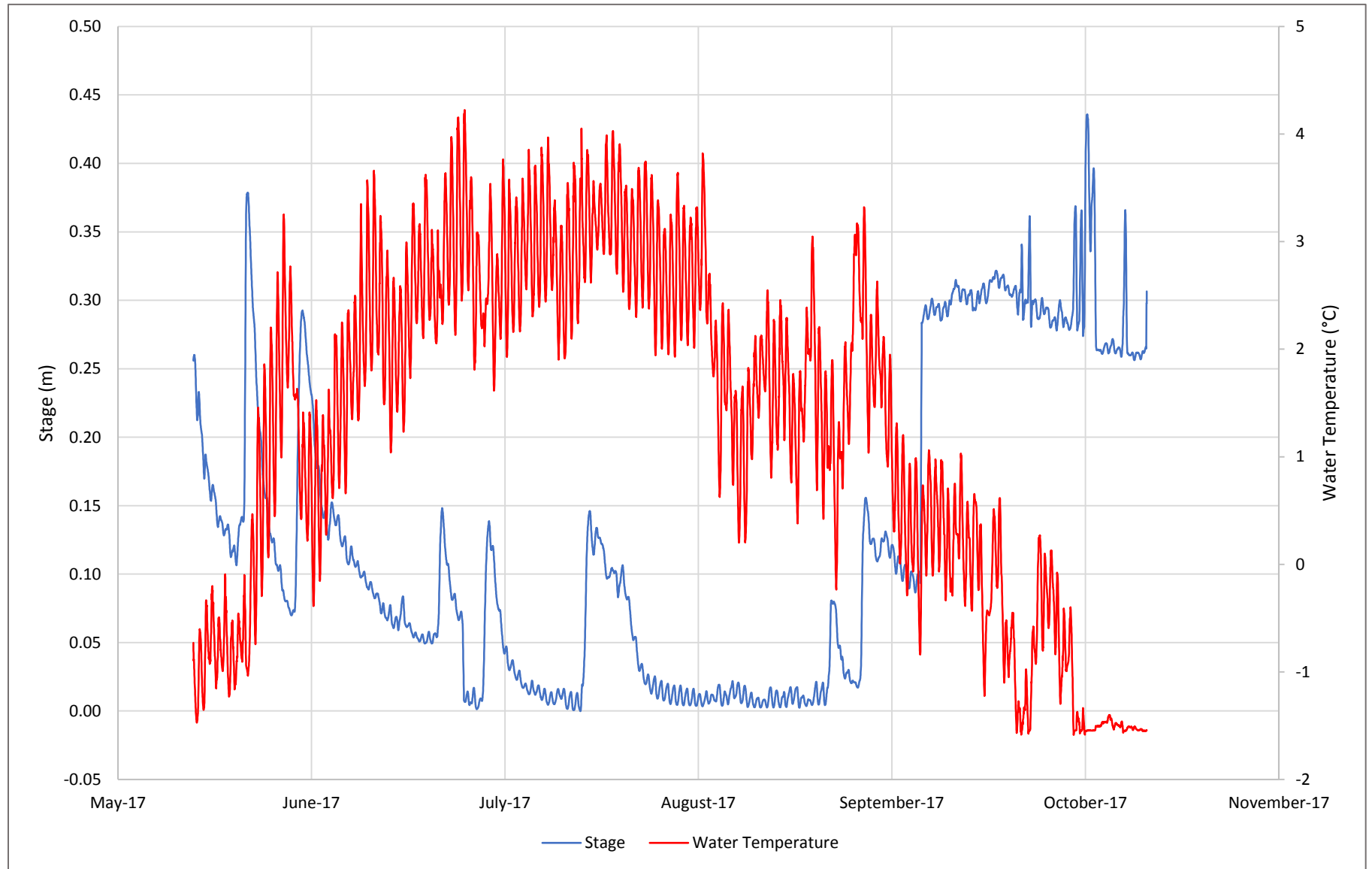


Figure 16: MN-2.5 Stage and Temperature Hydrograph

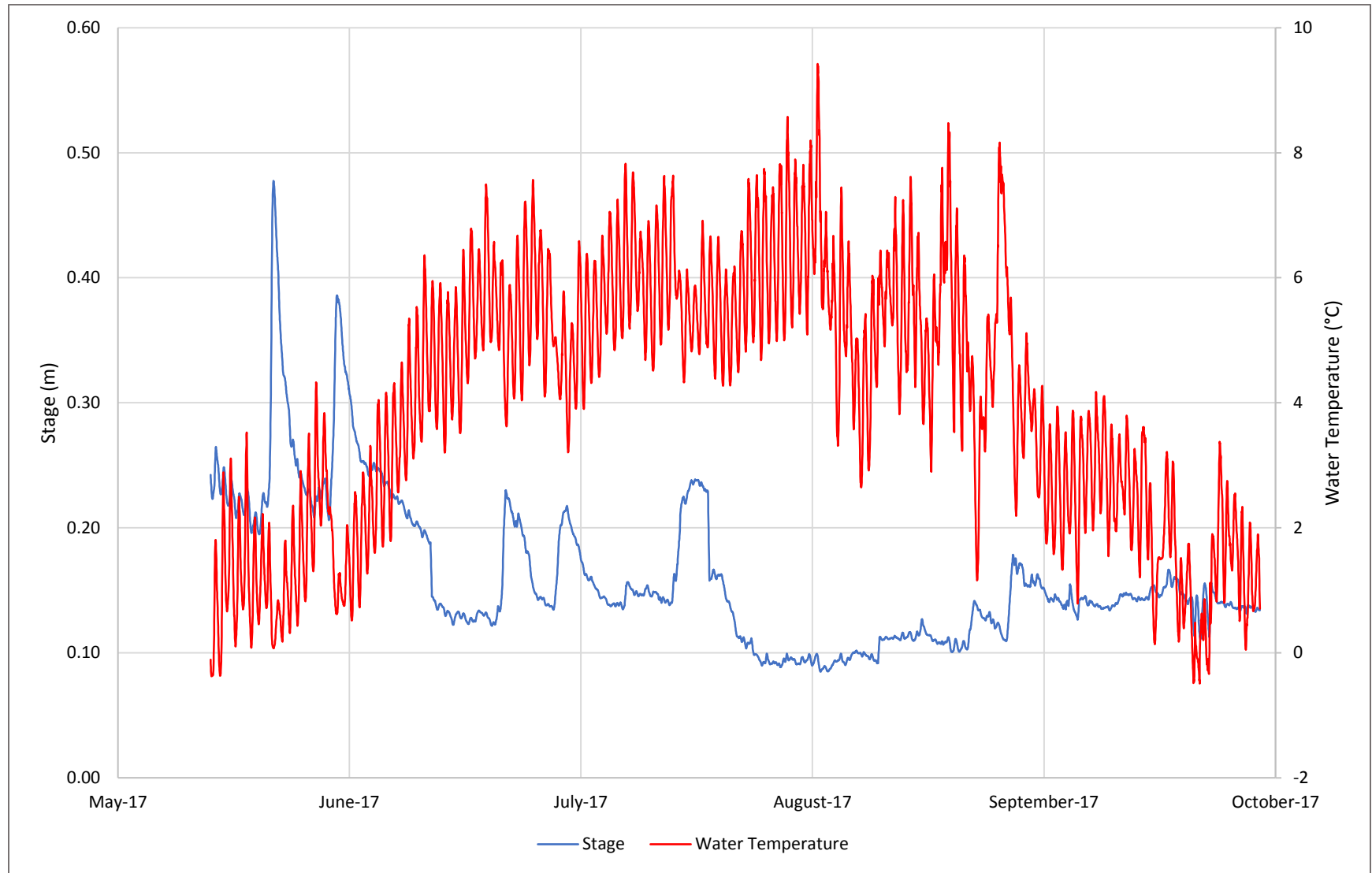


Figure 17: MN-4.5 Stage and Temperature Hydrograph

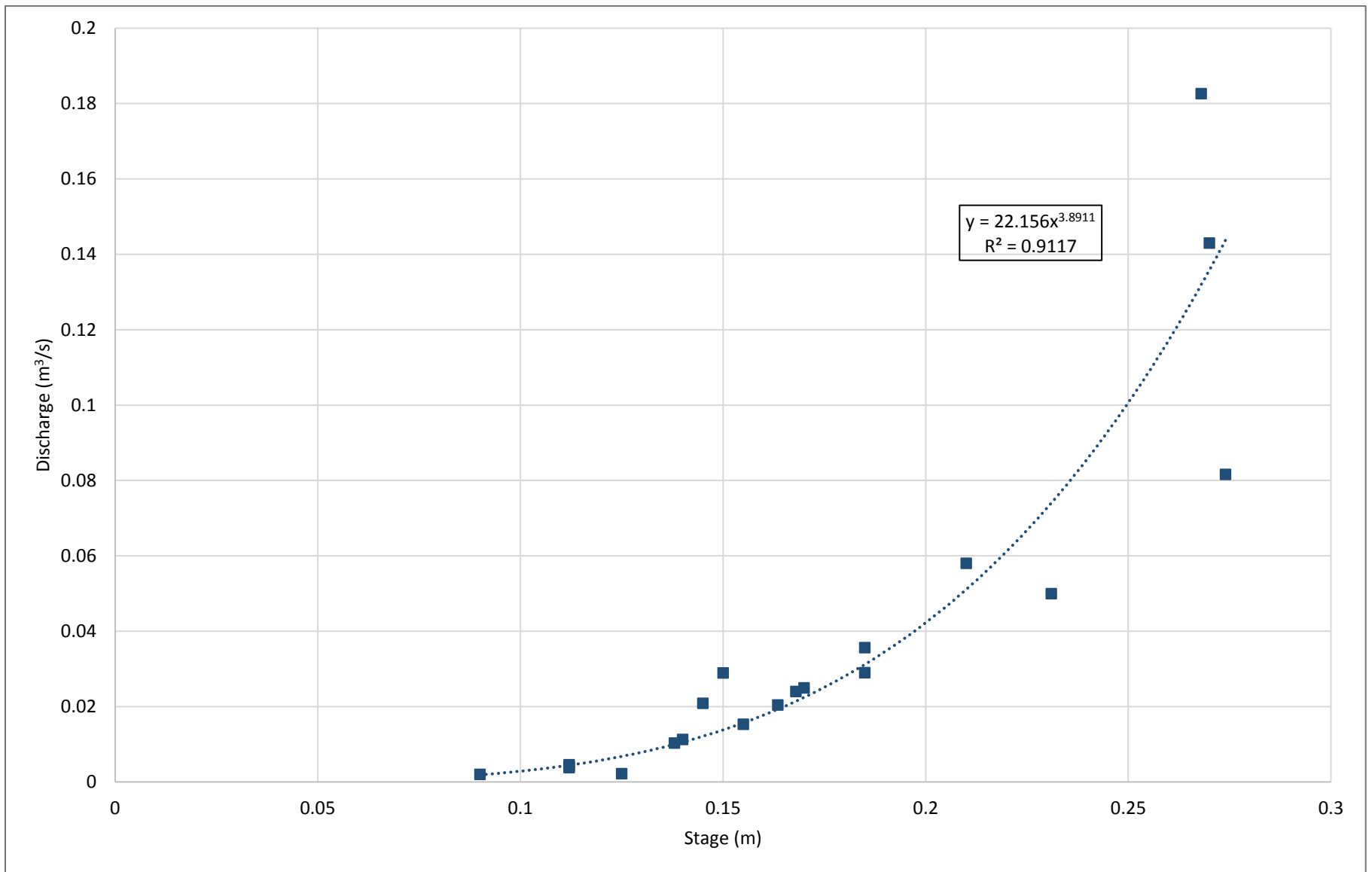


Figure 18: MN-4.5 Rating Curve

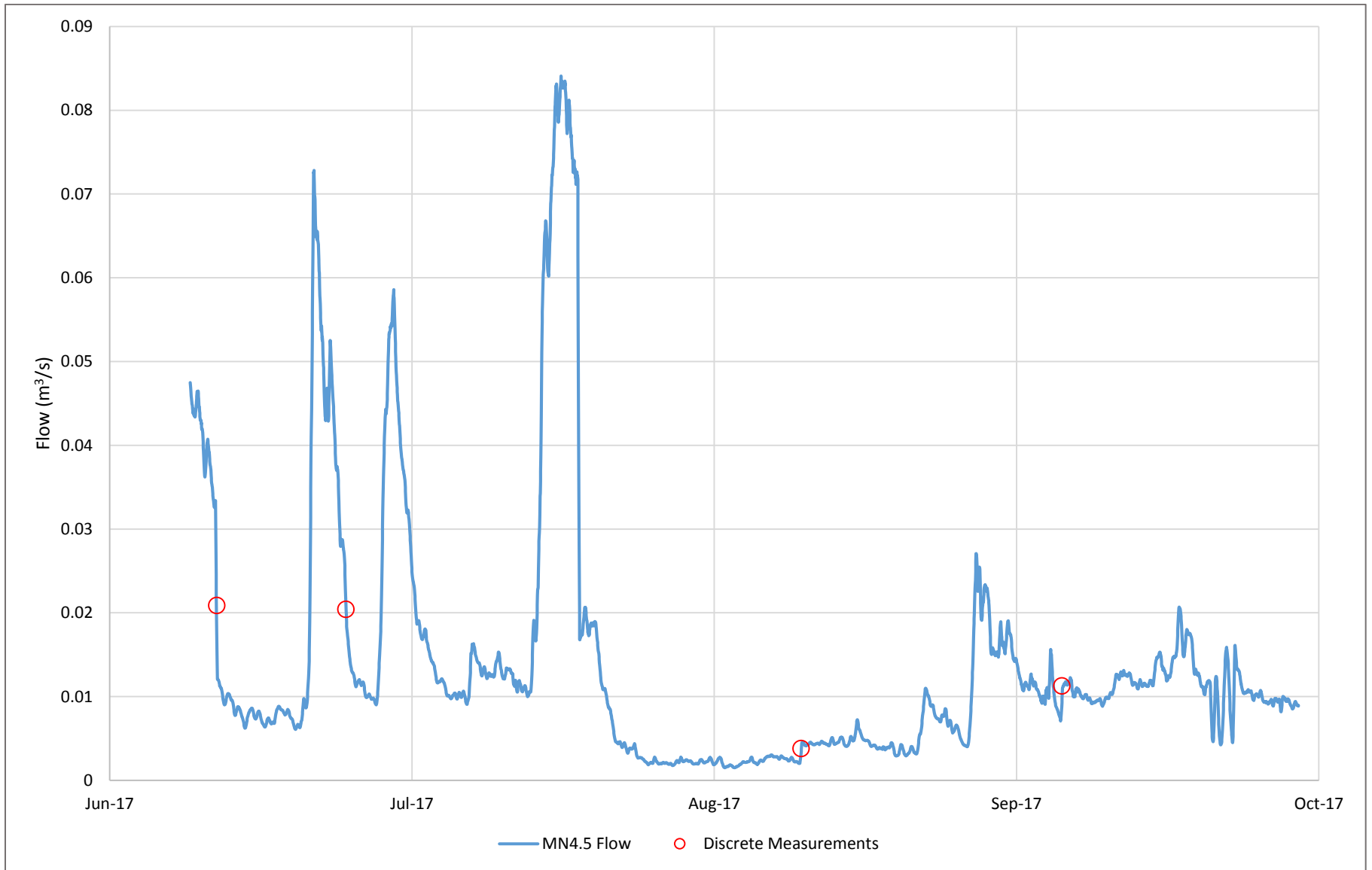


Figure 19: MN-4.5 Flow Hydrograph

Appendix G – 2017 Physical Monitoring Plan



**Revision 2017-1
Physical Monitoring Plan
Minto Mine, YT**

Prepared by:
Minto Explorations Ltd.
Minto Mine
December 2017

Minto Mine Physical Monitoring Plan

First Issue: June 2014

REVISION INFORMATION

| Rev. Number | Issue Date | Description & Revisions Made |
|-------------|----------------|---|
| - | June, 2014 | First issue |
| 2015-1 | November, 2015 | <p>Annual update of existing instrumentation and monitoring frequencies.</p> <p>Instruments Added: A215, A216, A217, A218, A2RAMP01, A2RAMP02, A2RAMP03, A2RAMP04, DSSH-26, DSSH-27, M82, M83, M84, M85, M86, M87, SWD06</p> <p>Instruments Removed: DSI-14, DSI-21, DSSH-21, DSSH-22, DSSH-23, DSSH-25, WSP2</p> |
| 2016-1 | December, 2016 | <p>Annual update of existing instrumentation and monitoring frequencies.</p> <p>Instruments Added: DSP-07, DSP-08, DSP-10, DSI-22, DSI-23, DSSH-28, DSSH-29, DSSH-30, DSSH-31, MV1, MV2, SWD-07, SWD-08, SWD-09</p> <p>Instruments Replaced: DSSH-06, DSSH-10, DSSH-15, DSSH-18, DSSH-19, DSSH-20</p> <p>Instruments Removed: A2RAMP01, A2RAMP02, A2RAMP03, A2RAMP04, SWD-02, SWD-02A, SWD-04A, SWD-05A, DSP-09</p> |
| 2017-1 | November, 2017 | <p>Annual update of existing instrumentation and monitoring frequencies.</p> <p>Instruments Added: DSI-24, DSSH-32, M88, M89, M91, M92, M93, M94, SWD10, SWD11</p> <p>Instruments Replaced: DSSH-17, DSSH-27, M82, M76, M86</p> <p>Instruments Removed: DSI-23, DSSH-20, DSSH-29, M73, M75, M87</p> |

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Appendix A: Instrumentation Map

Appendix B: Data Collection and Input Manuals

1 Introduction

The following document describes the instrumentation and monitoring program currently in place at Minto to monitor the stability of mining structures including waste rock, tailings, and water storage facilities. The program consists of two main components: instrumentation to measure ground conditions and deformation, and regular geotechnical inspections. The following sections summarize inspection and data collection frequencies, instrument installation details and locations, and data collection procedures.

Mining and monitoring activities at Minto included in this plan are licensed under the following:

- Type A Water Licence QZ14-031, August, 2015
- Type B Water Licence MS15-094, July 2016
- Quartz Mining Licence QML-0001, December, 2014

Existing mine structures at Minto are shown in Figure 1-1, and described in the following section.



Figure 1-1: Minto site plan (August 2017)

2 Mine Structures

Mine structures currently being monitored at Minto as well as future structures included in the Phase V/VI plan are listed in Table 1.

Table 1: Description of Mine Structures at Minto

| Structure | Description | Instrumentation |
|---|---|--|
| Area 2 Pit and Area 2 Pit Tailings Management Facility (A2PTMF) | <p>The Area 2 Pit was completed in 2015 to the extents licensed under Phase IV (Stages 1 and 2); the pit was extended to the south as part of Phase V/VI (Stage 3 and Stage 3 Expansion), scheduled to be complete in 2018.</p> <p>Tailings deposition into Area 2 Stage 2 pit (A2S2) began in March, 2015 and the pit is now maintained as a tailings management facility.</p> <p>Dumping of NP:AP<3 waste rock (SAT), intended to be below the final water table at closure, has commenced into the pit.</p> | <ul style="list-style-type: none"> Survey hubs GroundProbe radar (during active mining) |
| Area 2 Underground | The Area 2 underground began development in 2016 and is accessed by a portal and decline south of the Area 2 and Area 118 Pits. Production mining is currently taking place using a longhole stoping method and is expected to be completed in 2018. | None |
| Area 118 Pit | Mining of the Area 118 Pit was carried out in 2014. As part of Area 2 Stage 3 pit mining, overburden is being dispatched to the Area 118 pit, referred to as the Area 118 Backfill Dump. | <ul style="list-style-type: none"> Survey hubs |
| Area 118 Backfill Dump | The Area 118 Backfill Dump is included in the Phase V/VI licence and commenced in 2017. Construction will continue for the duration of the Area 2 Stage 3 Pit. The dump will fill in the Area 118 Pit. | None |
| Area 118 Underground | The Area 118 underground began development in 2013 and was completed in 2016. It is accessed by a portal and decline south of the Area 2 and Area 118 Pits. Production mining took place using a longhole stoping method. | None |
| Big Creek Bridge | Bridge on the Minto access road crossing Big Creek, located at Km 19. Licenced under Type B water licence MS15-094. | None |
| Barge Landings | Barge landings on the Minto access road at the Yukon river. Licensed under Type B water license MS15-094. | None |
| Camp | The camp consists of several connected bunkhouse buildings (Sherwood, Minto, Selkirk), a kitchen building, and several separate buildings including the gym and Site Services offices. | None |
| Copper Keel and Wildfire Underground | The Copper Keel and Wildfire underground are in the phase V/VI mining plan and have not commenced yet. | N/A |
| Dry Stack Tailings Storage Facility (DSTSF) | Construction of the DSTSF with filtered tailings placement was carried out from 2007 to November 2011. As part of progressive reclamation activities in 2012-2013, the DSTSF was covered with a layer of overburden approximately one to four meters thick. The DSTSF began showing deformation in 2009, interpreted as primarily horizontal sliding towards the north/northeast on an ice-rich layer in the underlying overburden, several meters above bedrock. The movement has continued since then but at a decreasing rate in response to construction of both the Mill Valley Fill waste rock buttress and the Mill Valley Fill Extension 2 waste rock buttress. | <ul style="list-style-type: none"> Survey hubs Thermistors Inclinometers Piezometers |

| Structure | Description | Instrumentation |
|---|---|---|
| Ice Rich Overburden Dump (IROD) | Originally constructed as a free-standing rockfill structure to contain ice-rich overburden. The IROD is no longer active and is now entirely surrounded by the Southwest Waste Dump rockfill. The area has been reclaimed with the Southwest Waste Dump in 2017. | None |
| Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF) | <p>Mining in the Main Pit was completed in 2011. Instability in the south wall of the pit occurred in 2009 during mining of Stage 3 of the pit, and subsequently a larger failure occurred in 2011 after completion of Stage 5. Continued sloughing and creep movement of the south wall led to the design and construction of a waste rock buttress, known as the South Wall Buttress, completed in 2013.</p> <p>Slurry tailings deposition into the pit began in 2012 and the pit is now maintained as a tailings management facility.</p> <p>Dumping of NP:AP<3 waste rock (SAT) below the final water table at closure, is not currently active but remains an alternate dispatch location to the Area 2 Pit Tailings Management Facility.</p> | <ul style="list-style-type: none"> • Survey hubs • Inclinometer |
| Main Pit Dump | The Main Pit Dump is included in the Phase V/VI licence. Construction commenced in 2017. The dump is located on the southwest side of the Main Pit. | <ul style="list-style-type: none"> • Survey hubs |
| Main Waste Dump (MWD) | The Main Waste Dump stores waste rock released during the mining of the first three stages of the Main Pit. The dump is no longer active. | <ul style="list-style-type: none"> • Inclinometer |
| Main Waste Dump Expansion (MWDE) | This dump is an extension of the MWD that stores waste rock released from the Minto North Pit. The dump is no longer active. Reclamation re-sloping began in 2016. | None |
| Main Waste Dump Wrap (MWDW) | This dump is a reclamation feature to shallow the slopes of the Main Waste Dump for reclamation purposes. | None |
| Mill Site | The mill site consists of the mill building, crusher and crusher stockpile pad. | None |
| Mill Valley Fill Extension (MFVE) | A waste rock buttress to the north of the DSTSF, constructed from January 2012 to March 2013 to prevent or decrease movement of the DSTSF. | <ul style="list-style-type: none"> • Survey hubs |
| Mill Valley Fill Extension 2 (MVFE2) | An extension of the MVFE waste rock buttress to the northeast, constructed from November 2015 to August 2016 to further decrease movement of the DSTSF. | <ul style="list-style-type: none"> • Piezometers • Survey hubs • Inclinometers |
| Mill Valley Fill Extension 2 Collection Sump | A replacement sump for the Minto Creek Detention Structure (MCDS), constructed in 2016. It detains surface water considered impacted from upstream sub-catchment areas and directs it to the MPTMF or water treatment plant. | None |
| Minto Access Road | Road from the Yukon River barge crossing to the mine site. Licenced under Type B water licence MS15-094. | None |
| Minto East Underground | Ramping to the Minto East underground began development in 2017 and is accessed by a portal and decline south of the Area 2 and Area 118 Pits. Production will use a longhole stoping method and is expected to start in 2018. | None |

| Structure | Description | Instrumentation |
|---|---|--|
| Minto North Pit | Mining of the North Pit was completed in September 2016. The pit is currently inactive and the access is barricaded. | None |
| Ore Stockpiles | There are two primary ore stockpiles on site – North and South stockpile. These are located south of the crusher and east of the Area 2 pit. | None |
| Reclamation Overburden Dump (ROD) | Received the bulk of the overburden released as part of Phase IV and earlier mining of the Main Pit. The material in the ROD is available for use in reclamation of the mine at closure. | None |
| Ridgetop Pit (Ridgetop North Pit, Ridgetop South Pit) | The Ridgetop Pits are included in the Phase V/VI licence and has not commenced yet. Mining is planned to start in 2018. | GroundProbe radar (during mining) |
| Ridgetop Waste Dump | The Ridgetop Waste Dump is included in the Phase V/VI licence and has not commenced yet. Dumping is planned to start in 2018. | N/A |
| South Diversion Ditch | This structure was decommissioned in 2017 to allow for Area 2 Stage 3 Expansion mining activities. | None |
| South Wall Buttress (SWB) | Waste rock buttress constructed against the Main Pit south wall from 2009-2011 as a result of instability in the south wall of the pit. | <ul style="list-style-type: none"> Survey hubs |
| Southwest Waste Dump (SWD) | The Southwest Waste Dump (SWD) stores waste rock released during phase IV mining. Dumping at the SWD is now complete and reclamation re-sloping began in 2015. Re-sloping is expected to be completed in 2018. | <ul style="list-style-type: none"> Survey hubs Inclinometers Thermistors Piezometers |
| Tailings Diversion Ditch (TDD) | A diversion ditch located south of the DSTSF to divert unimpacted water around the tailings facility. The intake structure was extended in 2017 to allow for the decommissioning of the South Diversion Ditch with A2S3 Expansion mining. | None |
| Water Storage Pond Dam (WSP) | The Water Storage Pond and Dam are located east of the mine along Minto Creek. The dam was constructed in 2006 as a clay-core water retention dam for collecting precipitation and surface water runoff at the site. Maximum depth of water at the face of the dam is approximately 15 m. | <ul style="list-style-type: none"> Survey hubs Thermistors Piezometers |

3 Design and Monitoring References

Table 2 lists the design reports for each structure and the monitoring/inspection guidance reports used to develop the inspection (Section 5) and instrumentation (Section 6) programs for each structure.

Table 2: Design Documents and Monitoring/Inspection Guidance Documents

| Structure | Design Reports | Monitoring/Inspection Guidance Reports |
|---|---|--|
| Area 2 Pit and Area 2 Pit Tailings Management Facility (A2PTMF) | <p><i>Prefeasibility Geotechnical Evaluation, Phase IV, Minto Mine.</i> SRK, December 2009.</p> <p><i>Review of Minto Area 2 West Wall Stability.</i> SRK, September 11, 2012.</p> <p><i>Review of Minto Area 2 West Wall Stability-April 2013.</i> SRK, April 18, 2013.</p> <p><i>Review of Minto Area 2 West Wall Stability-September 2013.</i> SRK, September 30, 2013.</p> <p><i>Main Dam – Area 2 Pit Stability Assessment.</i> SRK Consulting Project: 1CM002.003.0701, February, 2015.</p> | <p><i>Operation, Maintenance, and Surveillance Manual - Area 2 Pit Tailings Management Facility Revision 2015-2.</i> Minto, December 2015.</p> <p><i>Minto Mine Operations Adaptive Management Plan Revision 2016-01.</i> Minto, May, 2016.</p> |
| Area 2 Stage 3 Pit and Area 2 Stage 3 Expansion | <p><i>Pit Slope Stability Evaluation, Minto Mine, Area 2 Pit – Stage 3.</i> SRK Consulting Project: 219500.190, August 2015.</p> <p><i>Geotechnical Review of Saddle Between Area 2 Stage 2 and Area 2 Stage 4 Open Pits.</i> JDS Energy & Mining Inc., August 24, 2017.</p> | <p><i>Minto Mine Ground Control Plan – Open Pit Operations.</i> Minto, 2016.</p> |
| Area 2 Underground | <p><i>Area 2 Mining Stability Assessment Summary.</i> Golder Associates, June, 2016.</p> <p><i>Area 2 Mining Stability Assessment Summary.</i> Golder Associates, December, 2016.</p> | <p><i>Minto Mine Ground Control Plan – Underground Operations.</i> Minto, 2016.</p> <p><i>Inspection of Physical Stability of Underground Workings at Minto Mine, Yukon.</i> Golder Associates, August 2017.</p> <p><i>Minto Mine Geotechnical Mapping Program Memo Review.</i> Golder Associates, September 2017.</p> <p><i>Independent Review of Blasting Impacting Between Minto Surface and Underground Operations.</i> Golder Associates, September 2017.</p> |
| Area 118 Pit | <p><i>Prefeasibility Geotechnical Evaluation, Phase IV, Minto Mine.</i> SRK, December 2009.</p> <p><i>Review of Final Area 118 Pit Design.</i> SRK Consulting, Project: 219500.070. January, 2015.</p> | - |
| Area 118 Backfill Dump | <p><i>Phase V/IV Ridgetop South and Area 118 Backfill Dumps Physical Stability Assessment.</i> SRK, October 2013.</p> | - |

| Structure | Design Reports | Monitoring/Inspection Guidance Reports |
|---|--|---|
| Area 118 Underground | <p><i>Minto 118-Zone – FLAC3D Analysis of the Longhole Base Case Option.</i> Itasca, August 2014.</p> <p><i>Geotechnical Characterization of Existing and Proposed Longhole Open Stope Mining Areas.</i> Golder Associates File: 1528754-002-R-Rev0-3000. July 30, 2015.</p> <p><i>Longhole Open Stope Stability Addendum – Revised Mining Heights.</i> Golder Associates, File 1528754-006-TM-Rev0-3000, November 2015.</p> <p><i>Area 118 Plunge Mining Stability Assessment Summary.</i> Golder Associates, File: 1528754-008-PP-Rev0-5000, December 2015</p> | <p><i>Minto Mine Ground Control Plan – Underground Operations.</i> Minto, 2016.</p> <p><i>Ground Control Management Plan Review.</i> Golder Associates, File 1528754-007-TM-Rev0-1000. September 2015.</p> |
| Big Creek Bridge | - | - |
| Camp | - | - |
| Dry Stack Tailings Storage Facility (DSTSF) | <p><i>Geotechnical Design Report, Dry Stack Tailings Storage Facility, Minto Mine, Yukon.</i> EBA File: 1200173. January 2007.</p> | <p><i>Operation, Maintenance, and Surveillance Manual, Dry Stack Tailings Storage Facility, Minto Mine, YT.</i> Revision 2014-1 Minto, November 2014.</p> <p><i>Minto Mine Operations Adaptive Management Plan.</i> Revision 2016-01. Minto, May, 2016.</p> |
| Ice Rich Overburden Dump (IROD) | <p><i>Geotechnical Design Ice-Rich Overburden Dump, Minto Mine, Minto, YT.</i> EBA file: 1200173. January 2006.</p> <p><i>Ice-Rich Overburden Dump Containment Berm Inspection Report, Minto Mine Site, Minto Yukon.</i> EBA File: 1200173.001. June 19, 2007.</p> | <p><i>Geotechnical Design Ice-Rich Overburden Dump, Minto Mine, Minto, YT.</i> EBA file: 1200173. January 2006. EBA, 2007.</p> <p><i>Minto Mine Operations Adaptive Management Plan</i> Revision 2016-01. Minto, May, 2016.</p> |
| Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF) | <p><i>Pit Slope Evaluation for Area 1 Open Pit.</i> SRK Consulting, Project: 2CM022.03, July 2007.</p> <p><i>SAT Dump on Tailings.</i> SRK Consulting Project: 1CM002.043, March 2016.</p> | <p><i>Operation, Maintenance, and Surveillance Manual - Main Pit Tailings Management Facility.</i> Revision 2015-2 Minto, December, 2015.</p> <p><i>Minto Mine Operations Adaptive Management Plan</i> Revision 2017-01. Minto, January, 2017.</p> |
| Main Pit Dump | <p><i>Phase V/VI Main Pit Dump Physical Stability Assessment.</i> SRK Consulting Project: 1CM002.003.0701, November, 2013.</p> <p><i>Update to the Main Pit Dump Physical Stability Assessment.</i> SRK Consulting Project: 1CM002.003.0701. February, 2015.</p> <p><i>Main Pit Dump (Revision 5.6) Stability Analysis.</i> SRK Consulting, Project 1CM002-053, July, 2017.</p> | - |

| Structure | Design Reports | Monitoring/Inspection Guidance Reports |
|---|---|---|
| Main Waste Dump (MWD) | <i>Geotechnical Evaluation Proposed Main Waste Dump Minto Mine, Minto, YT. EBA. April, 1998.</i> | <i>Geotechnical Evaluation Proposed Main Waste Dump Minto Mine, Minto, YT. EBA. April, 1998.</i> <i>Minto Mine Operations Adaptive Management Plan Revision 2016-01. Minto, May, 2016.</i> |
| Main Waste Dump Expansion (MWDE) | <i>Minto Mine Phase V/VI Expansion Waste Rock and Overburden Management Plan. Minto. June, 2014.</i> <i>Phase V/VI Main Waste Dump Expansion – Physical Stability Assessment. SRK Consulting Project: 1CM002.012.012, November, 2013</i> | <i>Minto Mine Operations Adaptive Management Plan Revision 2016-01. Minto, May, 2016.</i> |
| Main Waste Dump Wrap (MWDW) | <i>Main Waste Dump Stability Analysis. SRK Consulting Project: 1CM002-049, April, 2017.</i> | - |
| Mill Site | - | - |
| Mill Valley Fill Extension (MFVE) | <i>Waste Rock and Overburden Management Plan, Phase IV Development, Minto Mine YT. EBA File: W14101068.015. September 9, 2011.</i> <i>Upstream Water Management for the Mill Valley Fill Expansion and Dry Stack Tailings Storage Facility. EBA File: W14101168.013. September 14, 2011.</i> | <i>Minto Mine Operations Adaptive Management Plan Revision 2016-01. Minto, May, 2016.</i> |
| Mill Valley Fill Extension 2 (MVFE2) | <i>Mill Valley Fill Extension Stage 2 Preliminary Design Report. SRK Consulting Project: 1CM002.015. March, 2014</i> <i>Minto Mine Phase V/VI Expansion Waste Rock and Overburden Management Plan. Minto. June, 2014.</i> <i>Mill Valley Fill Extension Stage 2 Final Design Report. SRK Consulting Project: 1CM002.040. September, 2015.</i> <i>Mill Valley Fill Extension Stage 2 Record of Construction. Minto. November, 2016.</i> | <i>Minto Mine Operations Adaptive Management Plan Revision 2016-01. Minto, May, 2016.</i> <i>Mill Valley Fill Extension Stage 2 – Expected Performance and Evaluation Criteria. SRK Consulting Project: 1CM002.050, November, 2016.</i> <i>Mill Valley Fill Extension Stage 2 Inclinometer Installations Field Report. SRK Consulting Project: 1CM002.052. June 2017.</i> |
| Mill Valley Fill Extension 2 Collection Sump | <i>Design for the MVFE Stage 2 Collection Sump. SRK Consulting Project: 1CM002.020. June, 2015.</i> <i>Mill Valley Fill Extension Stage 2 Collection Sump Record of Construction. Minto. April, 2016.</i> | - |
| Minto Access Road | - | - |
| Minto East, Copper Keel, Wildfire Underground | <i>Minto Phase VI Underground Geotech Evaluation, SRK Consulting Project: 2UC031.005, February, 2012.</i> <i>Geotechnical Characterization of Existing and Proposed Longhole Open Stope Mining Areas, Golder Associates, Reference No. 1528754-002-R-Rev0-3000, July, 2015.</i> <i>Minto Mine Underground Reserve Update Geotechnical Input, Golder Associates, Reference No. 1528754-003-R-Rev0-3000, July, 2015.</i> | - |

| Structure | Design Reports | Monitoring/Inspection Guidance Reports |
|---|---|---|
| | <p><i>Minto East – Revised Longhole Open Stope Stability.</i> Golder Associates, File: 1528754-009-TM-Rev0-6000, January, 2016.</p> <p><i>Wildfire Proposed Underground Mine Area – Geotechnical Characterization and Long Hole Open Stope Stability Assessment.</i> Golder Associates, September, 2016.</p> <p><i>Minto East Raise Geotechnical Investigation and Hydrogeological Testing Program Study.</i> Golder Associates, October, 2017.</p> | |
| Minto North Pit | <p><i>Minto Phase VI Preliminary Feasibility Study Technical Report.</i> SRK, January 2012.</p> <p><i>Review of Minto North Wall Stability.</i> SRK, May, 2016.</p> <p><i>Site Visit and Review of North Pit – South Wall.</i> BGC Engineering, July, 2016.</p> <p><i>Minto North South Wall Wedge Analysis.</i> SRK, August, 2016.</p> | <i>Minto Open Pit Ground Control Plan_ Rev0.</i> Minto, 2016. |
| Ore Stockpiles | - | - |
| Reclamation Overburden Dump (ROD) | <p><i>Geotechnical Design Proposed Reclamation Overburden Dump, Minto Mine, Yukon.</i> EBA File: W14101068.004. February 2008.</p> <p><i>Reclamation Overburden Dump Expansion Geotechnical Design Report.</i> EBA File: W14101068.0040. June 29, 2010.</p> | <p><i>Reclamation Overburden Dump Expansion Geotechnical Design Report.</i> EBA File: W14101068.0040. June 29, 2010.</p> <p><i>Minto Mine Operations Adaptive Management Plan Revision 2016-01.</i> Minto, May, 2016.</p> |
| Ridgetop Pit (Ridgetop North Pit, Ridgetop South Pit) | <p><i>Pre-Feasibility Geotechnical Evaluation Phase IV Minto Mine,</i> SRK Consulting Project: 2CM022.006, December, 2009.</p> <p><i>Ridgetop North Pit TMF Stability Assessment,</i> SRK Consulting Project: 1CM002.003.710, February, 2015.</p> | - |
| Ridgetop Waste Dump | <i>Phase V/VI Ridgetop Waste Dump Physical Stability Assessment.</i> SRK Consulting Project: 1CM002.012.0.12, November, 2013. | - |
| South Diversion Ditch (SDD) | <i>Phase 1 – Preliminary Engineering, Stormwater Diversion Ditches Minto Mine, YT,</i> EBA File: W14101068.013 | - |
| South Wall Buttress | <i>Area 1 South Wall Buttress Design Report, Minto Mine, Yukon.</i> EBA File: W141010668.012, July 2011. | - |

| Structure | Design Reports | Monitoring/Inspection Guidance Reports |
|--------------------------------|---|---|
| Southwest Waste Dump (SWD) | <p><i>Geotechnical Design Proposed Southwest Waste Dump, Minto Mine, Yukon.</i> EBA File: W14101068.005. September 2008.</p> | <p><i>Geotechnical Design Proposed Southwest Waste Dump, Minto Mine, Yukon.</i> EBA File: W14101068.005. September 2008.</p> <p><i>Minto Mine Operations Adaptive Management Plan</i> Revision 2016-01. Minto, May, 2016.</p> |
| Tailings Diversion Ditch (TDD) | <p><i>Preliminary Design of the Tailings Diversion Ditch Upgrade,</i> SRK Consulting Project: 1CM002.012.006, November, 2013.</p> <p><i>Area 2 Stage 3 Pit Expansion – Intake Structure and Overflow Spillway – Final Design,</i> SRK Consulting Project: 1CM002.056, May 2017.</p> | - |
| Water Storage Pond Dam (WSP) | <p><i>Geotechnical Design Tailings/Water Dam, Minto Project, Yukon.</i> EBA File: 0201-95-11509. Dec. 1995.</p> <p><i>As-built Construction Report, Water Retention Dam, Minto Mine, Minto, YT.</i> EBA File: 1200173.001. April 2008.</p> | <p><i>Operation, Maintenance and Surveillance Manual, Water Retention Dam, Minto Mine, Minto, YT.</i> EBA File: W14103414-01. August 2014.</p> |

4 Roles and Responsibilities

Table 3 lists the roles and responsibilities for physical monitoring on the site.

Table 3: Roles and Responsibilities

| Role | Responsibilities |
|-----------------------------|--|
| Mine Technician Assistants | <ul style="list-style-type: none"> • Collect instrumentation data at specified frequencies • Input data into monitoring spreadsheets/databases • Internal reporting of monitoring data • Maintain equipment |
| Geotechnical Engineers/EITs | <ul style="list-style-type: none"> • QA/QC of data collection • Ensure compliance with license requirements • Monthly and annual Water Licence reporting • Visual inspections at specified frequencies • Communicate with consultants as required • Review and update Physical Monitoring Plan |
| Environmental Officers | <ul style="list-style-type: none"> • Compile monthly and annual Water Licence reports • Visual inspections of water diversion/collection structures |
| Chief Engineer | <ul style="list-style-type: none"> • Review monthly and annual Water Licence reports • Ensure compliance with licence requirements |

5 Inspections

Table 4 lists the regular, required inspections.

Table 4: Inspections

| Structure | Frequency | Description |
|---|---|---|
| Area 2 Pit and Area 2 Pit Tailings Management Facility (A2PTMF) | Quarterly | Visual inspection by Geotechnical Engineer/EIT and review of monitoring data as per OMS Manual. |
| Area 2 Stage 3 Pit and Area 2 Stage 3 Pit Expansion | Weekly (during active mining) | Weekly visual inspection by Geotechnical Engineer/EIT during active pit mining. Documented in weekly wall inspection report and two-week operating plan documents. |
| Area 2 Underground | Quarterly | Visual inspection by Geotechnical Engineer/EIT as per Underground Ground Control Plan. |
| Area 118 Pit | N/A | No longer accessible. |
| Area 118 Backfill Dump | Minimum every 4 hours during active dumping | Visual inspection by the supervisor or other competent person (typically the Pelly Shifter or Minto Operations Supervisor) as per O.I.C. 2006/178 Clause 15.44. |
| Area 118 Underground | N/A | No longer accessible. |
| Big Creek Bridge | Annually | Visual inspection by a Professional Engineer as per MS15-094. |
| Camp | Semi-Annually – May/June post thaw, and September pre freeze-up | Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year. |
| Copper Keel, Wildfire Underground | N/A | N/A – structure does not exist yet. |
| Dry Stack Tailings Storage Facility (DSTSF) | Monthly | Visual inspection by Geotechnical Engineer/EIT and review of monitoring data as per OMS Manual. |
| Ice Rich Overburden Dump (IROD) | Semi-Annually – May/June post thaw, and September pre freeze-up | Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year. |
| Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF) | Quarterly | Visual inspection by Geotechnical Engineer/EIT and review of monitoring data as per OMS Manual. |

| Structure | Frequency | Description |
|--|---|---|
| Main Pit Dump | Minimum every 4 hours during active dumping | Visual inspection by the supervisor or other competent person (typically the Pelly Shifter or Minto Operations Supervisor) as per O.I.C. 2006/178 Clause 15.44. |
| Main Waste Dump (MWD) | Semi-Annually – May/June post thaw, and September pre freeze-up | Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year. |
| Main Waste Dump Expansion (MWDE) | Semi-Annually – May/June post thaw, and September pre freeze-up | Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year. |
| Main Waste Dump Wrap (MWDW) | Minimum every 4 hours during active dumping | Visual inspection by the supervisor or other competent person (typically the Pelly Shifter or Minto Operations Supervisor) as per O.I.C. 2006/178 Clause 15.44. |
| Mill Site | Semi-Annually – May/June post thaw, and September pre freeze-up | Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year. |
| Mill Valley Fill Extension (MFVE) | Monthly | Visual inspection by Geotechnical Engineer/EIT and review of monitoring data as part of DSTSF monthly inspection. |
| Mill Valley Fill Extension 2 (MVFE2) | Monthly | Visual inspection by Geotechnical Engineer/EIT and review of monitoring data as part of DSTSF monthly inspection. |
| Mill Valley Fill Extension 2 Collection Sump | Monthly | Visual inspection by Geotechnical Engineer/EIT and review of monitoring data as part of DSTSF monthly inspection. |
| Minto Access Road | Annually | Visual inspection by a Professional Engineer as per MS15-094. |
| Minto East Underground | Quarterly | Structure does not exist yet. Once development commences, a visual inspection by Geotechnical Engineer/EIT as per Underground Ground Control Plan. |
| Minto North Pit | Semi-Annually – May/June post thaw, and September pre freeze-up | Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year. |
| Ore Stockpiles | Semi-Annually – May/June post thaw, and September pre freeze-up | Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year. |
| Reclamation Overburden Dump (ROD) | Semi-Annually – May/June post thaw, and | Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year. |

| Structure | Frequency | Description |
|---|---|---|
| | September pre freeze-up | |
| Ridgetop Pit (Ridgetop North Pit, Ridgetop South Pit) | Weekly (during active mining) | Weekly visual inspection by Geotechnical Engineer/EIT during active pit mining. Documented in weekly wall inspection report and two-week operating plan documents. |
| Ridgetop Waste Dump | Minimum every 4 hours during active dumping | Visual inspection by the supervisor or other competent person (typically the Pelly Shifter or Minto Operations Supervisor) as per O.I.C. 2006/178 Clause 15.44. |
| South Wall Buttress (SWB) | Quarterly | Visual inspection by Geotechnical Engineer/EIT and review of monitoring data as part of the MPTMF quarterly inspection. |
| Southwest Waste Dump (SWD) | Semi-Annually – May/June post thaw, and September pre freeze-up | Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year. |
| Tailings Diversion Ditch (TDD) | Semi-Annually – May/June post thaw, and September pre freeze-up | Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year. |
| Water Storage Pond Dam (WSP) | Monthly | Visual inspection by Geotechnical Engineer/EIT as per OMS Manual. |

6 Instrumentation

A map of site wide active instrumentation is shown in Appendix A. Installation information and data collection schedules are contained in the following sections. Instruments with a strikethrough shown were destroyed in 2017 or are no longer operational.

Inclinometers

Inclinometers are used to measure lateral, differential ground movement in a borehole. Inclinometer stations consist of grouted, slotted PVC pipe into which the inclinometer probe is lowered and deflection is measured at 0.5m intervals. The current probe used on site is an RST digital MEMS inclinometer system.

Table 5: Inclinometers

| Area | ID | Northing (m) | Easting (m) | Elevation (m) | A0 Azimuth | Hole Depth (m) | Date Installed | Reading Frequency |
|---|-------------------|--------------------|---------------------|--------------------|----------------|----------------|-----------------------|-------------------|
| Area 2 Pit | A2I-1 | 6944164.73 | 385298.95 | 822.46 | 302 | 55.5 | 2013-04-26 | Quarterly |
| Dry Stack Tailings Storage Facility and Mill Valley Fill Extension 2 | DSI-22 | 6945229 | 386043.4 | 723.471 | 034 | 14 | 2016-12-12 | Bi-weekly |
| Dry Stack Tailings Storage Facility and Mill Valley Fill Extension 2 | DSI-23 | 6945119 | 385886.8 | 765.679 | 070 | 49 | 2016-12-17 | NA |
| Dry Stack Tailings Storage Facility and Mill Valley Fill Extension 2 | DSI-24 | 6944971 | 385951.4 | 774.416 | 005 | 108 | 2017-02-01 | Bi-weekly |
| Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF) | MDI -2 | 6945013.08 | 384217.20 | 858.67 | 93 | 50.5 | 2010-02-10 | Quarterly |
| Southwest Waste Dump | SDI-3 | 6944591.11 | 383966.00 | 847.42 | 90 | 46.5 | 2010-02-11 | Quarterly |

Survey Hubs

Survey hubs are used to monitor surface movement of structures and are comprised of steel posts cemented into waste rock or bedrock and equipped with a threaded base to which a high precision RTK-corrected GPS instrument is attached. The GPS currently used on site is a Trimble R8.

Table 6: Survey Hubs

| Area | ID | Northing (m) | Easting (m) | Elevation (m) | Date Installed | Frequency |
|-------------------------------------|---------|--------------|-------------|---------------|----------------|-----------|
| Area 2 Pit | A210 | 6944268.42 | 384934.69 | 861.28 | 2011-07-01 | Monthly |
| Area 2 Pit | A215 | 6944649.45 | 385155.49 | 808.72 | 2015-09-17 | Monthly |
| Area 2 Pit | A216 | 6944749.21 | 385046.39 | 805.78 | 2015-09-17 | Monthly |
| Area 2 Pit | A217 | 6944756.78 | 384852.52 | 806.68 | 2015-09-17 | Monthly |
| Area 2 Pit | A218 | 6944707.23 | 384783.21 | 806.83 | 2015-09-17 | Monthly |
| Area 2 Pit | A219 | 6944081.774 | 385158.519 | 846.042 | 2017-09-15 | Monthly |
| Dry Stack Tailings Storage Facility | ASH05 | 6944280.52 | 385830.65 | 850.16 | 2011-03-07 | Monthly |
| Dry Stack Tailings Storage Facility | ASH06 | 6944331.73 | 385623.79 | 824.17 | 2011-03-07 | Monthly |
| Dry Stack Tailings Storage Facility | DSSH-24 | 6944757.90 | 385712.10 | 792.07 | 2014-02-28 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-26 | 6944601.28 | 385490.96 | 796.35 | 2015-07-28 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-27 | 6944757.178 | 385883.856 | 792.366 | 2017-06-25 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-06 | 6944971.372 | 385553.396 | 783.866 | 2016-08-21 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-10 | 6944992.584 | 385806.037 | 769.004 | 2016-08-21 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-12 | 6944947.303 | 385707.165 | 778.364 | 2016-08-16 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-14 | 6944920.27 | 385606.55 | 782.88 | 2012-04-21 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-15 | 6944944.092 | 385490.104 | 784.82 | 2016-08-16 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-18 | 6945070.727 | 385513.039 | 782.379 | 2016-08-16 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-19 | 6945109.679 | 385575.406 | 781.303 | 2016-08-16 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-20 | 6945072.083 | 385754.334 | 775.779 | 2016-08-21 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-28 | 6945045.016 | 385930.244 | 768.015 | 2017-06-25 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-29 | 6945162.176 | 385833.535 | 766.045 | 2016-08-21 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-30 | 6944883.247 | 385890.044 | 789.008 | 2016-08-21 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-31 | 6945030.732 | 386040.736 | 776.254 | 2016-11-01 | Weekly |
| Dry Stack Tailings Storage Facility | DSSH-32 | 6944984.803 | 385895.604 | 772.638 | 2017-09-10 | Weekly |
| Dry Stack Tailings Storage Facility | MV1 | 6945249.731 | 386021.140 | 727.554 | 2016-04-04 | Weekly |
| Dry Stack Tailings Storage Facility | MV2 | 6945216.537 | 385979.321 | 740.349 | 2016-04-04 | Weekly |

| Area | ID | Northing (m) | Easting (m) | Elevation (m) | Date Installed | Frequency |
|------------------------|--------|--------------|-------------|---------------|----------------|-----------|
| South Wall Buttress | M76 | 6944609.57 | 384538.801 | 836.161 | 2011-05-23 | Monthly |
| South Wall Buttress | M79 | 6944846.97 | 384208.90 | 847.66 | 2011-09-04 | Monthly |
| South Wall Buttress | M80 | 6944931.70 | 384256.33 | 842.06 | 2011-09-04 | Monthly |
| Main Pit | M81 | 6944971.63 | 384890.13 | 806.83 | 2012-05-08 | Monthly |
| South Wall Buttress | M82 | 6944891 | 384526.4 | 807.338 | 2017-04-05 | Bi-weekly |
| South Wall Buttress | M83 | 6944947.98 | 384475.79 | 809.06 | 2015-01-08 | Bi-weekly |
| South Wall Buttress | M84 | 6945021.46 | 384445.11 | 807.37 | 2015-01-08 | Bi-weekly |
| South Wall Buttress | M85 | 6944846.60 | 384315.66 | 826.08 | 2015-07-27 | Monthly |
| South Wall Buttress | M86 | 6944636 | 384408.4 | 838.959 | 2017-09-12 | Monthly |
| South Wall Buttress | M88 | 6944873.313 | 384376.559 | 837.776 | 2017-09-04 | Monthly |
| South Wall Buttress | M89 | 6944688.487 | 384284.45 | 843.026 | 2017-09-04 | Monthly |
| South Wall Buttress | M91 | 6944830.118 | 384397.843 | 849.617 | 2017-09-04 | Monthly |
| South Wall Buttress | M92 | 6944785.25 | 384707.139 | 800.568 | 2017-09-14 | Monthly |
| South Wall Buttress | M93 | 6944779.161 | 384620.593 | 801.16 | 2017-09-14 | Monthly |
| South Wall Buttress | M94 | 6944827.05 | 384583.178 | 800.551 | 2017-09-14 | Monthly |
| Southwest Waste Dump | SWD01 | 6944760.85 | 384077.86 | 859.07 | 2011-03-07 | Monthly |
| Southwest Waste Dump | SWD05A | 6943939.94 | 383837.70 | 869.16 | 2011-03-07 | Monthly |
| Southwest Waste Dump | SWD06 | 6944762.06 | 384189.37 | 836.42 | 2015-07-27 | Monthly |
| Southwest Waste Dump | SWD07 | 6944743.49 | 384111.649 | 840.00 | 2016-11-21 | Monthly |
| Southwest Waste Dump | SWD08 | 6944560.14 | 383883.182 | 867.25 | 2016-11-21 | Monthly |
| Southwest Waste Dump | SWD09 | 6944163.106 | 383790.749 | 861.532 | 2016-11-21 | Monthly |
| Southwest Waste Dump | SWD10 | 6943943.374 | 383838.099 | 868.236 | 2017-07-10 | Monthly |
| Southwest Waste Dump | SWD11 | 6944511.715 | 383916.357 | 849.792 | 2017-07-10 | Monthly |
| Water Storage Pond Dam | WSP1 | 6945613.04 | 386480.98 | 723.31 | 2011-06-09 | Monthly |
| Water Storage Pond Dam | WSP3 | 6945551.85 | 386548.62 | 719.73 | 2011-06-09 | Monthly |
| Water Storage Pond Dam | WSP4 | 6945531.56 | 386555.22 | 719.93 | 2011-06-09 | Monthly |
| Water Storage Pond Dam | WSP5 | 6945504.74 | 386560.23 | 721.02 | 2011-06-09 | Monthly |

Thermistors

Thermistor strings are used to measure ground temperature profiles in boreholes, and in particular permafrost conditions at Minto. Thermistor strings consist of multiple temperature sensor nodes distributed along a single multi-conductor cable, installed within or attached to the outside of grouted PVC pipe. EBA and RST thermistor strings have been installed on site. EBA thermistors are read using a basic ohmmeter and RST thermistors are read using a RST TH2016B readout unit.

Table 7: Thermistors

| Area | ID | Northing (m) | Easting (m) | Elevation (m) | Thermistor String No. | Nodes | Hole Depth (m) | Date Installed | Reading Frequency |
|-------------------------------------|--------|--------------|-------------|---------------|-----------------------|-------|----------------|----------------|-------------------|
| Area 2 Pit | A2T-1 | 6944162.01 | 385305.61 | 822.39 | 3491 | 16 | 63.4 | 2013-04-21 | Quarterly |
| Dry Stack Tailings Storage Facility | DST-10 | 6944584.06 | 385489.49 | 797.13 | 3492 | 16 | 63.4 | 2013-04-17 | Quarterly |
| Dry Stack Tailings Storage Facility | DST-11 | 6944899.64 | 385538.89 | 787.66 | 3494 | 16 | 86.9 | 2013-04-05 | Quarterly |
| Dry Stack Tailings Storage Facility | DST-13 | 6945014.60 | 386271.29 | 777.01 | 3495 | 16 | 101.5 | 2013-04-02 | Quarterly |
| Dry Stack Tailings Storage Facility | DST-14 | 6944769.09 | 385713.42 | 791.47 | 3497 | 16 | 66.5 | 2013-04-12 | Quarterly |
| Dry Stack Tailings Storage Facility | DST-15 | 6945033.78 | 385958.17 | 764.51 | 3493 | 16 | 64.0 | 2013-03-25 | Quarterly |
| Water Storage Pond | WDT-1 | 6945523.08 | 386550.83 | 720.03 | 2072 | 16 | 42.49 | 2007-11-16 | Monthly |
| Water Storage Pond | WDT-2 | 6945532.89 | 386574.77 | 713.66 | 2073 | 6 | 44.50 | 2007-11-07 | Monthly |
| Water Storage Pond | WDT-3 | 6945544.10 | 386544.43 | 719.78 | 2074 | 16 | 49.42 | 2007-11-11 | Monthly |
| Water Storage Pond | WDT-4 | 6945534.98 | 386547.90 | 719.85 | 2075 | 16 | 49.42 | 2007-11-10 | Monthly |
| Water Storage Pond | WDT-5 | 6945504.57 | 386557.50 | 721.03 | 2076 | 16 | 35.13 | 2007-11-13 | Monthly |
| Water Storage Pond | WDT-6 | 6945505.55 | 386556.32 | 721.03 | 2077 | 16 | 33.72 | 2007-11-13 | Monthly |
| Water Storage Pond | WDT-7 | 6945504.65 | 386556.39 | 721.08 | 2078 | 16 | 33.92 | 2007-11-13 | Monthly |

| | | | | | | | | | |
|----------------------|-------|------------|-----------|--------|------|----|-------|------------|-----------|
| Water Storage Pond | WDT-8 | 6945532.89 | 386574.77 | 713.66 | 2079 | 16 | 34.14 | 2007-11-07 | Monthly |
| Southwest Waste Dump | SDT-1 | 6944766.71 | 384779.13 | 836.36 | 2220 | 16 | 59.1 | 2010-02-04 | Quarterly |
| Southwest Waste Dump | SDT-2 | 6944595.06 | 383971.30 | 847.11 | 2221 | 16 | 14.6 | 2010-01-31 | Quarterly |
| Southwest Waste Dump | SDT-3 | 6944333.87 | 383824.67 | 860.17 | 2222 | 16 | 15.8 | 2010-01-28 | Quarterly |
| Southwest Waste Dump | SDT-4 | 6944163.62 | 383783.54 | 860.99 | 2223 | 16 | 13.1 | 2010-01-30 | Quarterly |

Vibrating Wire Piezometers

Vibrating wire piezometer strings are used to measure piezometric pressure profiles in boreholes. They consist of multiple vibrating wire sensors installed on PVC pipe in grouted boreholes. RST vibrating wire piezometers are installed on site and data is collected with an RST VW2106 readout unit.

Table 8: Vibrating Wire Piezometers

| Area | ID | Northing (m) | Easting (m) | Elevation (m) | Sensor | No. | Sensor Elevation (m) | Date Installed | Reading Frequency |
|-------------------------------------|-------|--------------|-------------|---------------|---------|---------|----------------------|----------------|-------------------|
| Dry Stack Tailings Storage Facility | DSP-5 | 6944769 | 385713 | 791.47 | DSP-5A | VW24851 | 765.47 | 2013-04-16 | Monthly |
| | | | | | DSP-5B | VW24853 | 761.47 | | |
| Dry Stack Tailings Storage Facility | DSP-6 | 6944900 | 385539 | 787.66 | DSP-6A | VW24850 | 769.56 | 2013-04-05 | Monthly |
| | | | | | DSP-6B | VW24852 | 765.56 | | |
| Dry Stack Tailings Storage Facility | DSP-7 | 6944990 | 385390 | 780.404 | DSP-7-1 | VW34657 | 771.404 | 2015-12-09 | Bi-weekly |
| | | | | | DSP-7-2 | VW34658 | 763.404 | 2015-12-09 | Bi-weekly |
| | | | | | DSP-7-3 | VW34659 | 756.404 | 2015-12-09 | Bi-weekly |
| | | | | | DSP-7-4 | VW34660 | 753.404 | 2015-12-09 | Bi-weekly |
| | | | | | DSP-7-5 | VW34661 | 751.404 | 2015-12-09 | Bi-weekly |
| | | | | | DSP-7-6 | VW34662 | 747.404 | 2015-12-09 | Bi-weekly |
| Dry Stack Tailings Storage Facility | DSP-8 | 6945058 | 385872 | 755.548 | DSP-8-1 | VW34663 | 750.548 | 2015-12-10 | Bi-weekly |
| | | | | | DSP-8-2 | VW34664 | 745.548 | 2015-12-10 | Bi-weekly |
| | | | | | DSP-8-3 | VW34665 | 740.548 | 2015-12-10 | Bi-weekly |
| | | | | | DSP-8-4 | VW34666 | 735.458 | 2015-12-10 | Bi-weekly |
| | | | | | DSP-8-5 | VW34667 | 730.458 | 2015-12-10 | Bi-weekly |
| | | | | | DSP-8-6 | VW34668 | 720.458 | 2015-12-10 | Bi-weekly |

| | | | | | | | | | |
|-------------------------------------|--------|------------|-----------|---------|--------|---------|---------|------------|---------|
| Dry Stack Tailings Storage Facility | DSP-10 | 6945223 | 385944 | 724.509 | DSP-10 | VW34617 | 717.209 | 2015-11-27 | Weekly |
| Southwest Waste Dump | SDP-2 | 6944595.06 | 383971.30 | 843.41 | SDP-2A | VW12912 | 843.414 | 2010-01-31 | Monthly |
| | | | | | SDP-2B | VW12911 | 842.714 | | |
| Southwest Waste Dump | SDP-3 | 6944333.87 | 383824.67 | 854.27 | SDP-3A | VW12906 | 854.266 | 2010-01-28 | Monthly |
| | | | | | SDP-3B | VW12907 | 853.566 | | |
| Southwest Waste Dump | SDP-4 | 6944163.62 | 383783.54 | 858.49 | SDP-4A | VW12908 | 858.494 | 2010-01-30 | Monthly |
| | | | | | SDP-4B | VW12909 | 857.794 | | |
| Water Storage Pond | WDP-2 | 6945632 | 386545 | 701.67 | WDP-2 | VW7212 | 701.67 | 2007-11-04 | Monthly |
| Water Storage Pond | WDP-3A | 6945618 | 386498 | 712.62 | WDP-3A | VW7557 | 712.62 | 2007-11-28 | Monthly |
| Water Storage Pond | WDP-3 | 6945609 | 386500 | 712.60 | WDP-3 | VW7202 | 712.60 | 2007-11-12 | Monthly |
| Water Storage Pond | WDP-4 | 6945609 | 386500 | 702.60 | WD -4 | VW7210 | 702.60 | 2007-11-14 | Monthly |
| Water Storage Pond | WDP-5 | 6945605 | 386526 | 712.35 | WDP-5 | VW7204 | 712.35 | 2007-11-20 | Monthly |
| Water Storage Pond | WDP-6 | 6945605 | 386526 | 701.50 | WDP-6 | VW7214 | 701.50 | 2007-11-20 | Monthly |
| Water Storage Pond | WDP-7 | 6945605 | 386526 | 689.20 | WDP-7 | VW7208 | 689.20 | 2007-11-20 | Monthly |
| Water Storage Pond | WDP-8 | 6945554 | 386542 | 693.10 | WDP-8 | VW7200 | 693.10 | 2007-11-18 | Monthly |
| Water Storage Pond | WDP-9 | 6945554 | 386542 | 687.93 | WDP-9 | VW7206 | 687.93 | 2007-11-18 | Monthly |
| Water Storage Pond | WDP-10 | 6945554 | 386542 | 676.17 | WDP-10 | VW7211 | 676.17 | 2007-11-18 | Monthly |
| Water Storage Pond | WDP-11 | 6945523 | 386551 | 712.96 | WDP-11 | VW7201 | 712.96 | 2007-11-16 | Monthly |
| Water Storage Pond | WDP-12 | 6945523 | 386551 | 694.64 | WDP-12 | VW7209 | 694.64 | 2007-11-16 | Monthly |
| Water Storage Pond | WDP-13 | 6945533 | 386578 | 684.55 | WDP-13 | VW7205 | 684.55 | 2007-11-07 | Monthly |

7 Instrumentation Procedures and Documentation

Data collection manuals for all monitoring devices are included in Appendix B.

After collection, data is input into a series of spreadsheets and databases used for storing, tracking and interpreting instrumentation data. Instructions for data input are contained in the instrumentation manuals in Appendix B.

8 Quality Assurance/Quality Control

Planned job observations (PJO's) are routinely performed and documented on Mine Technician Assistants to verify data collection is consistent with the designed procedures.

Data collection equipment is returned to the manufacturers as per their recommended calibration schedules, typically annually.

All data is reviewed and summarized by the Geotechnical Engineer/EIT monthly as part of the Water Licence reporting.

9 Reporting

Regular processing and review of monitoring data is completed and presented in the following documents.

Table 9: Reporting

| Report | Frequency | Submission |
|---|---|---|
| Pit Wall Inspection Reports | Weekly | Submitted internally each week |
| Minto Mine Type A Water Licence QZ14-031 Monthly Report (Clause 4.4) | Monthly | Submitted to Yukon Water Board maximum 30 days following each month |
| DSTSF Inspection Reports | Monthly | Filed internally within one week of the inspection |
| Water Storage Pond Dam Inspection Reports | Monthly | Filed internally within one week of the inspection |
| Area 2 and Main Pit Tailings Storage Facility Inspection Reports | Quarterly | Filed internally within one month of the inspection |
| Semi-Annual Site-wide Geotechnical Inspection Report | After spring melt (May/June) and before freeze-up (September) | Submitted to Yukon Water Board within 60 days of inspection. |
| Minto Mine Type A Water Licence QZ14-031 Annual Report (Clause 4.5) | Annually | Submitted to Yukon Water Board by March 31 each year |
| Minto Mine Type B Water Licence MS15-094 Annual Inspection Report (Clause 34) | Annually | Submitted to Yukon Water Board with the Annual Report |

Appendix A: Instrumentation Map

Appendix B: Data Collection and Input Manuals

Inclinometer Measurements

Please refer to RST MEMS Digital Inclinometer System Instruction Manual for complete instruction.

System Overview:



Figure 1 – System Overview

1. Soft Shell Case
2. Digital Inclinometer Probe (w/ protective end cap)
3. Reel Battery Charger
4. 70mm/2.75" OD Cable Grip
5. 85mm/3.34" OD Cable Grip
6. Ultra-Rugged Field PC
7. 12V DC car adapter for Reel Battery Charger or Ultra-Rugged Field PC
8. Spare Reel Battery
9. Silicone Lubricant (for use on connectors)
10. USB Cable for Ultra-Rugged Field PC
11. AC Adapter (110-240V) for Reel Battery Charger
12. AC Adapter (110-240V) for Ultra-Rugged Field PC
13. Cable Reel with Wireless Communication System and protective end cap
14. Reel Carrying Case

1. Make sure the battery for the reel and the Field PC are charged.
2. Lift up protective box with two hands and put it on side as a work bench.



3. Remove cap from inclinometer casing and look for A_0 marking (black mark).



4. Remove excess water inside the probe and the cable connector.
Probe is very sensitive and susceptible to vibration. **DO NOT BANG THE PROBE.** Use a paper towel to wipe it.
5. Apply silicon lubricant to probe and cable connector when needed.



6. Connect the inclinometer cable to the probe by aligning the keyways and threading the connector onto the probe. Turn the threaded ring, but not the cable.



7. Turn on the power of the reel. A green light indicates that the power is on. This energizes the accelerometers and makes them less susceptible to shock.



8. Check the depth of the hole. Turn on Field PC and select the hole you are going to measure.



9. Always start with **UPPER** Wheel in the A_0 direction.



10. Lower the probe gently and carefully. When it gets close to the bottom lower it very gently to avoid bouncing the probe off the bottom of the hole. The cable has aluminum sleeve marks which are spaced at 0.5m and it has a red measure mark with label every 5m.



11. Lower the probe gently to ensure the bottom of the hole is encountered. (Slightly passed the designated depth). Double check your correct depth by pulling out reel to the next 5m mark and counting back each 0.5m for each increment.
12. Place the cable grip on top of the casing and hang the cable by the aluminum crimps.



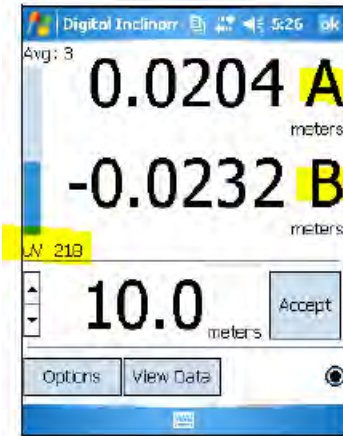
13. Connect the Field PC to the reel. Use the pen attached to the field PC and press "Connections".



14. Once connected, hit "Readings".



15. At each depth allow the A and B readings as well as the noise level become stabilized before you accept the readings. Ideally noise level should be at or below 30 μ V.

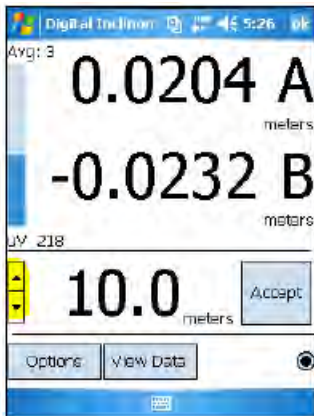


16. Wear gloves as the Envirobind inside the inclinometer casing can be sticky and irritable. Pull up gently to the next marker and let the aluminum crimp to sit on the metal grip. Wait for the readings and noise level to stabilize and then hit "Accept".



17. If you accidentally pull the probe too far (more than an inch), lower the probe back down to the previous bead then pull up to the bead you want to measure. This will ensure that the readings remain consistent.

18. At each 5m mark, check that you are at the right location. If you miss or overpass a reading, go back to the previous 5m depth. For examples, if something goes wrong at 41.5m, go back to 45m and drop the cable to 45.5m. Then gently pull up to 45m and hit "Accept" again. There are arrow keys on the Field PC which allow you to adjust your depth.



19. Once the last reading (0.5m) is taken, gently take out the probe and turn it 180° so that the **Lower** wheel



is now in the A_0 direction.

20. Go back gently to the bottom of hole and take the second set of readings.

21. During the measurement of the second set of readings, checksum data will appear in a smaller font below the current readings. Checksum should be reasonably small and consistent. Ideally it should be somewhere between -0.0035m to +0.0045m.

22. If the checksum is large ($> 0.01\text{m}$) and inconsistent, check the following:
 - Is the probe at the right depth?
 - Is the probe in the correct direction?
 - Lower the probe to the previous depth and retake the reading again.

It is possible that checksum is high due to differential pressure in the ground. In that case continue measurement and keep monitoring checksum.

23. Once readings are completed, take out the probe and wipe away the Envirobind gently. Put the caps back onto the probe and connector.



Data Input

Note: Windows Mobile Device Center must be installed on the computer in order to collect the readout unit to the computer.



1. Connect the USB cable from the readout unit to the computer and turn the power on.
2. Open DMM for Windows



3. *File – Open – Project Database*

The database for all inclinometer data is stored here:

<X:\Mine Technical\03 - Monitoring\! Inclinometers\Master Database>

4. *File – Import – Import RPP file*

Navigate to the mobile device and select the .rpp file for the appropriate monitoring station and date. The data will then import and save in the database automatically.

Thermistor Readings

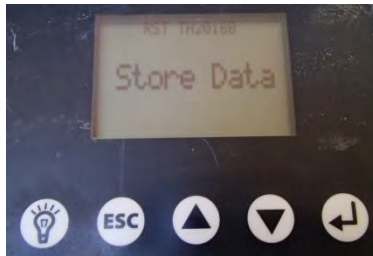
Two different types of thermistors are currently installed on site – RST and EBA thermistors.

To read RST thermistors:

1. Connect adapter cord to the TH2016B Readout Box.
2. Record the resistivity (Ohms) for each thermistor node on paper or store the data in the readout box with the following steps:
 - a. Scroll with the Up/Down arrows to the **Memory** screen and press enter (arrow key)



- b. Scroll with the Up/Down arrows to the **Store Data** screen and press enter



- c. Scroll with the Up/Down arrows to the station being monitored and press enter to store the reading



- d. The data is now stored and the readbox can be turned off by pressing the escape button (ESC) three times to get back to the main menu and scrolling to Power Off.



To read EBA thermistors:

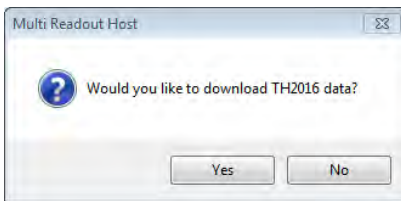
1. Connect the EBA 16 Point Ground Temperature Dial into the thermistor cable.
2. Connect the multi-meter to the EBA 16 Point Ground Temperature Dial.
3. Record on paper the resistance in Ohm's (Ω) for each point.

Data Downloading

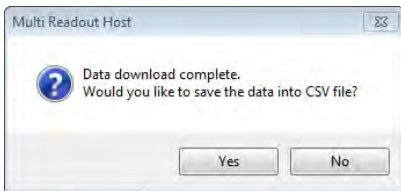
1. Connect USB cord from computer to the readout box.
2. Open the software Multi Readout Host.



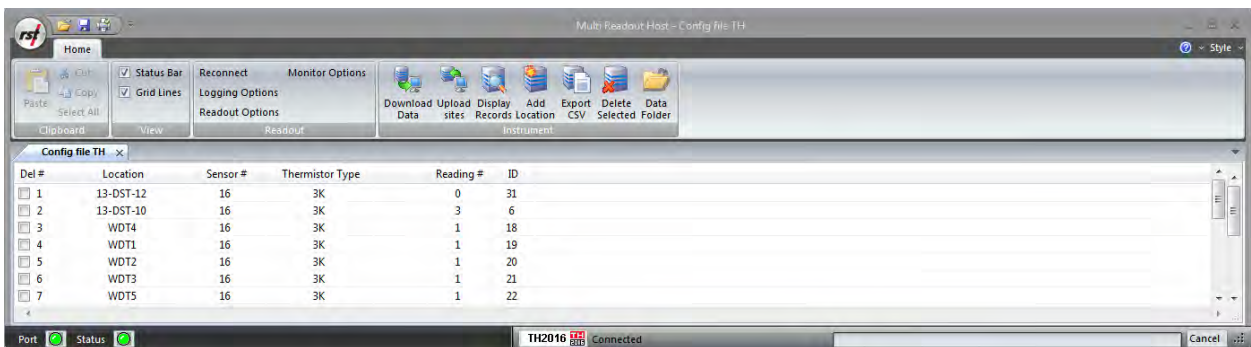
3. Turn on the power on the readout box.
4. The software will recognize the readout unit and prompt to download data. Choose "Yes" to download the data from the readout unit.



5. Once data is downloaded you will have the option to save all data as .csv file. Choose "Yes" and the data will be stored in My Documents in a folder named "TH2016data".



6. The software can be used to setup new locations or view data but no further steps are required.

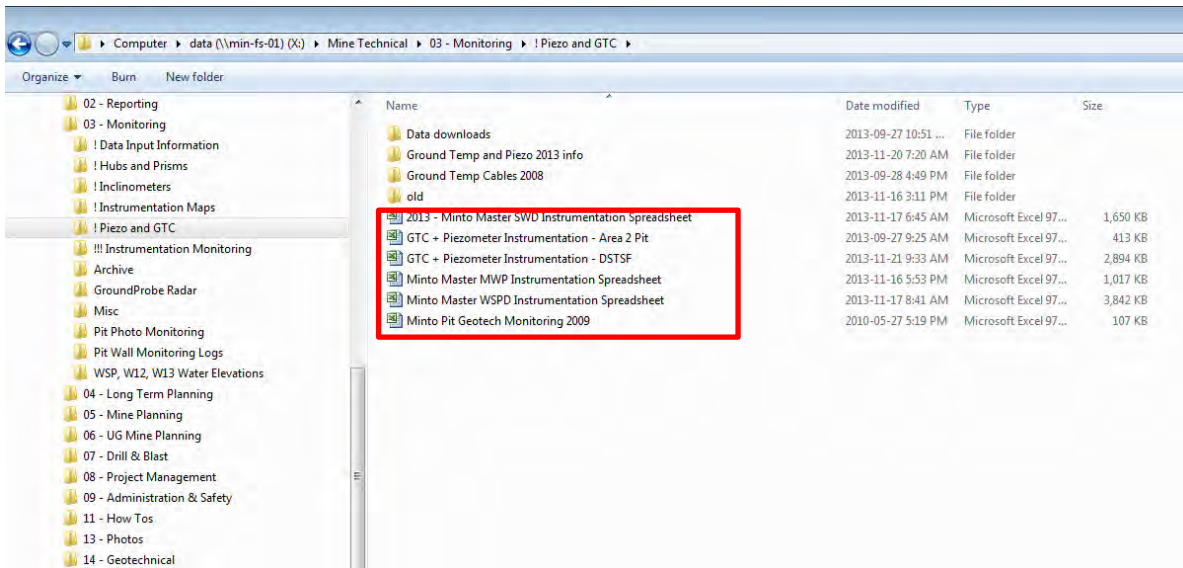


Data Input

Spreadsheets for piezometer data input and tracking are stored here:

X:\Mine Technical\03 - Monitoring\! Piezo and GTC

1. Open the spreadsheet for the area monitored



2. Open the tab "GTC Readings"



- In a new column enter the date and copy the resistivity data (Ohms) from the paper records, or from the .csv file saved in either "TH2016data" or "VW2016data" saved in My Documents.

| WDT-3 | | | | | | | | | | | | |
|-------|---------|-----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-------|-----------|--|
| Date | BeadNo. | 15-Sep-11 | 5-Oct-11 | 24-Nov-11 | 28-Feb-12 | 27-Mar-12 | 11-Apr-12 | 18-Apr-12 | 14-May-12 | ##### | 14-Jul-12 | |
| 1 | 9.71 | 10.24 | 12.55 | 13.73 | 14.00 | 14.11 | 14.15 | 14.17 | 11.30 | 9.77 | | |
| 2 | 10.55 | 10.86 | 12.59 | 13.68 | 13.87 | 13.95 | 13.98 | 14.04 | 12.57 | 10.84 | | |
| 3 | 11.03 | 11.11 | 12.53 | 13.71 | 13.90 | 13.98 | 14.01 | 14.08 | 13.66 | 11.99 | | |
| 4 | 11.38 | 11.26 | 12.36 | 13.61 | 13.80 | 13.89 | 13.93 | 14.02 | 13.89 | 12.58 | | |
| 5 | 11.99 | 11.71 | 12.39 | 13.55 | 13.75 | 13.84 | 13.87 | 13.97 | 13.97 | 13.16 | | |
| 6 | 12.49 | 12.16 | 12.50 | 13.50 | 13.69 | 13.78 | 13.81 | 13.91 | 13.96 | 13.49 | | |
| 7 | 13.05 | 12.70 | 12.69 | 13.49 | 13.67 | 13.75 | 13.79 | 13.89 | 13.97 | 13.78 | | |
| 8 | 13.38 | 13.10 | 12.88 | 13.45 | 13.61 | 13.69 | 13.72 | 13.82 | 13.90 | 13.87 | | |
| 9 | 13.57 | 13.40 | 13.15 | 13.50 | 13.63 | 13.69 | 13.71 | 13.80 | 13.86 | 13.89 | | |
| 10 | 13.67 | 13.61 | 13.42 | 13.58 | 13.66 | 13.70 | 13.73 | 13.79 | 13.84 | 13.89 | | |
| 11 | 13.66 | 13.66 | 13.55 | 13.58 | 13.63 | 13.66 | 13.67 | 13.72 | 13.76 | 13.81 | | |
| 12 | 13.68 | 13.70 | 13.66 | 13.63 | 13.66 | 13.68 | 13.68 | 13.72 | 13.75 | 13.79 | | |
| 13 | 13.74 | 13.77 | 13.77 | 13.71 | 13.71 | 13.72 | 13.72 | 13.74 | 13.77 | 13.80 | | |
| 14 | 13.87 | 13.89 | 13.90 | 13.83 | 13.82 | 13.83 | 13.83 | 13.85 | 13.87 | 13.90 | | |
| 15 | 13.95 | 13.96 | 13.94 | 13.88 | 13.87 | 13.88 | 13.88 | 13.90 | 13.92 | 13.95 | | |
| 16 | 13.99 | 13.99 | 13.92 | 13.87 | 13.88 | 13.88 | 13.89 | 13.91 | 13.94 | 13.97 | | |

Vibrating Wire Piezometer Readings

1. Connect adapter cord to the VW2106 Readout Box.
2. Connect the coloured wires to the correct wire clips on the extension cable. Make sure the wires do not touch each other.
3. Record the **DATE** and **TIME** as barometric pressure will be needed to calibrate the water level.
4. Record the measurement (between 7000B to 9000B) and the temperature (°C) for each piezometer. The piezometer ID should be labeled on the wire (eg. P5a and P5b).



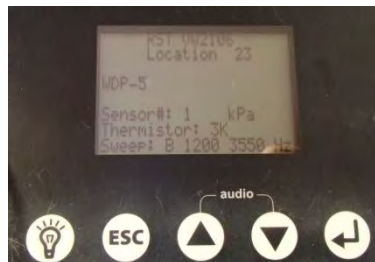
5. Alternatively the data can be stored in the readout box:
 - a. Scroll with the Up/Down arrows to the **Memory** screen and press enter (arrow key)



- b. Scroll with the Up/Down arrows to the **Store Data** screen and press enter



- c. Scroll with the Up/Down arrows to the station being monitored and press enter to store the reading



- d. The data is now stored and the readout box can be turned off by pressing the escape button (ESC) three times to get back to the main menu and scrolling to Power Off.

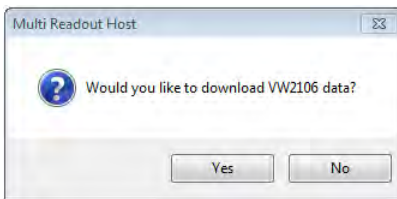


Data Downloading

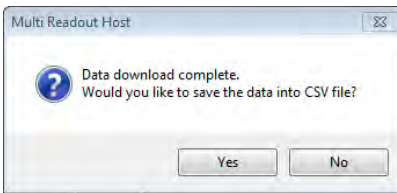
7. Connect USB cord from computer to the readout box.
8. Open the software Multi Readout Host.



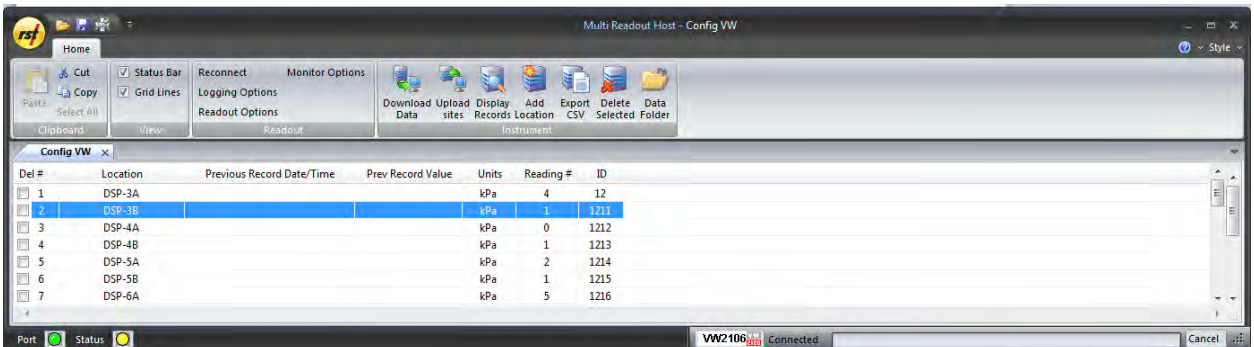
9. Turn on the power on the readout box.
10. The software will recognize the readout unit and prompt to download data. Choose "Yes" to download the data from the readout unit.



11. Once data is downloaded you will have the option to save all data as .csv file. Choose "Yes" and the data will be stored in My Documents in a folder named "VW2016data".



12. The software can be used to setup new locations or view data but no further steps are required.

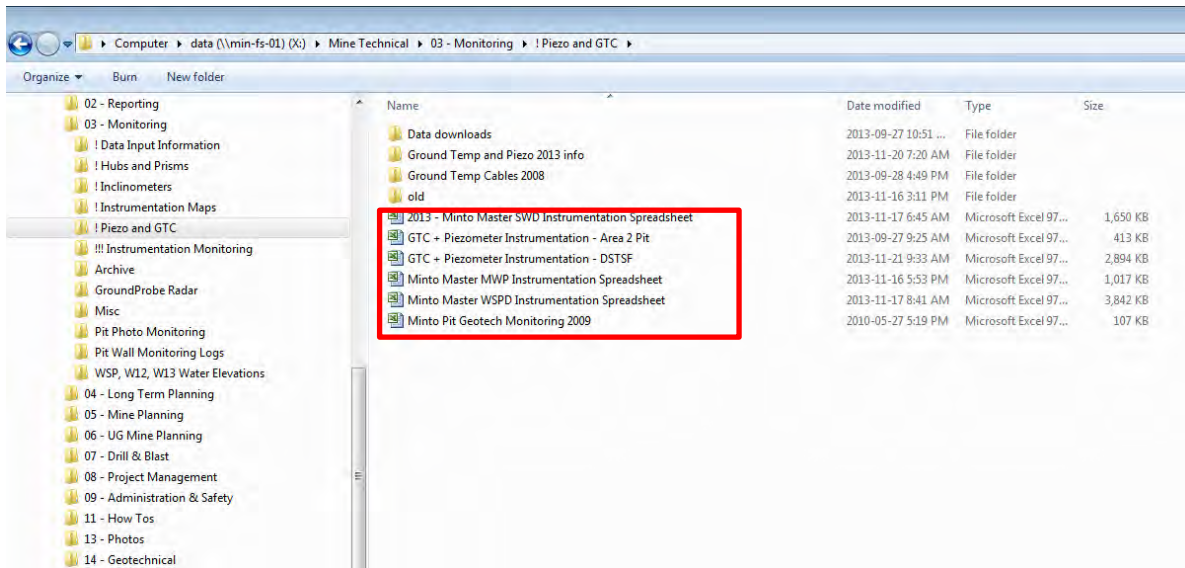


Data Input

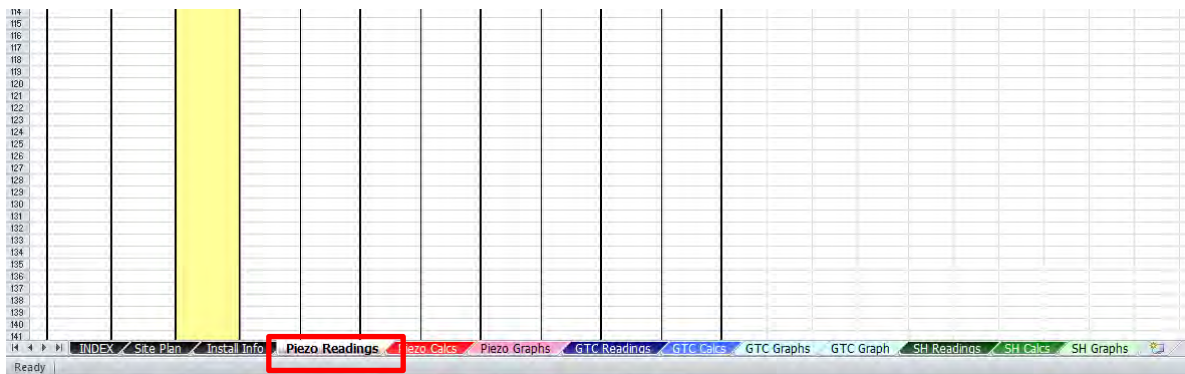
Spreadsheets for piezometer data input and tracking are stored here:

X:\Mine Technical\03 - Monitoring\! Piezo and GTC

4. Open the spreadsheet for the area monitored



5. Open the tab "Piezo Readings"



- In a new row, input the date, time, barometric pressure, B-unit and temperature readings for each instrument.

MINTO MINE: DRY STACK TAILINGS STORAGE FACILITY

Tab Use Instructions:
 1. Enter Date
 2. Enter Time
 3. Enter Reading (B) and Temp Reading (C) to corresponding piezo.
 4. Enter Barometer Reading

Note:
 Barometer readings obtained from VW Piezometer readings obtained
 RED indicates assumed values (re
 Grey row highlight indicates begin
 #N/A indicates a missing reading

| DATE | TIME | BAROMETER READING (kPa) | DSP-5A | | DSP-5B | | DSP-6A | | DSP-6B | |
|-------------|-------|-------------------------|-------------|-------------------|-------------|-------------------|-------------|-------------------|-------------|-------------------|
| | | | Reading (B) | Temp. Reading (C) | Reading (B) | Temp. Reading (C) | Reading (B) | Temp. Reading (C) | Reading (B) | Temp. Reading (C) |
| 2013-Apr-08 | 21:30 | 89.00 | | | | | 8938 | -0.8 | 9008.3 | 0 |
| 2013-Apr-16 | 6:15 | 89.00 | 8137.6 | -0.7 | 7709.1 | -0.1 | 8921.5 | 0.4 | 8998.7 | -0.2 |
| 2013-Apr-26 | 17:00 | 87.80 | 8333.9 | -0.8 | 7569.1 | -0.3 | 8939.3 | -0.2 | 9028.8 | -0.7 |
| 2013-Apr-27 | 13:30 | 89.20 | | | | | 8936.1 | -0.3 | 9023.7 | -0.2 |
| 2013-Apr-28 | 10:00 | 89.10 | 8334.8 | -0.9 | 7581.5 | -0.4 | 8931.5 | -0.1 | 9017.2 | -0.5 |
| 2013-Apr-30 | 10:30 | 89.00 | 8355.2 | -0.9 | 7597 | -0.4 | 8932.8 | -0.4 | 9016.7 | -1.3 |
| 2013-May-16 | 12:00 | 89.50 | 8388.2 | -0.9 | 7585.5 | -0.5 | 8936.3 | -0.3 | 9024.7 | -0.4 |
| 2013-Jun-17 | 12:00 | 89.50 | | | | | 8917.1 | -0.3 | 9013 | -0.6 |
| 2013-Jun-18 | 12:00 | 89.50 | 8410.8 | -0.9 | 7576.7 | -0.5 | | | | |
| 2013-Jul-10 | 12:00 | 89.50 | | | | | 8921.9 | -0.2 | 9021 | -0.6 |

Barometric pressure can be obtained from the site’s weather monitoring stations. Data is stored here:

X:\Environmental\Environmental Monitoring Program\1 MASTER LOGS\Meteorology Station Data\Met Station 1 and 2 Data Summary.xlsx

Appendix H – 2017 AMP Groundwater SRK Memo

Memo

| | | | |
|-----------------|---|--------------------|-------------------------|
| To: | Ryan Herbert, Minto Explorations Ltd. | Client: | Minto Explorations Ltd. |
| From: | Dan Mackie, PGeo Ryan Burgess, MSc | Project No: | 1CM002.057 |
| Cc: | | Date: | January 31, 2018 |
| Subject: | Minto Mine – Summary of 2017 Groundwater OAMP SPT Exceedances | | |

1 Purpose

Groundwater monitoring at the Minto Mine, Yukon, is conducted and reviewed through the Minto Mine Groundwater Monitoring Plan (Minto, 2016) and the Operational Adaptive Management Plan (OAMP; Minto, 2017). The purpose of this memo is to summarize groundwater quality (and locations) at Minto that have exceeded a specific performance threshold (SPT) of the OAMP in 2017.

2 Background

The groundwater monitoring network at Minto includes 10 active multi-level monitoring wells that have been installed between 2009 and 2017. The monitoring wells are located across the site, both outside of the current mining footprint and topographically (and hydraulically) down gradient of mining activities. Monitoring locations are shown on Figure 1. All of these monitoring wells were installed after the start of mining (except MW09-03, which was installed after the main Minto operations began, but before mining at the adjacent Minto North Pit started). Details of groundwater monitoring locations can be found in SRK (2018).

Groundwater monitoring is conducted as required by the Groundwater Monitoring Plan. Review of groundwater monitoring results is carried out as part of the OAMP. In the OAMP, performance thresholds have been defined to establish changes in concentration and concentration values for specific constituents of concern (CoCs) at which actions may need to be taken by Minto to avoid potential impacts to the environment. Specifically, the OAMP states:

Specific Performance Thresholds (SPTs) are defined for each of the Effluent Quality Standards (EQS) parameters identified in Clause 9 (a), Table 1 of Water Use Licence QZ14-031, with the exception of pH, oil and grease, iron and nitrite.

There are three SPT levels for groundwater quality defined in the OAMP for the Minto Creek Catchment, and two for the McGinty Creek Catchment. Of the 10 multi-port monitoring wells active in the monitoring network, only three are compared to the SPT in the AMP. They are MW12-05 and MW12-06 (Minto Creek Catchment), and MW09-03 (McGinty Creek Catchment). All three of these monitoring wells are located hydraulically or topographically down gradient of certain mine components:

- MW09-03 – topographically down gradient of the Minto North Pit in the McGinty Creek catchment;
- MW12-06 – hydraulically and/or topographically down gradient of the Main and Area 2 open pits, DSTSF and MVFE, in the Minto Creek catchment;
- MW12-05 – hydraulically and topographically down gradient of all mine activities in the Minto Creek catchment.

Attachment 1 provides table of SPT threshold concentrations. SPTs for each catchment are summarized below:

Minto Creek Catchment

1. SPT-1 corresponds to a trend-based assessment designed to flag potential rapidly-increasing groundwater concentrations that have not yet exceeded concentration-based thresholds.
2. SPT-2 generally corresponds to the EQS concentrations defined in the OAMP (with four exceptions: Cr-D, Cu-D, Ni-D and sulphate).
3. SPT-3 generally corresponds to the estimated concentrations in groundwater that would be necessary to cause exceedance of the Water Quality Objectives in lower Minto Creek under long term steady state conditions.

McGinty Creek Catchment

1. SPT-1 is triggered when there are three consecutive exceedances of the 75th percentile background level in a single monitoring port.
2. SPT-2 is triggered when there are three consecutive exceedances of the 95th percentile background level in a single monitoring port.

Groundwater monitoring results are reviewed monthly and, if a SPT is reached or exceeded, data are reviewed, interpretations are made, the risk narrative is assessed (in terms of the receiving environment), and management actions are defined. If an OAMP SPT has not been reached for any parameter at any location, no further action is taken on the assumption that there has been no change of significance from defined baseline conditions. Monthly OAMP reports are provided to the Yukon Government as per the OAMP.

3 Groundwater AMP SPT Events

Table 1 and Table 2 summarize groundwater locations and parameters for which OAMP SPTs have been reached for the 2017 monitoring year. CoCs at any groundwater monitoring location that are not identified in this table are assumed to not have changed by a significant amount relative to established baseline conditions. Baseline groundwater conditions are defined in the OAMP based on data from MW09-03 prior to 2015 (start of Minto North mining).

Groundwater monitoring data for all CoCs are included in Attachment 2.

Table 1 Minto Creek Catchment threshold exceedances

| Monitoring Well Zone | Parameter | SPT | Context |
|----------------------|-----------------|-----|---|
| MW12-05-01 | SO ₄ | 2 | 4 out of 4 samples exceeded threshold concentration |
| MW12-05-02 | | 2 | 4 out of 4 samples exceeded threshold concentration |
| MW12-05-03 | | 1 | Increase in concentration has stabilized |
| MW12-06-01 | Se | 1 | Isolated variation in data resulted in exceedance; see Attachment 2 |
| | As | 1 | Isolated variation in data resulted in exceedance; see Attachment 2 |
| | Cr | 3 | 3 out of 3 samples exceeded threshold concentration |

Table 2 McGinty Creek Catchment threshold exceedances

| Monitoring Well Zone | Parameter | SPT | Context |
|----------------------|-----------------|---|---|
| MW09-03-01 | As | 1 | 9 out of 9 samples exceeded threshold concentration |
| | | 2 | 4 out of 9 samples exceeded threshold concentration |
| | Zn | 1 | 5 out of 9 samples exceeded threshold concentration |
| | | 2 | 3 out of 9 samples exceeded threshold concentration |
| | Mo | 1 | 2 out of 9 samples exceeded threshold concentration |
| Se | 1 | 3 out of 9 samples exceeded threshold concentration | |
| MW09-03-02 | SO ₄ | 1 | 6 out of 9 samples exceeded threshold concentration but concentration is < 5 mg/L |
| | NO ₃ | 2 | 9 out of 9 samples exceeded threshold concentration |
| | Cd | 1 | 5 out of 9 samples exceeded threshold concentration |
| | Zn | 1 | 8 out of 9 samples exceeded threshold concentration |
| | Zn | 2 | 7 out of 9 samples exceeded threshold concentration |

4 Discussion

Monitoring results for CoCs are routinely reviewed to provide context on potential impacts of mining activities to groundwater. Groundwater SPT exceedances (events) have occurred for a limited number of parameters and do not necessarily correlate with distance from mining activities (i.e., events have not necessarily all occurred at monitoring wells in relatively close proximity to mining activities). Some of these events may reflect elevated background concentrations that were not identified prior to start of mining because monitoring wells were not in place at that time.

Ongoing events are addressed specifically as follows:

- Sulphate SPT events in MW12-05 have been restricted to the deeper zones (MW12-05-01, MW12-05-02, and MW12-05-03) which monitor depths greater than 85 meters below ground surface (m bgs). Recently, the MW12-05-03 sulphate trend appears to have stabilised at a concentration below that of Minto Creek catchment SPT-2. The sulphate trend at MW12-05-01 continues to increase, but at a slower rate than previously. This may suggest that Zone 1 may be approaching equilibrium with groundwater. Zones shallower than Zone 3 all record stable and far lower sulphate concentrations (<100 mg/L). Surface water stations in the Minto Creek catchment downstream of the mine footprint (e.g. MC1) display stable trends in sulphate at similar concentrations to those observed in the shallow zones at MW12-05 (SRK, 2018).
- Nitrate at MW09-03-02 has increased recently, and has exceeded the McGinty Creek SPT-2. The nitrate concentration of the deeper zone, MW09-03-01, remains stable and below both SPTs. Presently, the Minto North Pit acts as a hydraulic sink, capturing (locally) groundwater topographically downgradient (including MW09-03). Therefore, migration of pit water is not the cause of the nitrate increase observed at MW09-03-02. The likely explanation for the observed water quality at MW09-03 is flushing of blasting residuals from the rock used to construct the mine haul road on the topographically downgradient side of the Minto North Pit, and immediately adjacent to the monitoring well. This effect is expected to be relatively short-lived, as blasting residuals will flush out over time. Data from the nearest McGinty Creek surface water monitoring station (MN-1.5) indicate nitrate concentrations remain within the range observed during baseline monitoring (SRK, 2018).
- As with nitrate, since the Minto North Pit is acting as a hydraulic sink, the other SPT events at MW09-03 (As, Cd, Se, Mo, sulphate, and Zn) are also likely to be caused by flushing of the rock used to construct the mine haul road. The concentration of these parameters at MN-1.5 are within pre-mining conditions, indicating no identifiable impact from SPT events.
- Events occurring at MW12-06-01 (As, Se and Cr) are likely caused by parameter concentrations that are reflective of background concentrations. MW12-06-01 was not sampled prior to October 2016, and only sampled four times in total since. In addition, the data are rather scattered (As and Se) or display a possible decreasing trend (Cr). Further regular sampling, as per the OAMP, will provide further information to assess changes over time.

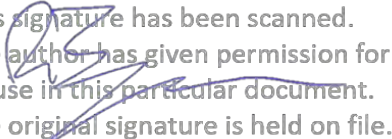
5 Conclusions

Groundwater exceedances of the OAMP SPTs in 2017 have been limited. SPT exceedance is not widespread; most wells (~70%) did not exceed OAMP SPTs in 2017.


Where regular exceedances have been identified (As and Zn at MW09-03-01; Cd, Zn, nitrate, and sulphate at MW09-03-02; sulphate at MW12-05-01; Cr at MW12-06-01), the likely cause is either a lack of characterization or the range of pre-mining groundwater concentrations (MW12-05-01 and MW12-06-01), or local, temporary mine-related sources of CoCs (i.e., apparent influence of the haul road rock on groundwater in the MW09-03 zones).

Overall, the groundwater CoC exceedances of the OAMP SPTs have not required mitigation. Groundwater monitoring should continue as per the Minto Mine Groundwater Monitoring Plan, and results should continue to be evaluated against the Operational Adaptive Management Plan SPTs and compared with other studies assessing natural background conditions.

Regards,
SRK Consulting (Canada) Inc.


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The original signature is held on file.

Ryan Burgess, MSc.
Consultant


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Dan Mackie, PGeo
Principal Consultant

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

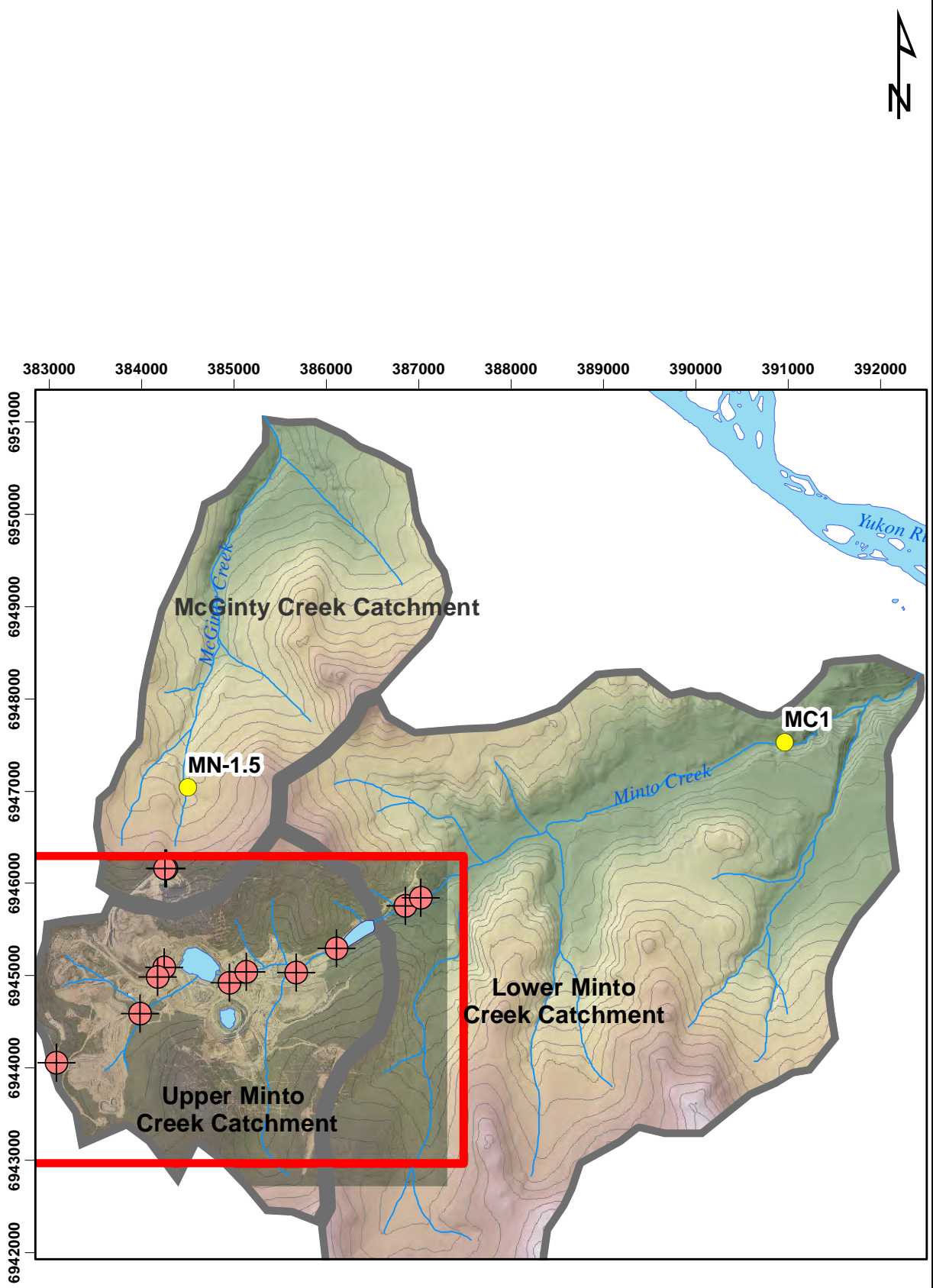
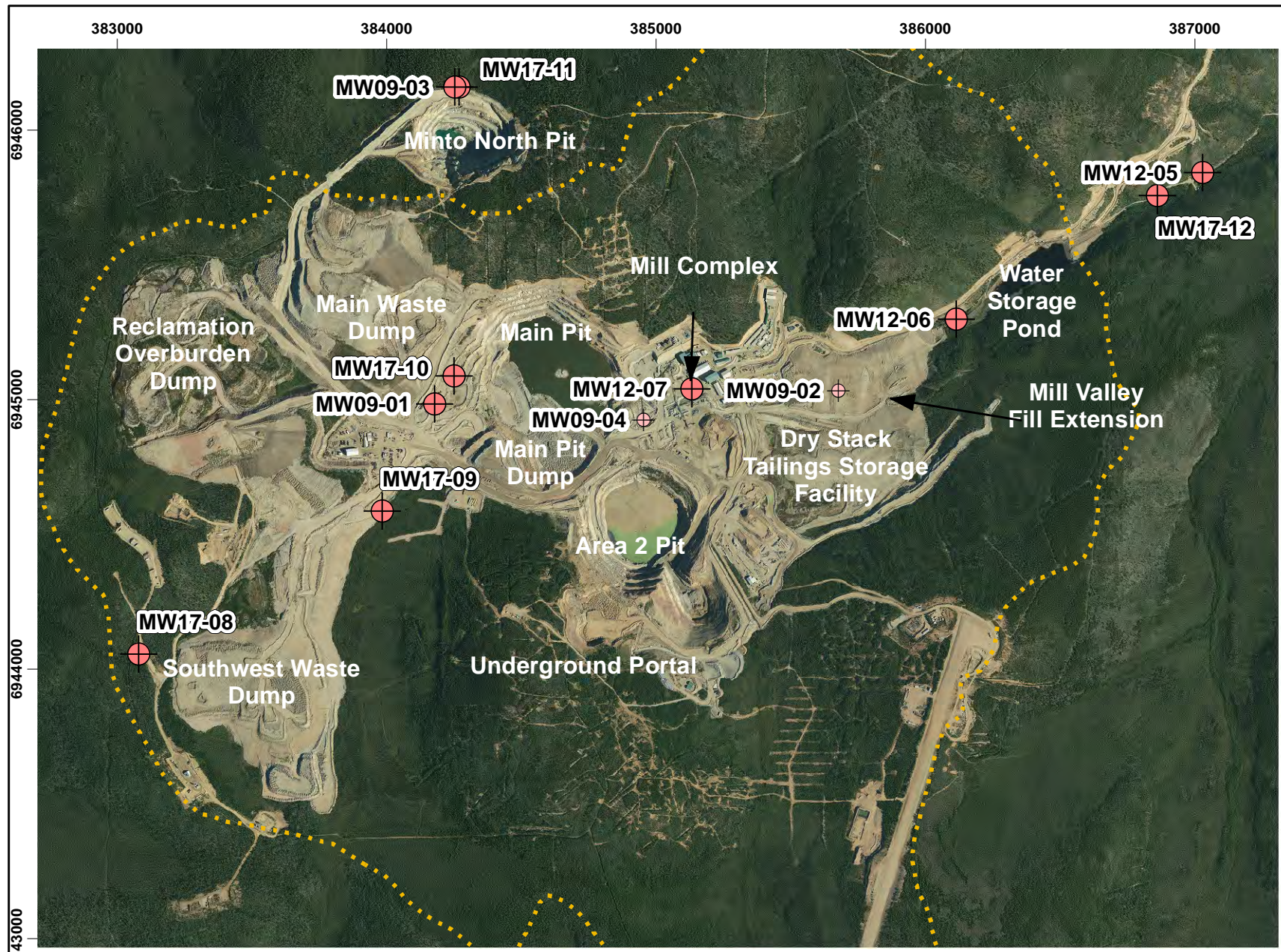
6 References

Minto Explorations Ltd., 2016. Minto Mine Groundwater Monitoring Plan, Version 2016-01. Report prepared by Minto Explorations Limited, with contributions from SRK Consulting. July 2016.

Minto Explorations Ltd., 2017. Minto Mine Operations Adaptive Management Plan 2017-02. April 2017.

SRK Consulting (Canada) Inc., 2018. Minto Groundwater Characterization and Hydrogeologic Conceptual Model Update Report. Report submitted to Minto Explorations Ltd. SRK project number 1CM002.057. January 2018. 35 pages.

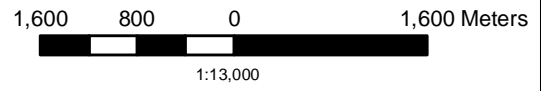
Figures



Legend

- Streams
- Elevation Contours 20m
- Upper Minto Creek Catchment
- MP Monitoring Wells
- Surface Water Stations
- Topography (masl)**
 - High : 1020
 - Low : 650

Notes:
 1. Data presented in NAD 1983 UTM Zone 8N.
 2. Topography provided by Minto Mine, 2017.
 3. Base orthophoto provided by Minto Mine, 2017.



srk consulting | **capstone** | **MINTO MINE**
 OPERATED BY MINTO EXPLORATIONS LTD.

Job No: 1CM002.057
 Filename: Monitoring_Sites_rev01_rob.mxd

Summary of 2017 Groundwater OAMP SPT Exceedances

Groundwater Monitoring Stations

MINTO MINE | Date: January 2018 | Approved: ROB | Figure: **1**

I:\enviro\Projects\101_Sites\Minto\1CM002.057_Enviro_Tracer_Trategy\080_Deliverables\Groundwater\Quality_Summary\Figures

Attachment 1: SPT Threshold Concentrations

Appendix A

Minto Creek SPTs

| | Ag-D | Al-D | As-D | Cd-D | Cr-D | Cu-D | Pb-D | Mo-D | Ni-D | Se-D | Zn-D | N-NO3 | Ammonia | Sulphate |
|-------|---------|------|-------|-------|--------|-------|-------|------|-------|--------|-------|-------|---------|----------|
| | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| SPT-2 | 0.00030 | 0.30 | 0.015 | 0.003 | 0.0015 | 0.030 | 0.012 | 0.22 | 0.165 | 0.0060 | 0.090 | 27 | 0.75 | 1000 |
| SPT-3 | 0.00046 | 0.48 | 0.025 | 0.006 | 0.0030 | 0.060 | 0.020 | 0.34 | 0.34 | 0.0093 | 0.13 | 45 | 1.0 | 4951 |

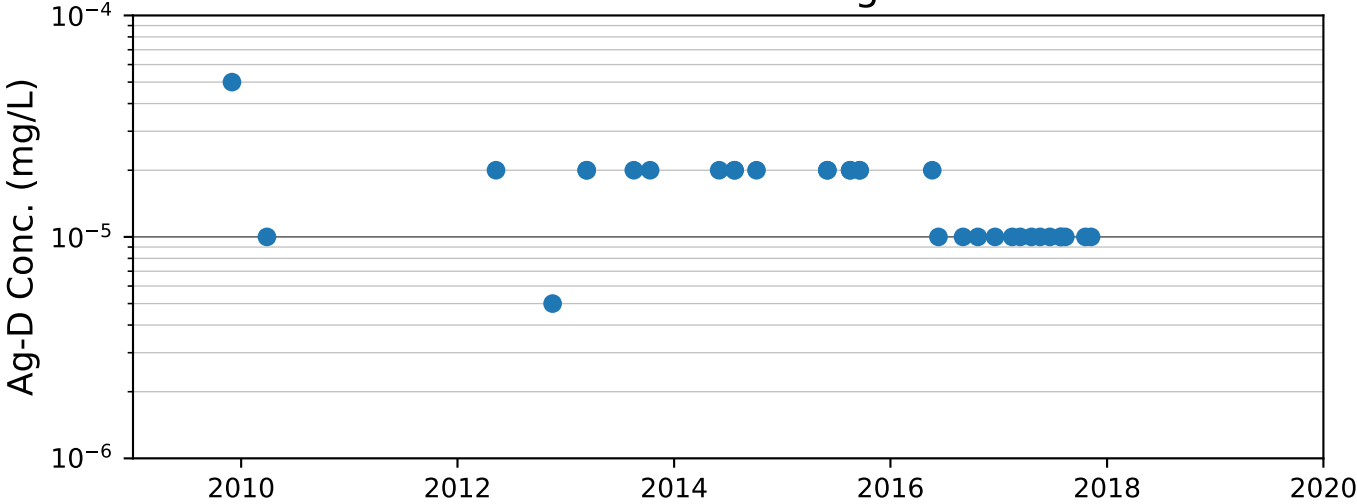
McGinty Creek SPTs

| | | Ag-D | Al-D | As-D | Cd-D | Cr-D | Cu-D | Pb-D | Mo-D | Ni-D | Se-D | Zn-D | N-NO3 | Ammonia | Sulphate |
|------------|-------|----------|--------|---------|----------|----------|---------|--------|-------|--------|--------|-------|-------|---------|----------|
| | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| MW09-03-01 | SPT-1 | 0.000010 | 0.0065 | 0.00011 | 0.000075 | 0.000500 | 0.00155 | 0.0001 | 0.005 | 0.0021 | 0.0001 | 0.013 | 0.13 | 0.067 | 24 |
| | SPT-2 | 0.000016 | 0.0101 | 0.00081 | 0.000272 | 0.000575 | 0.00625 | 0.0003 | 0.026 | 0.0060 | 0.0015 | 0.022 | 0.28 | 0.133 | 38 |
| MW09-03-02 | SPT-1 | 0.000018 | 0.0073 | 0.00074 | 0.000031 | 0.000500 | 0.00263 | 0.0001 | 0.018 | 0.0009 | 0.0005 | 0.010 | 0.03 | 0.230 | 7 |
| | SPT-2 | 0.000034 | 0.0095 | 0.00092 | 0.000272 | 0.000796 | 0.01080 | 0.0002 | 0.062 | 0.0026 | 0.0040 | 0.015 | 0.07 | 0.282 | 67 |
| MW09-03-03 | SPT-1 | 0.000010 | 0.0047 | 0.00005 | 0.000023 | 0.000500 | 0.00247 | 0.0001 | 0.006 | 0.0005 | 0.0004 | 0.008 | 0.50 | 0.020 | 12 |
| | SPT-2 | 0.000010 | 0.0075 | 0.00014 | 0.000069 | 0.000500 | 0.00500 | 0.0003 | 0.018 | 0.0011 | 0.0004 | 0.011 | 0.54 | 0.058 | 13 |

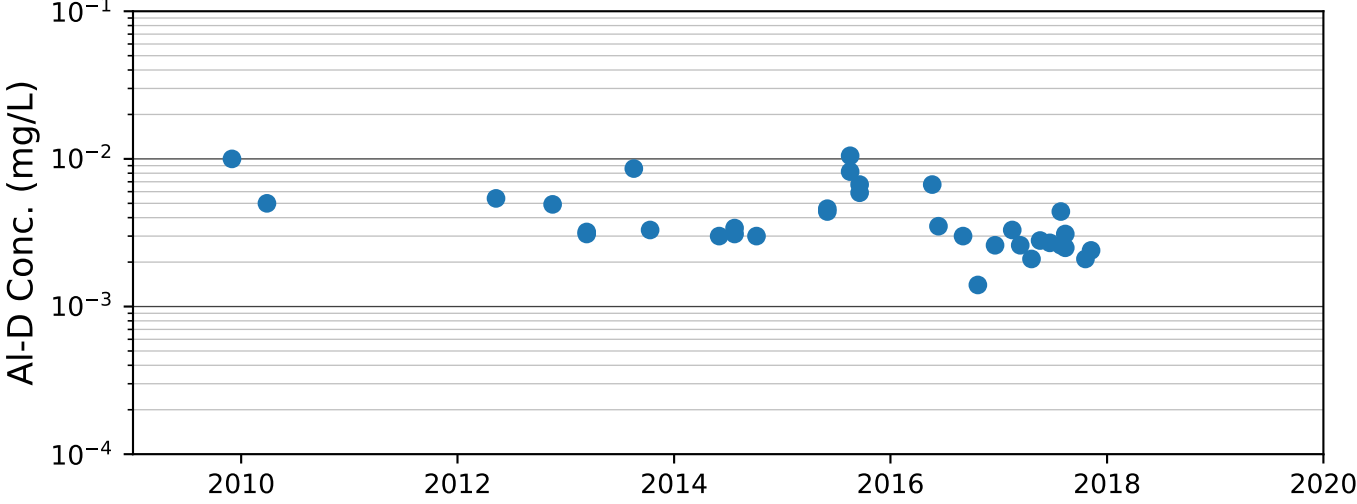
Source: Minto 2017-02 OAMP, pages 21 and 25 (Minto, 2017)

Attachment 2: Groundwater Monitoring Data for All CoCs

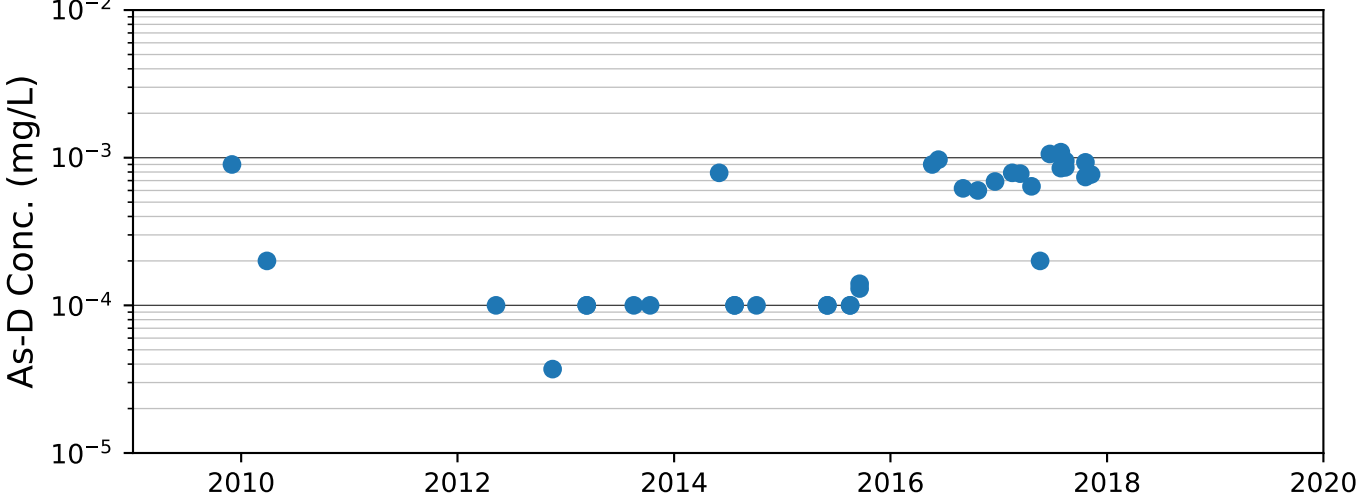
MW09-03-01 - Ag-D

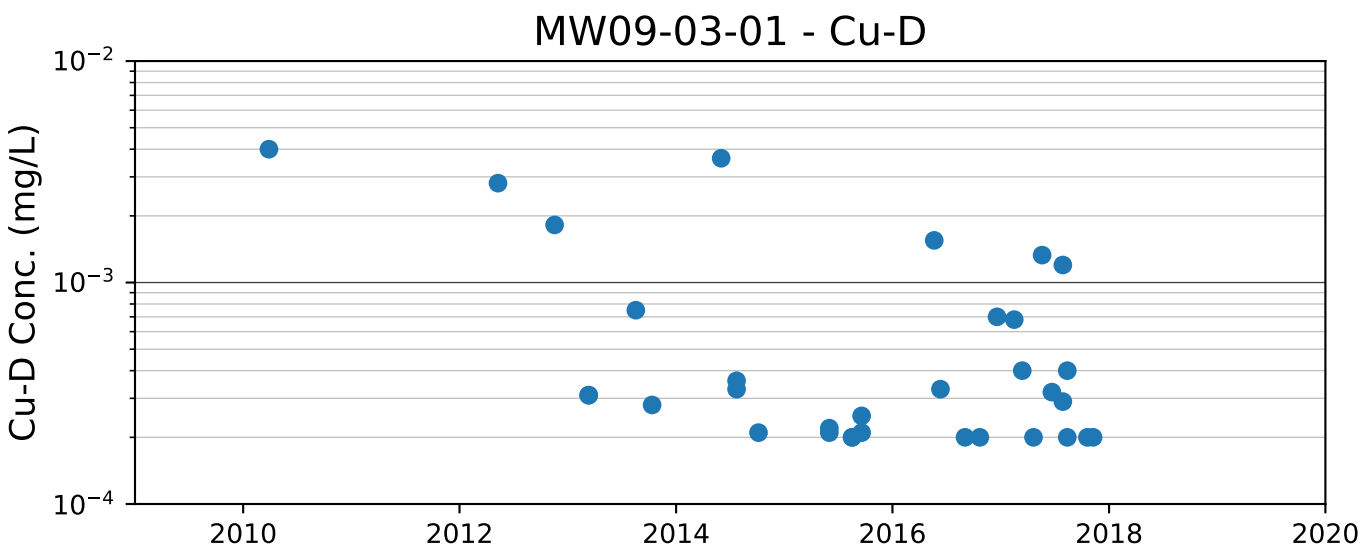
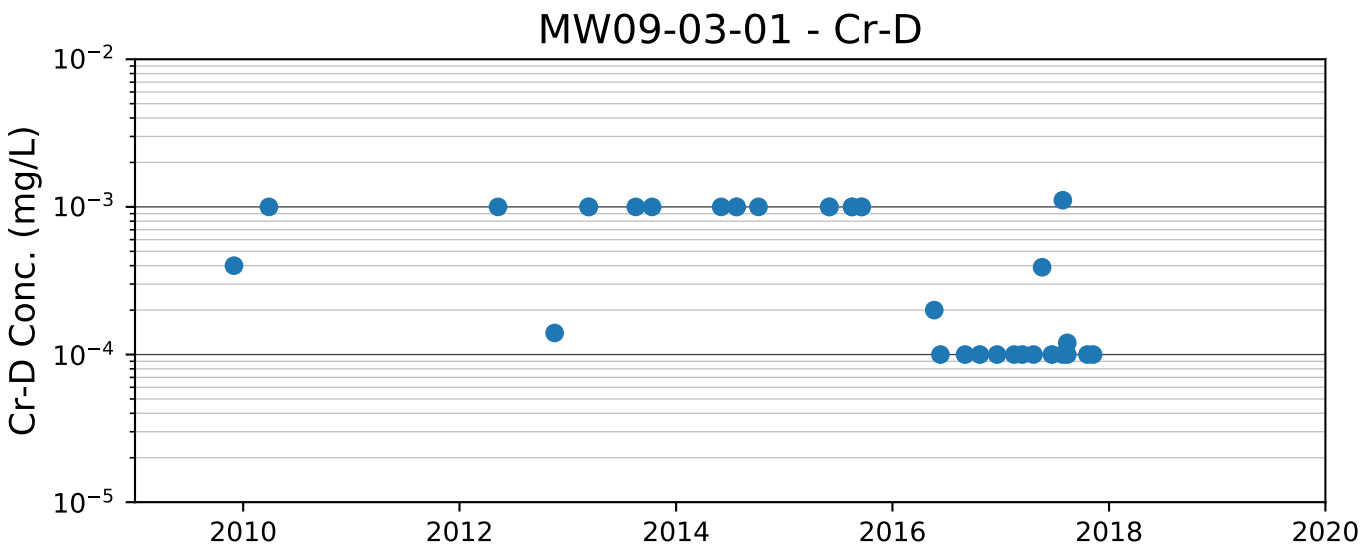
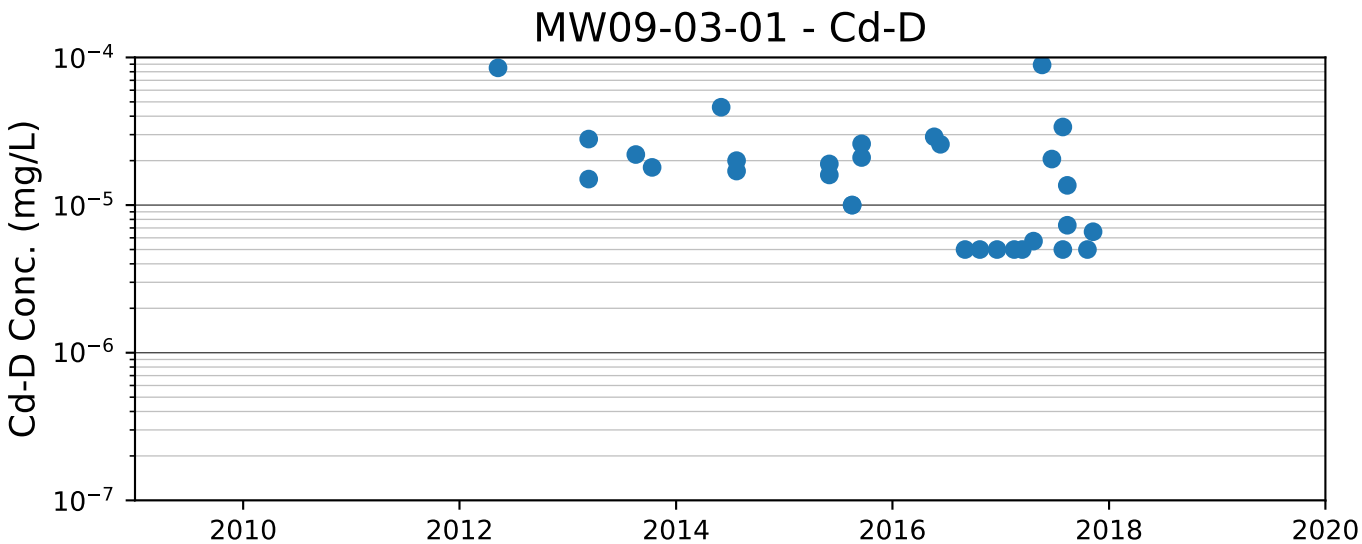


MW09-03-01 - Al-D

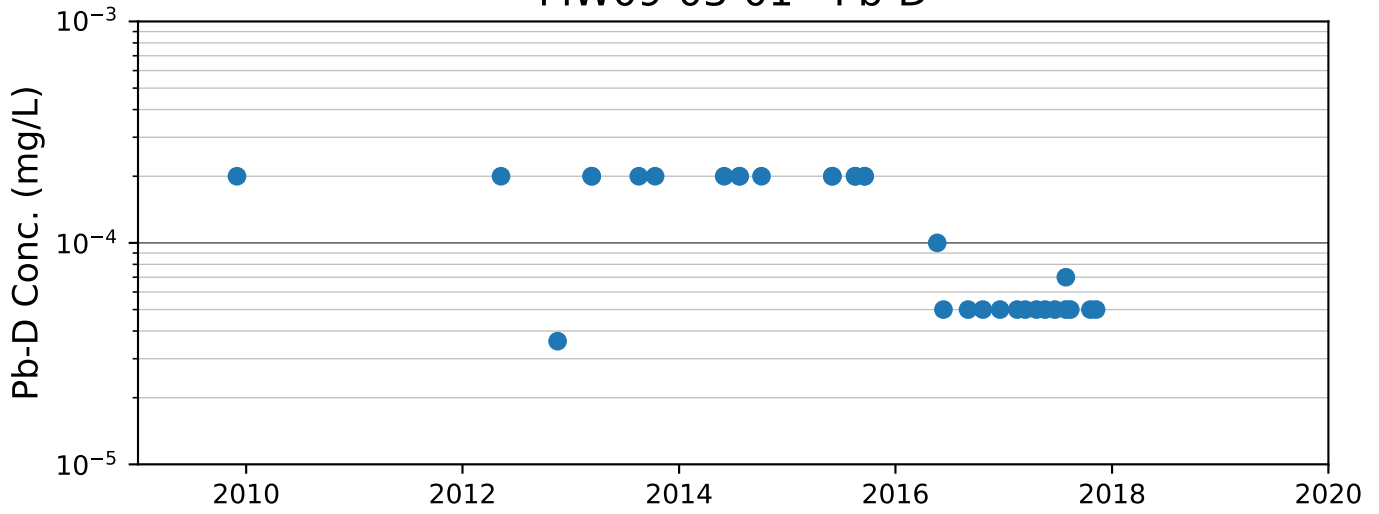


MW09-03-01 - As-D

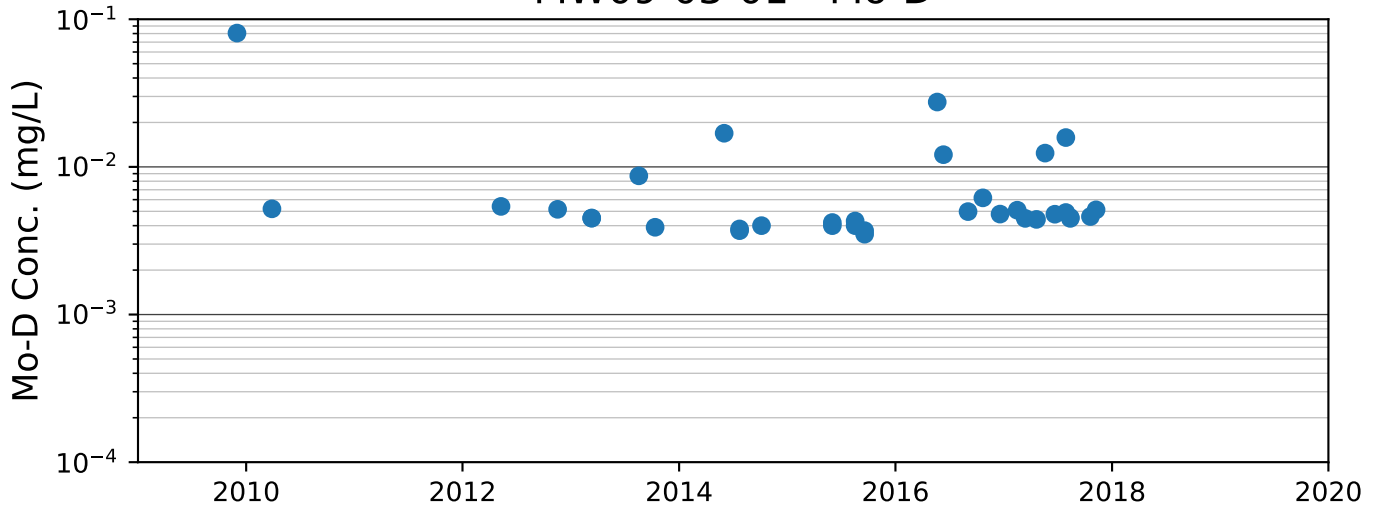




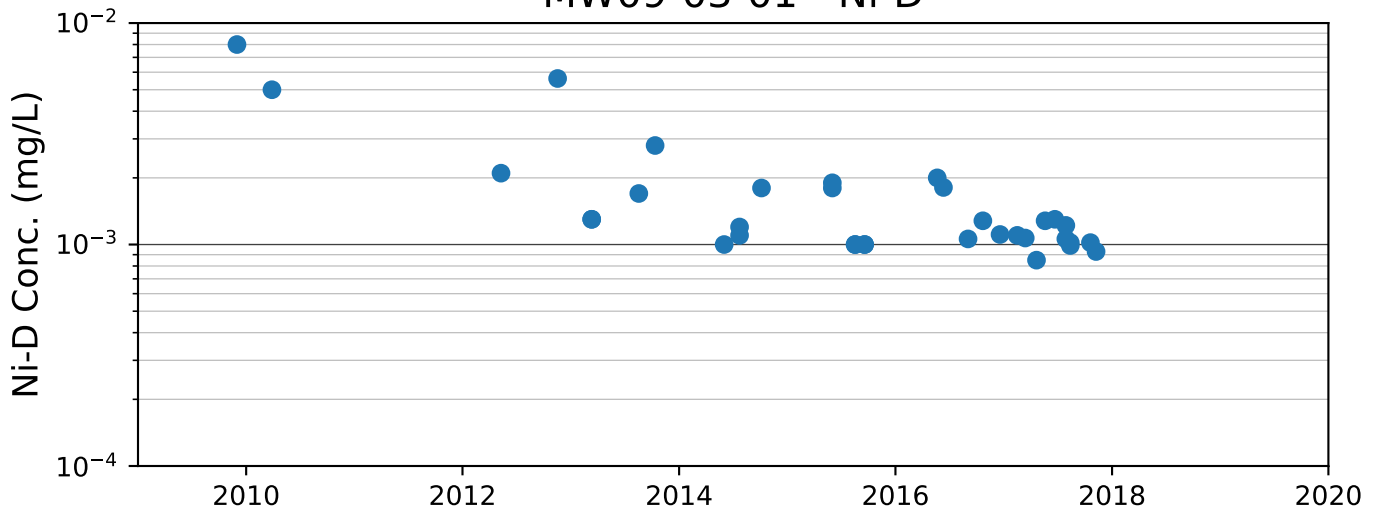
MW09-03-01 - Pb-D



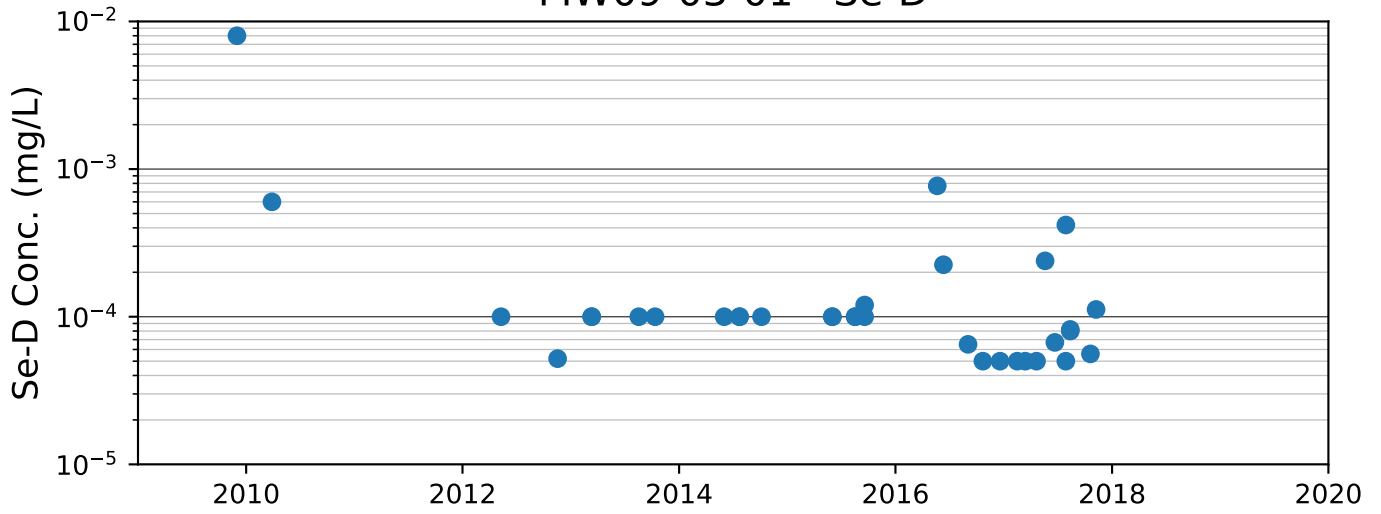
MW09-03-01 - Mo-D



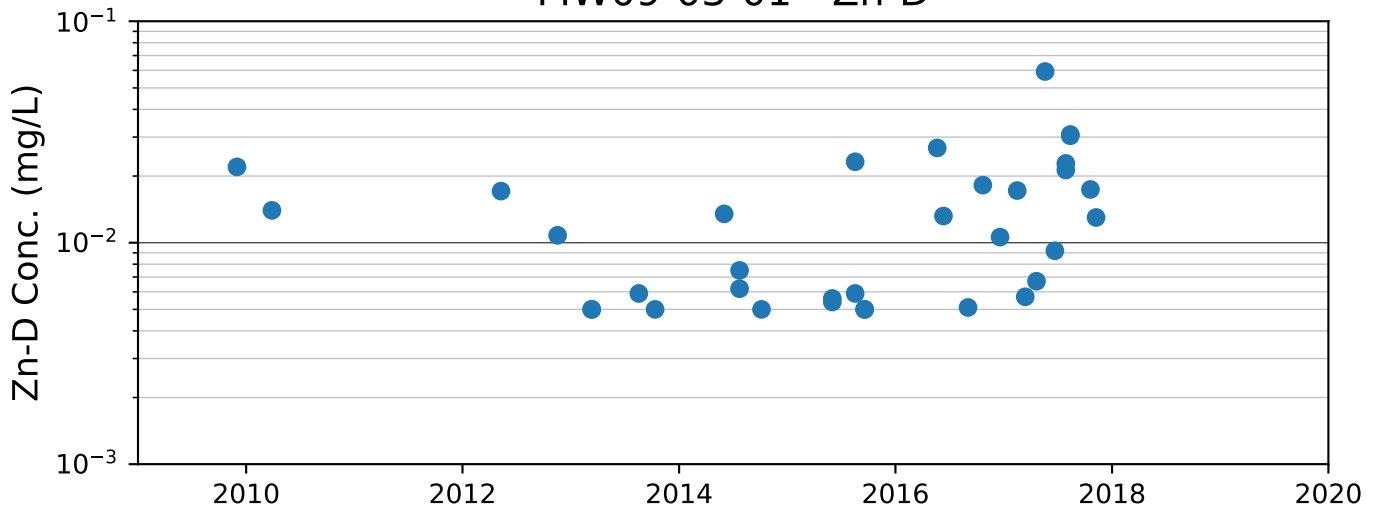
MW09-03-01 - Ni-D



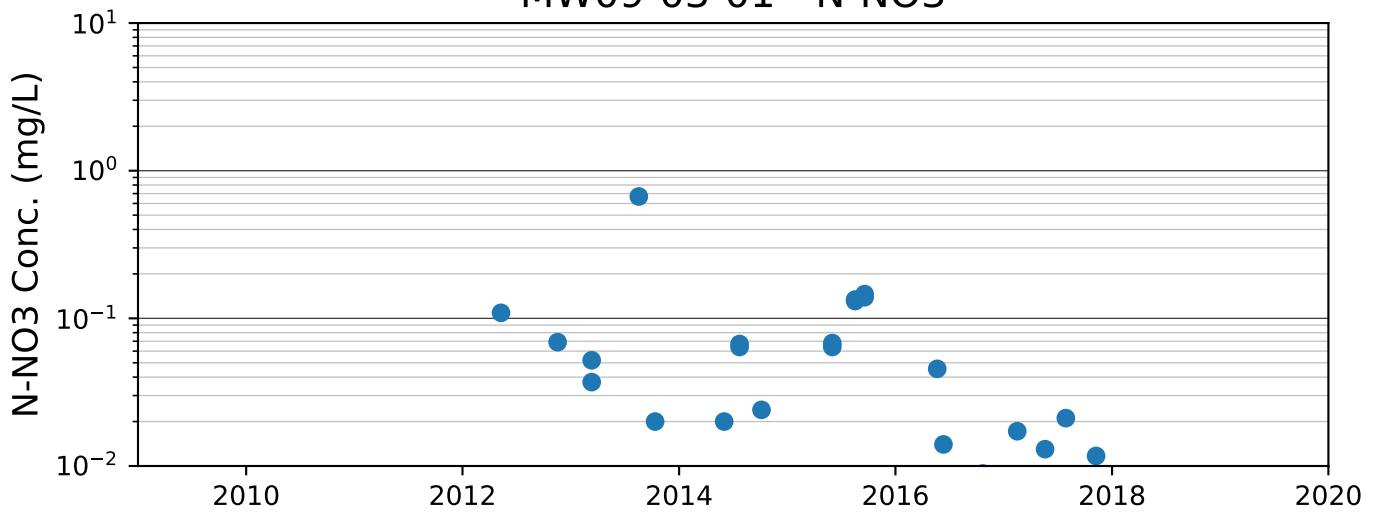
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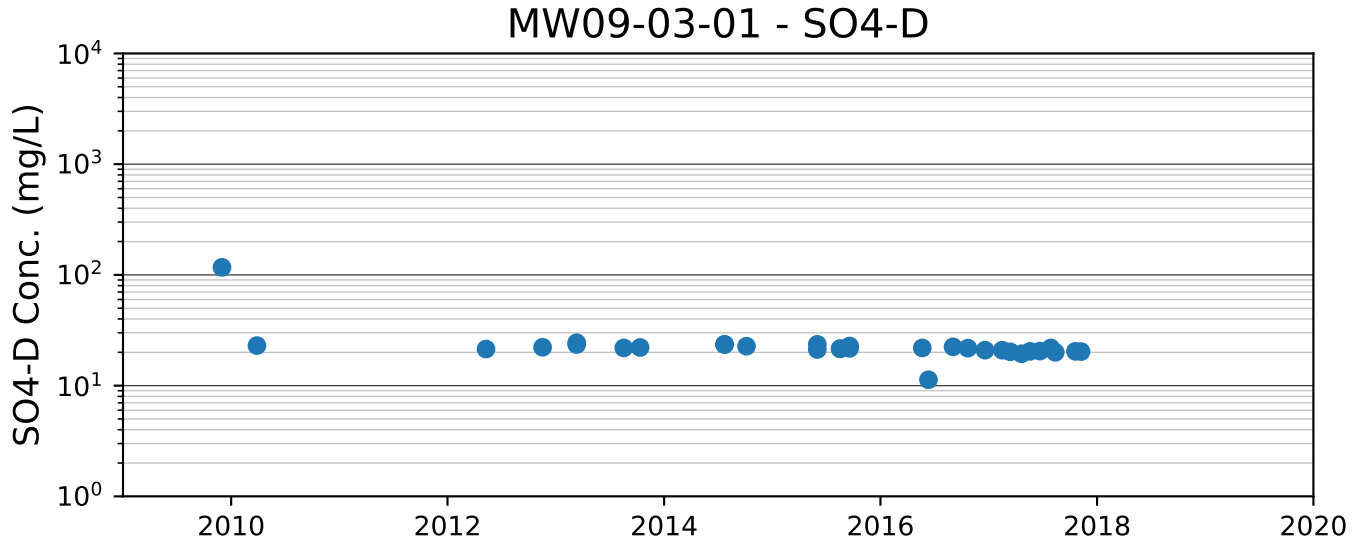


MW09-03-01 - Zn-D

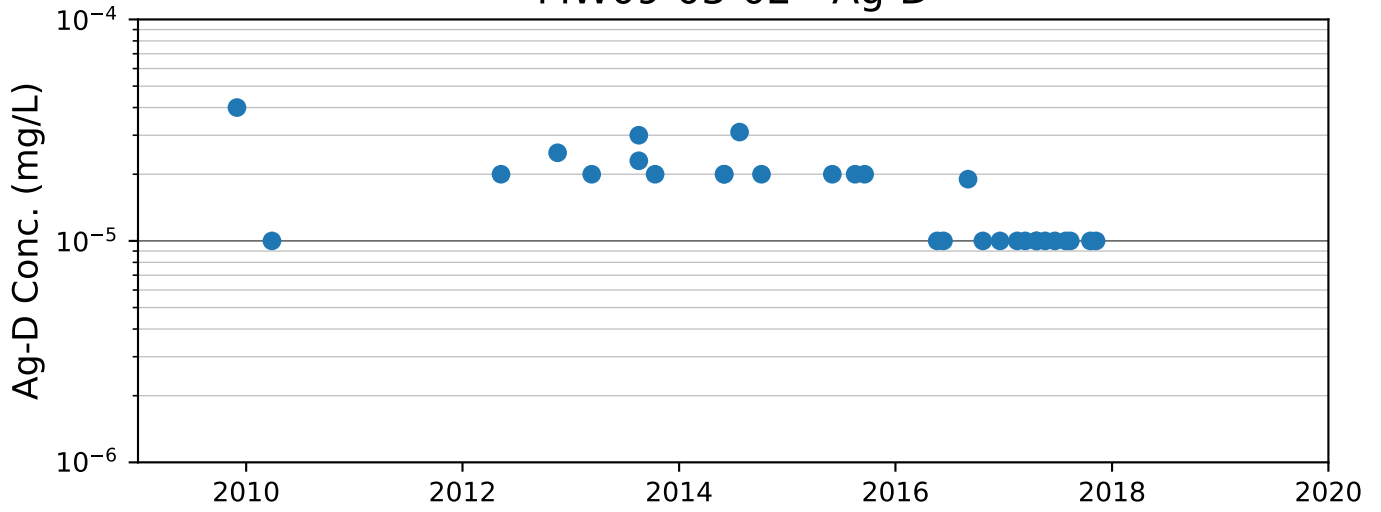


MW09-03-01 - N-NO3

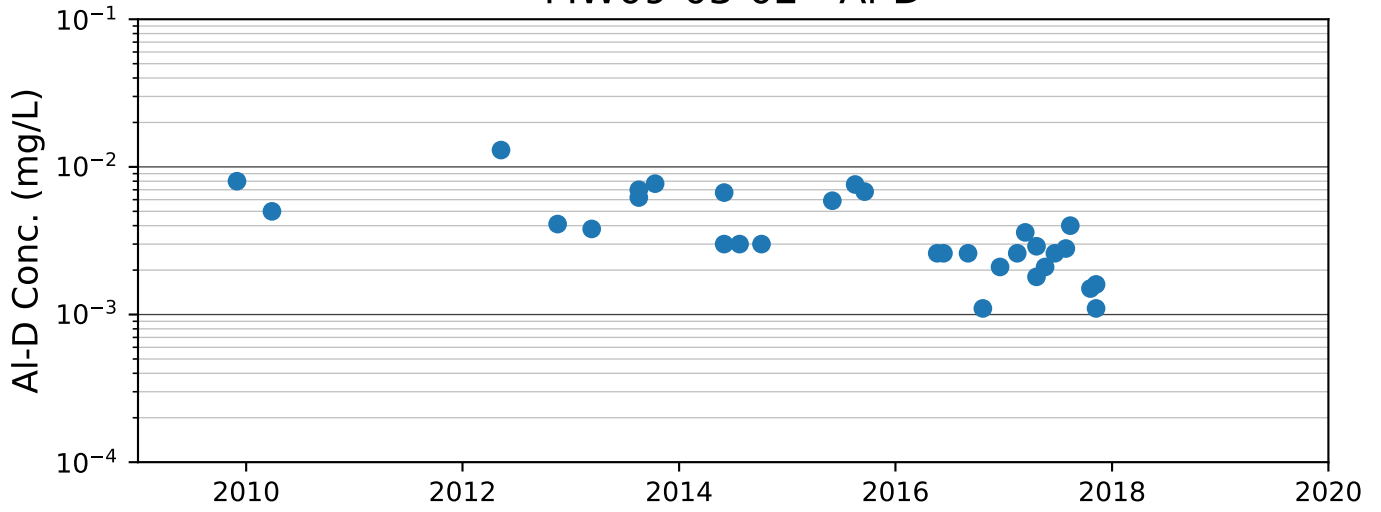




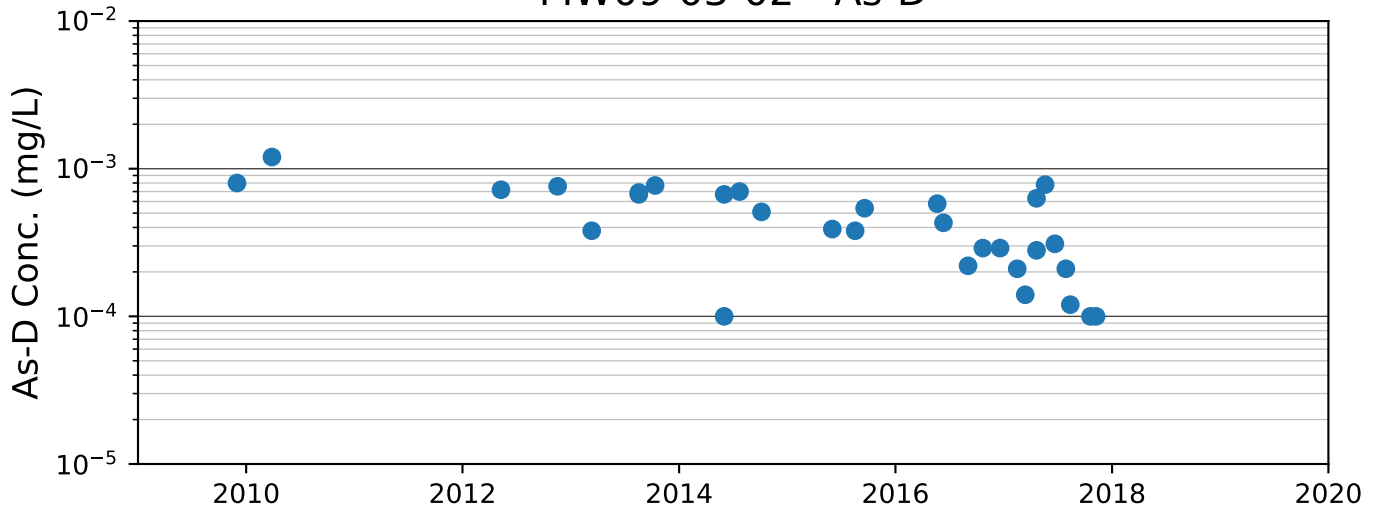
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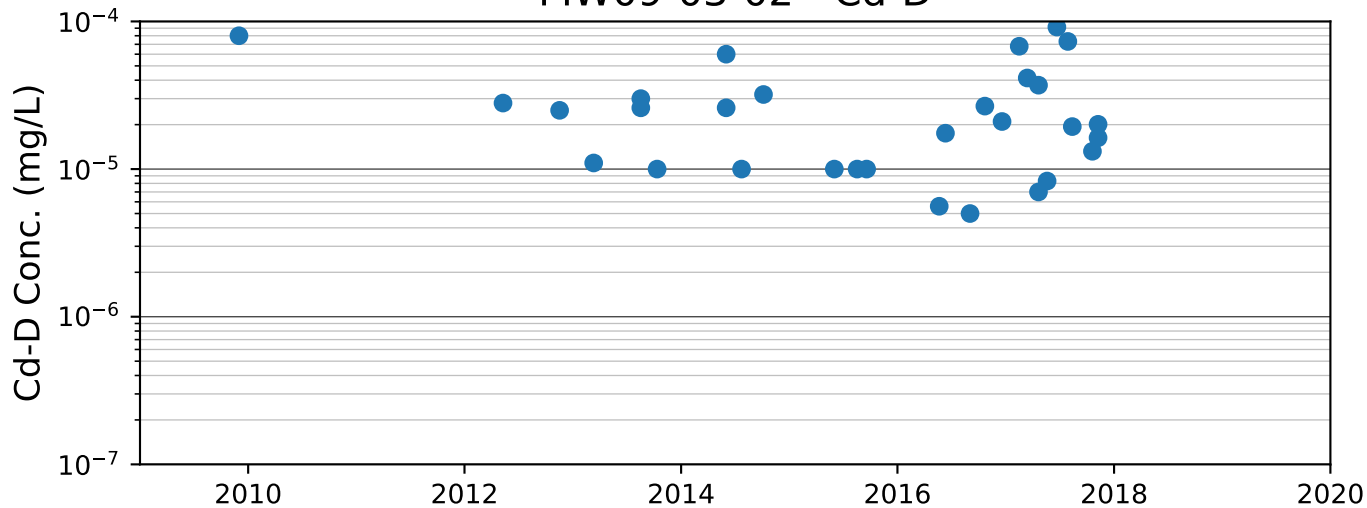
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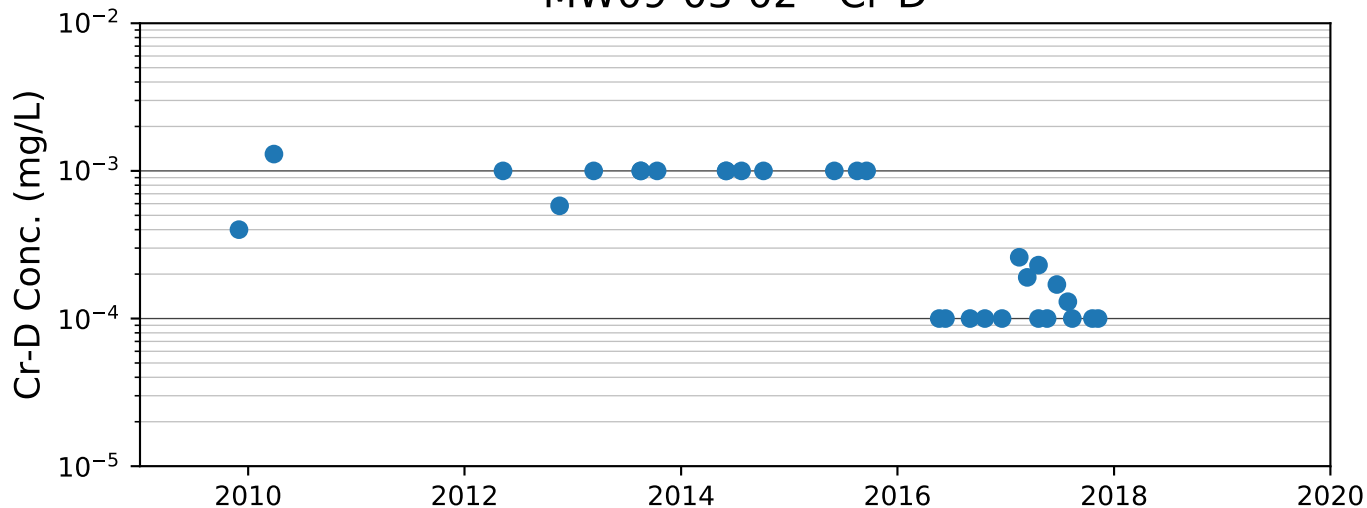
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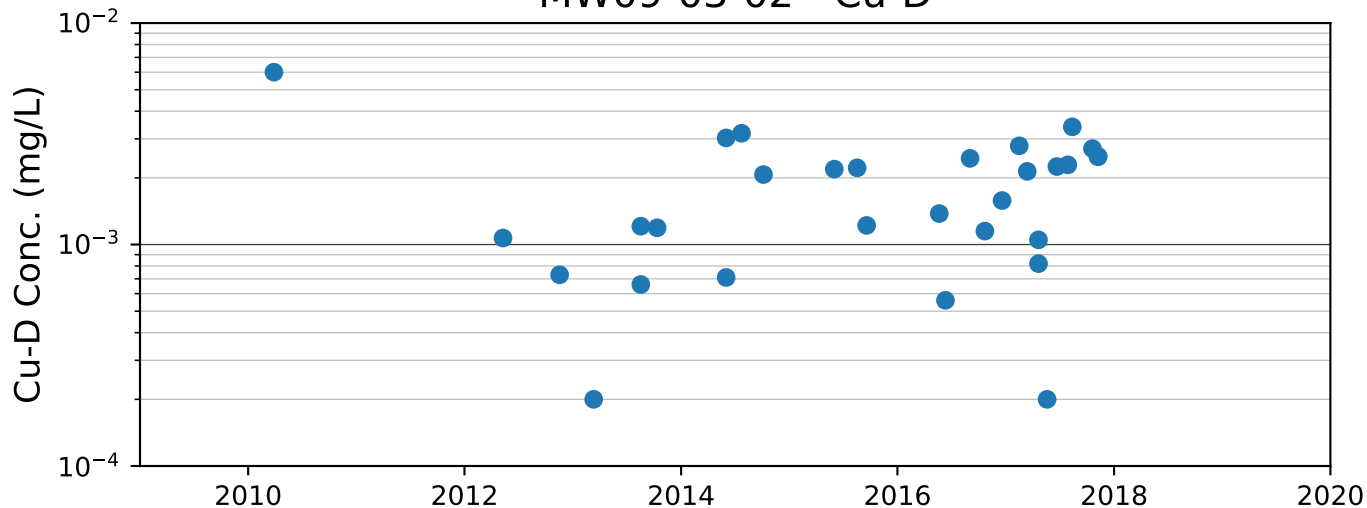
MW09-03-02 - Cd-D



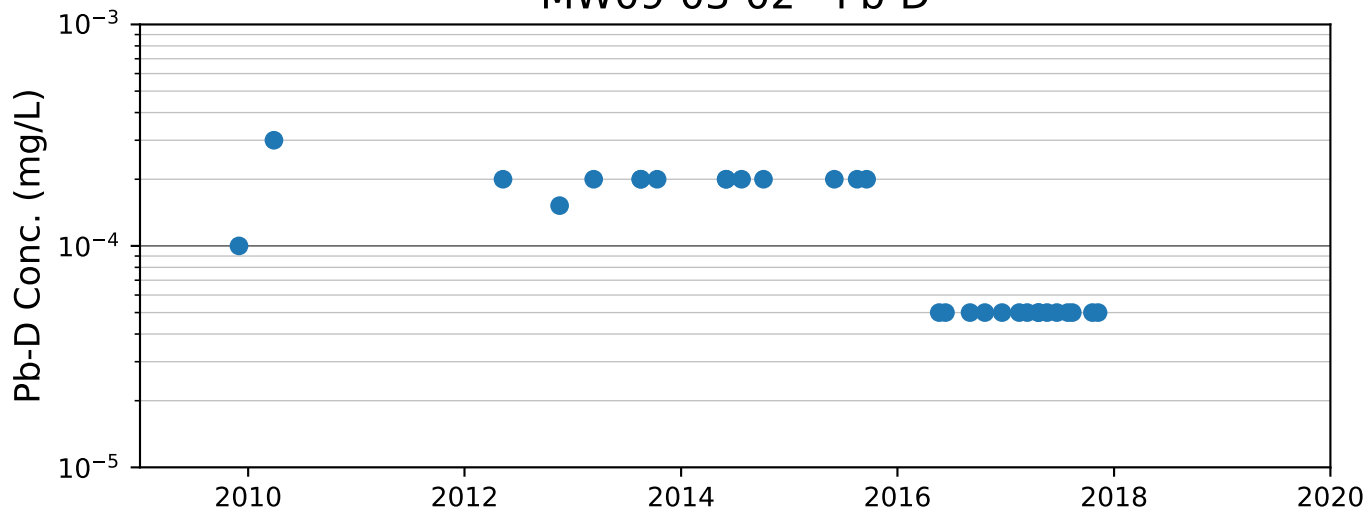
MW09-03-02 - Cr-D



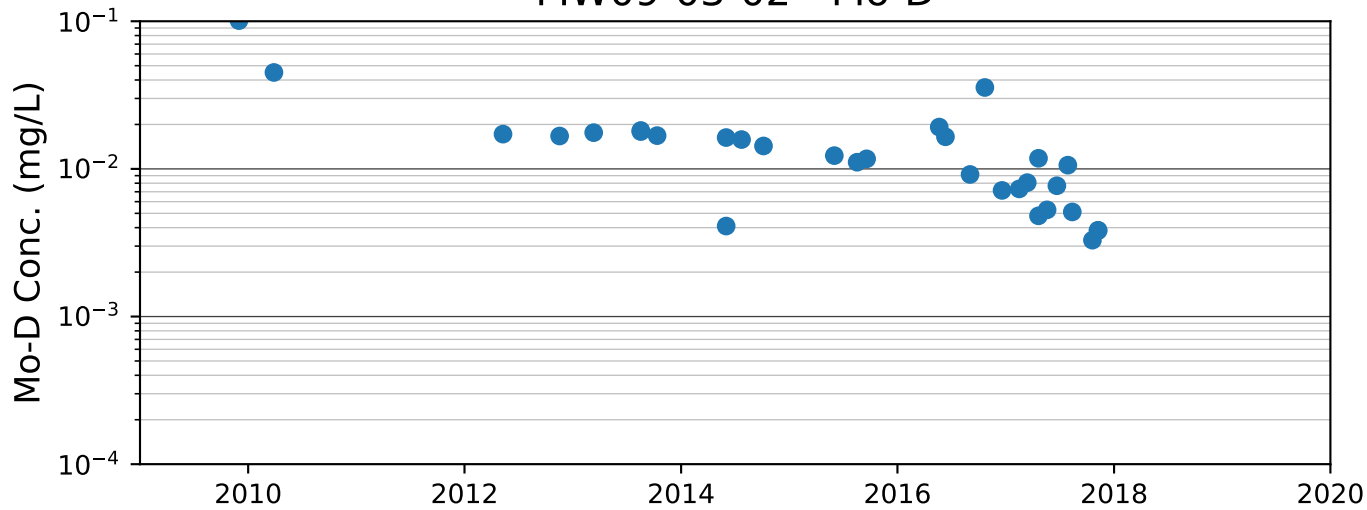
MW09-03-02 - Cu-D



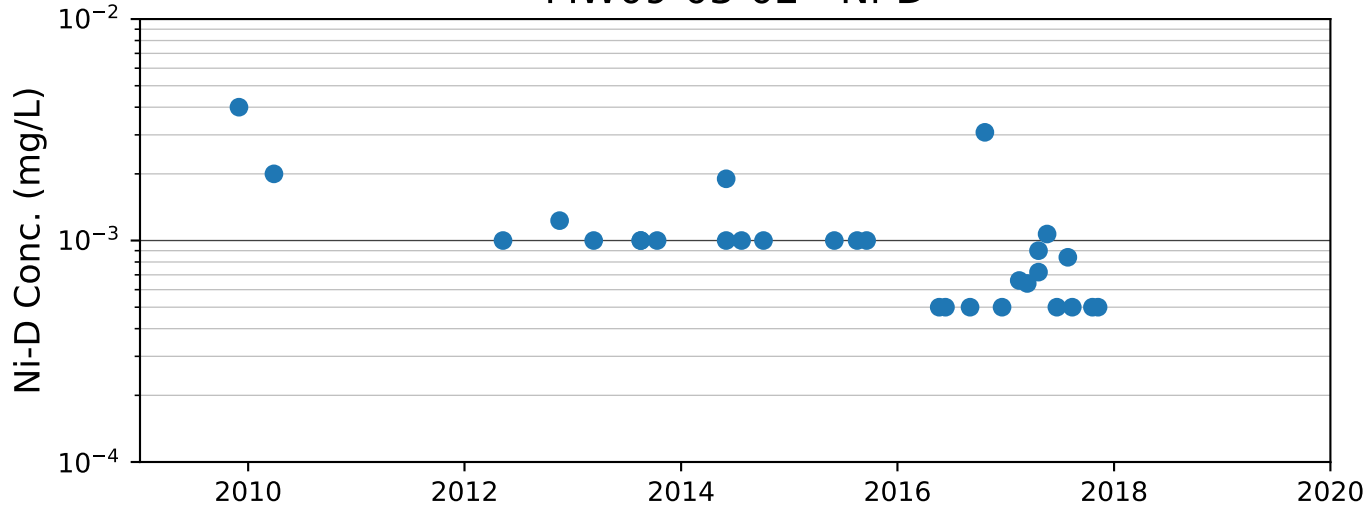
MW09-03-02 - Pb-D



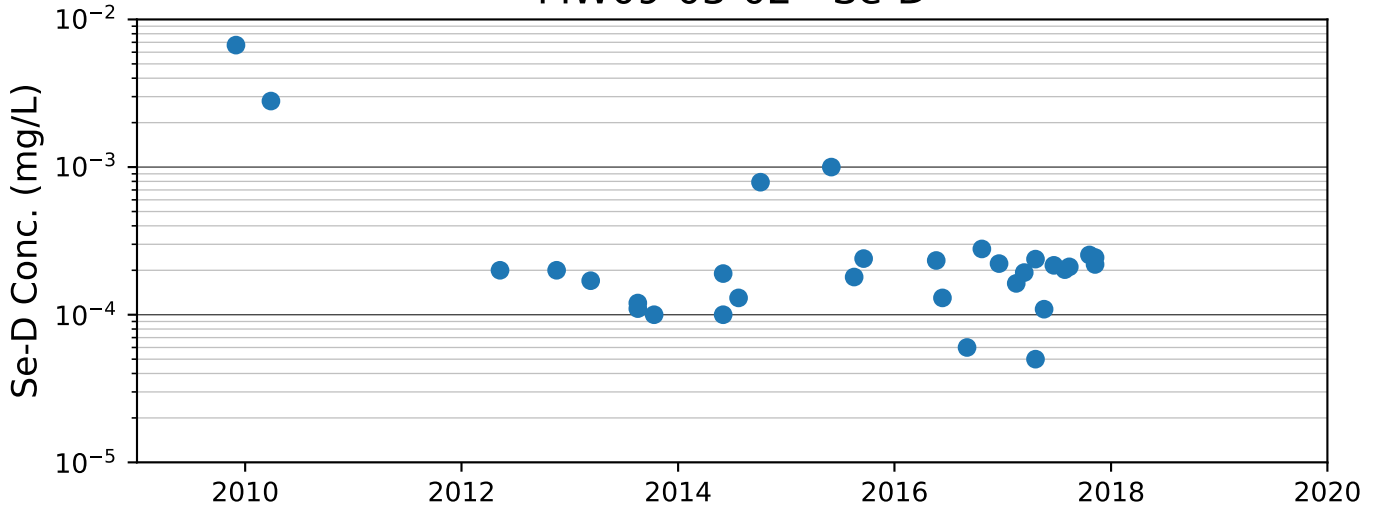
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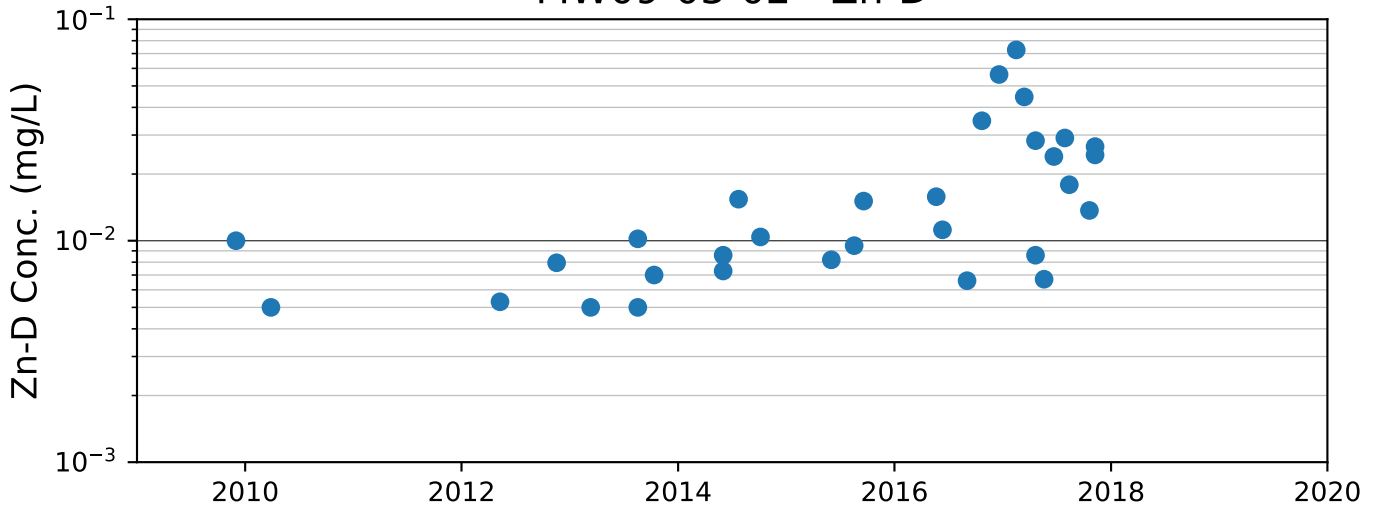
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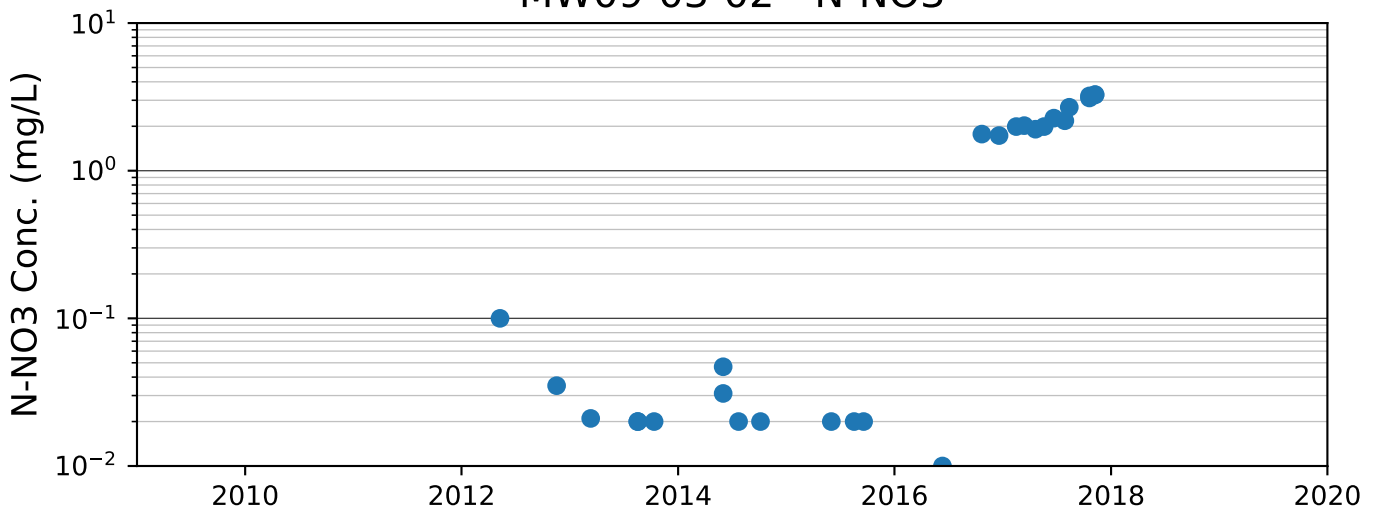
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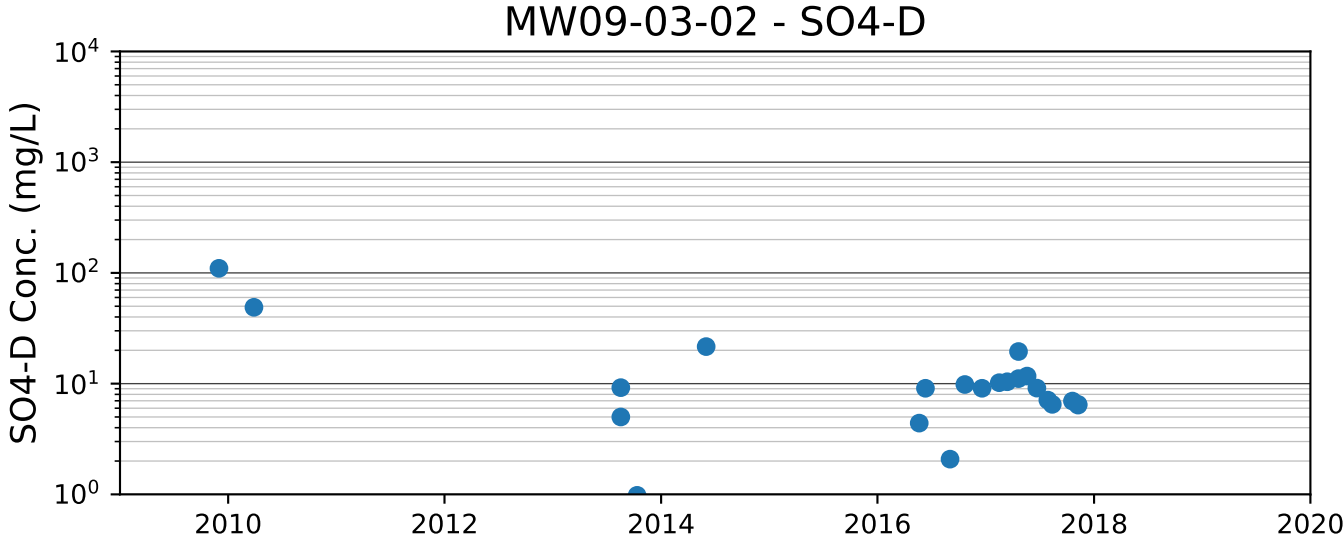


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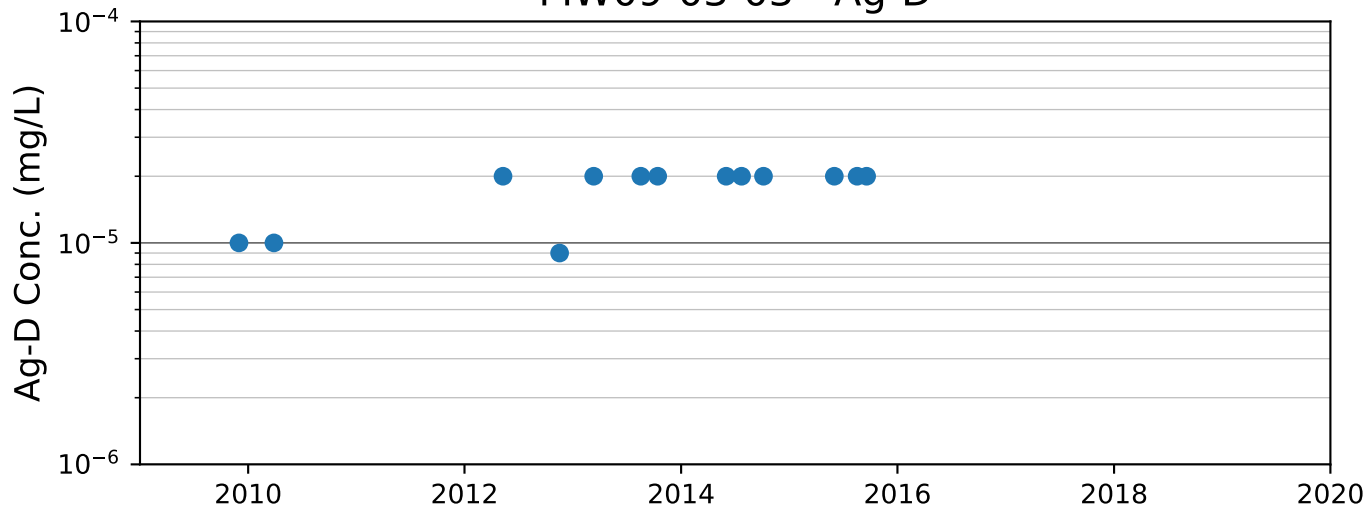


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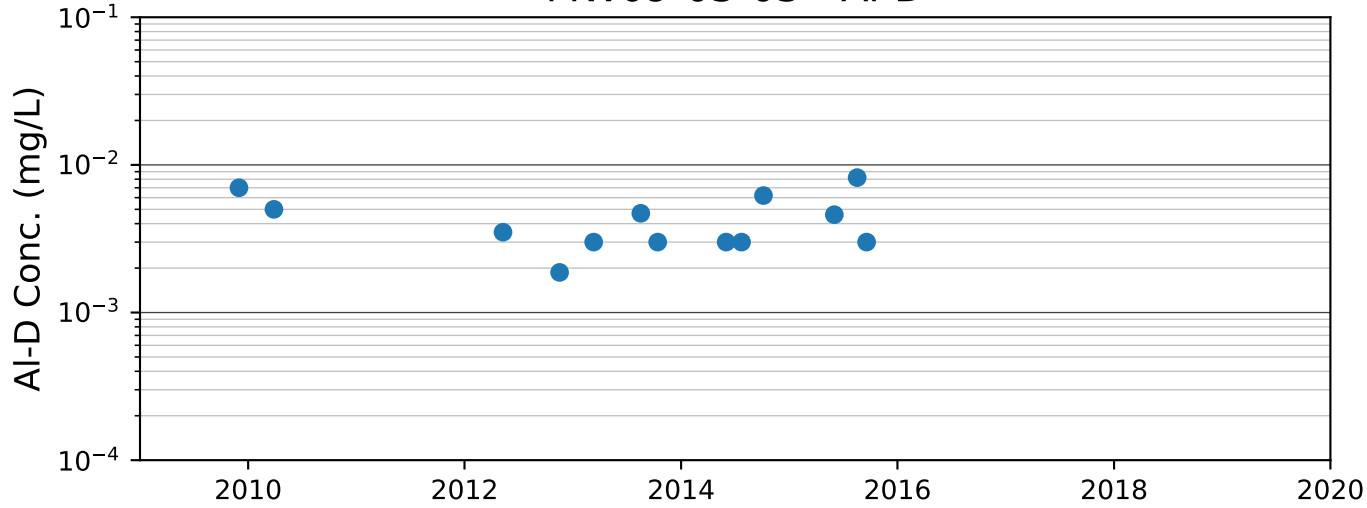




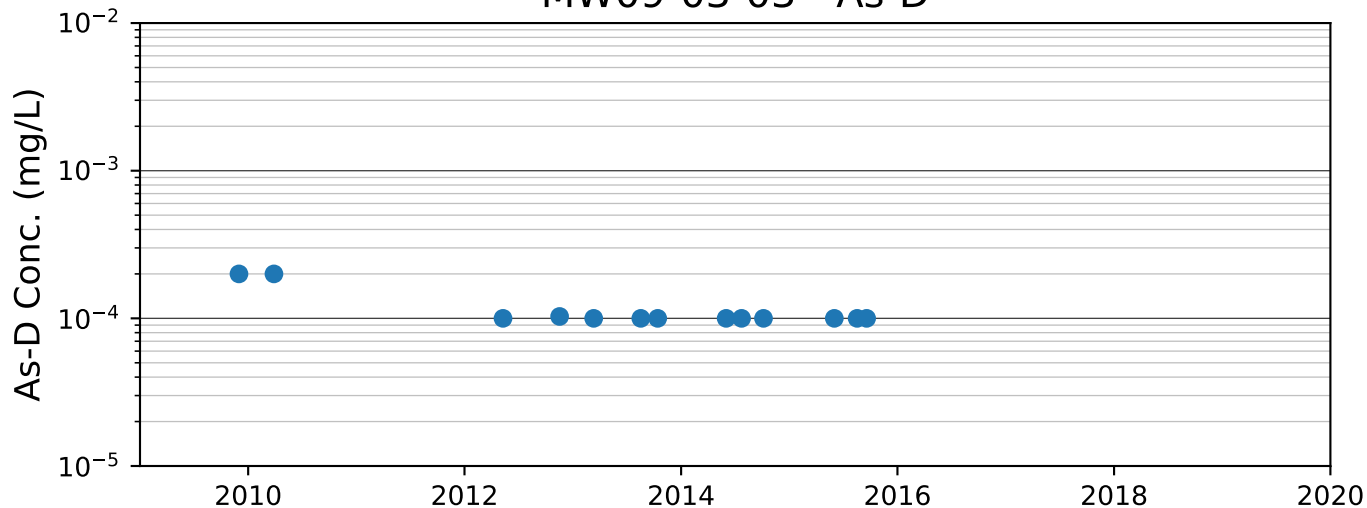
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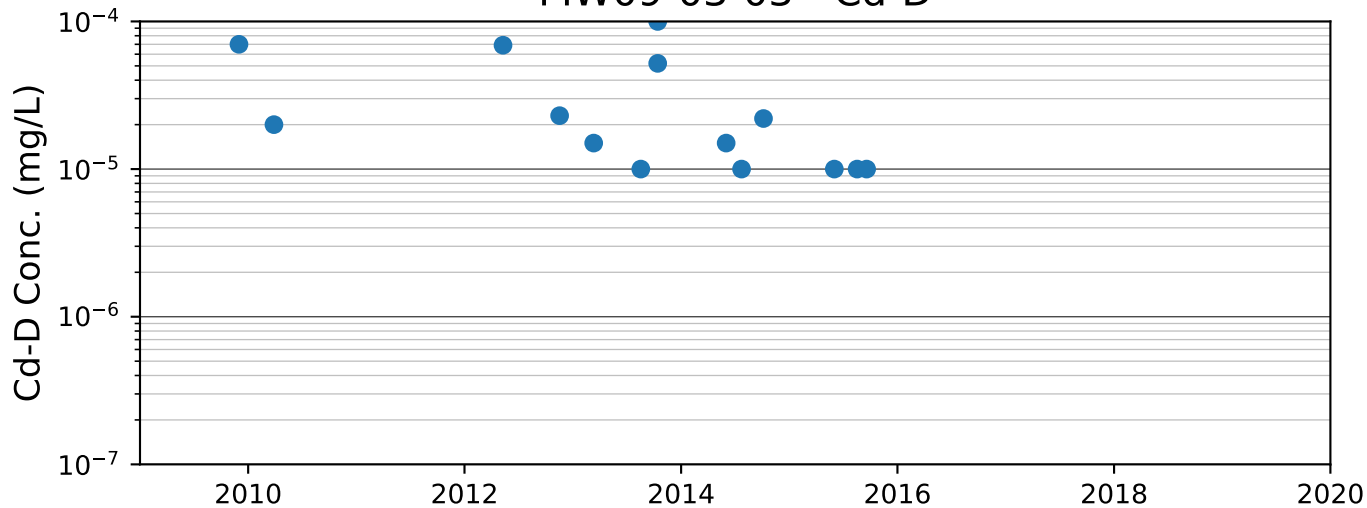
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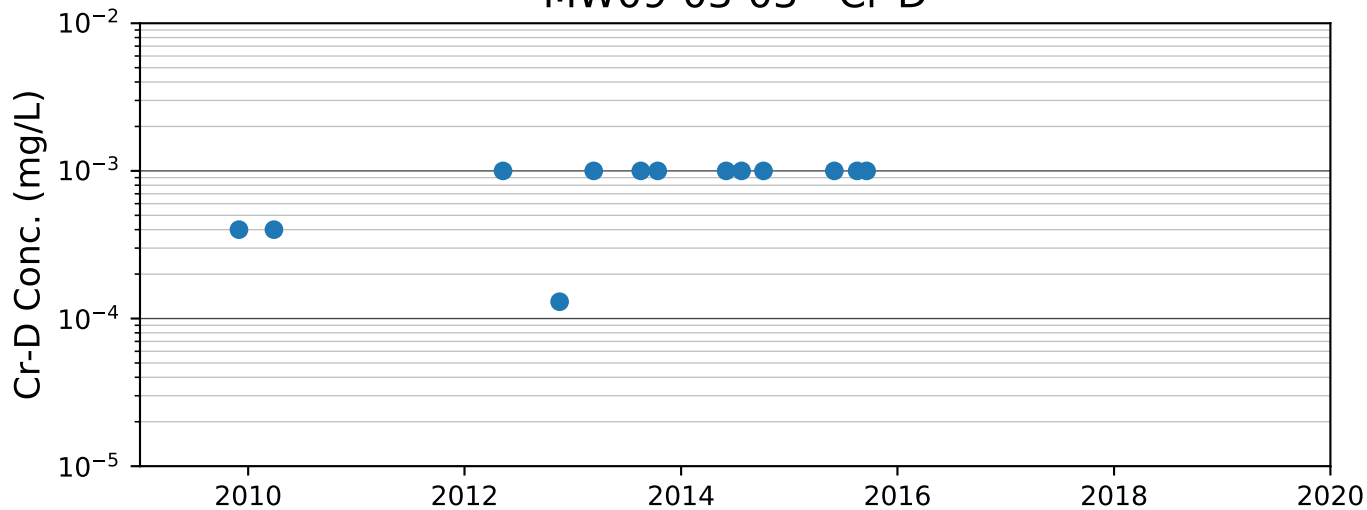
MW09-03-03 - As-D



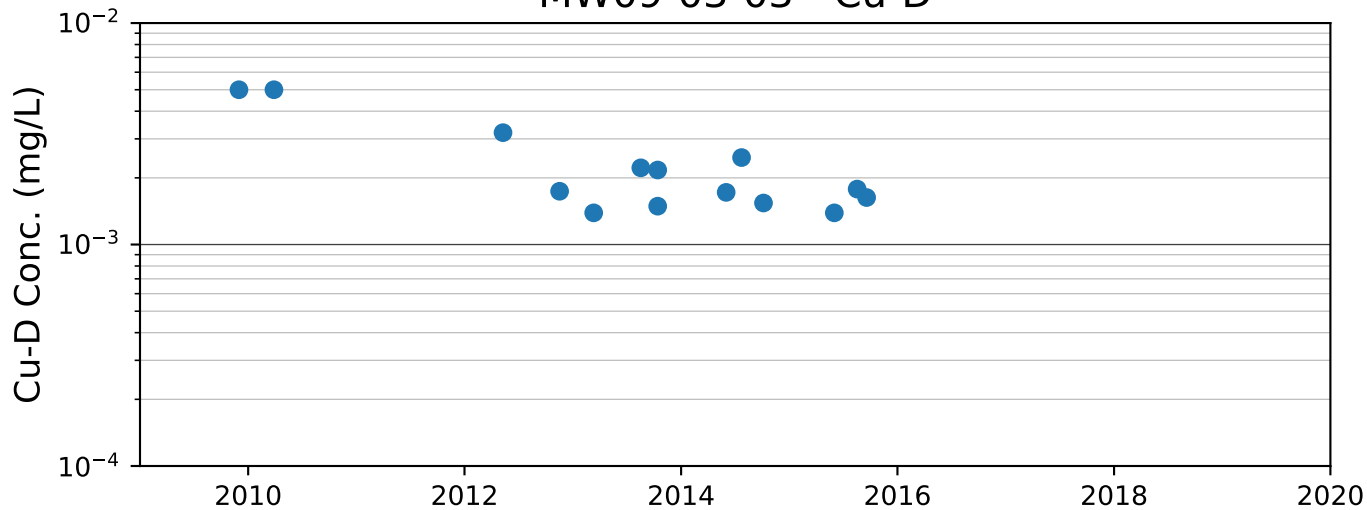
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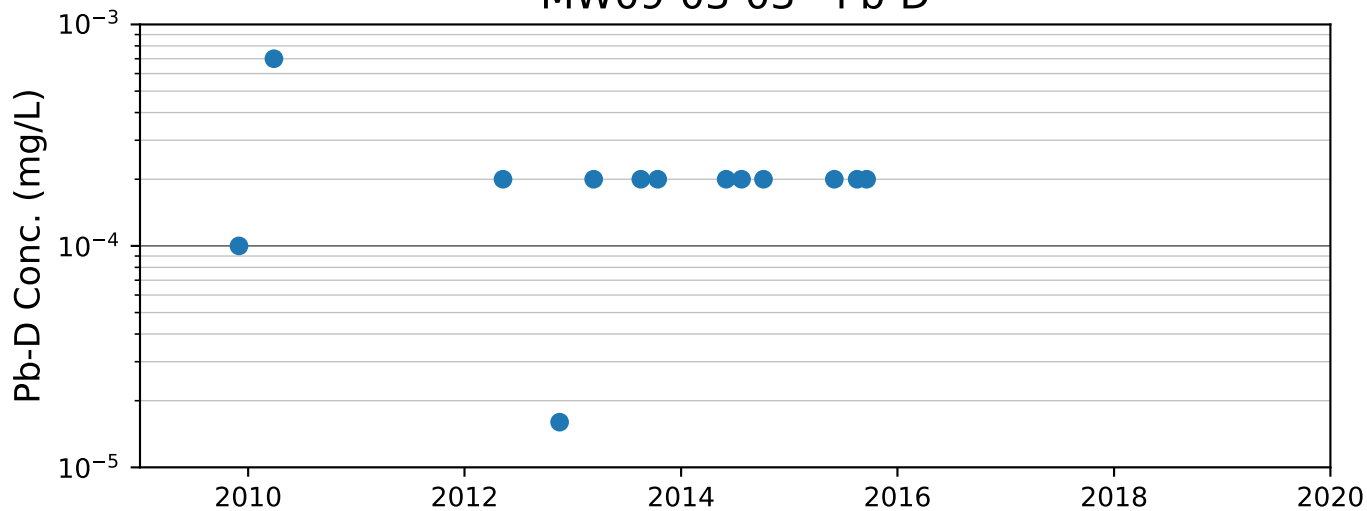
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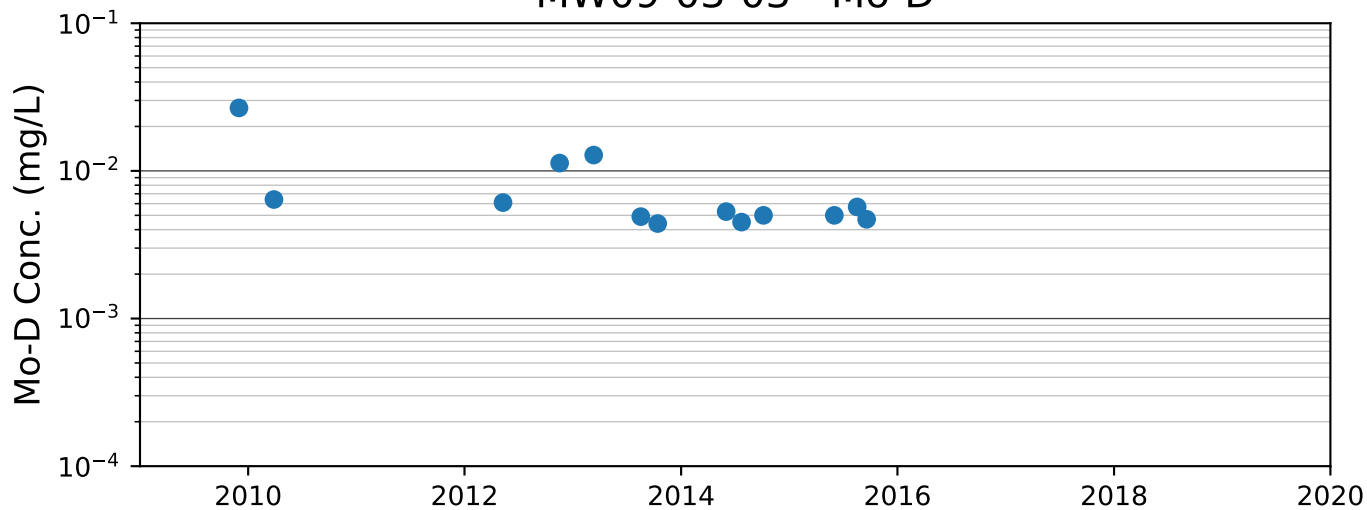
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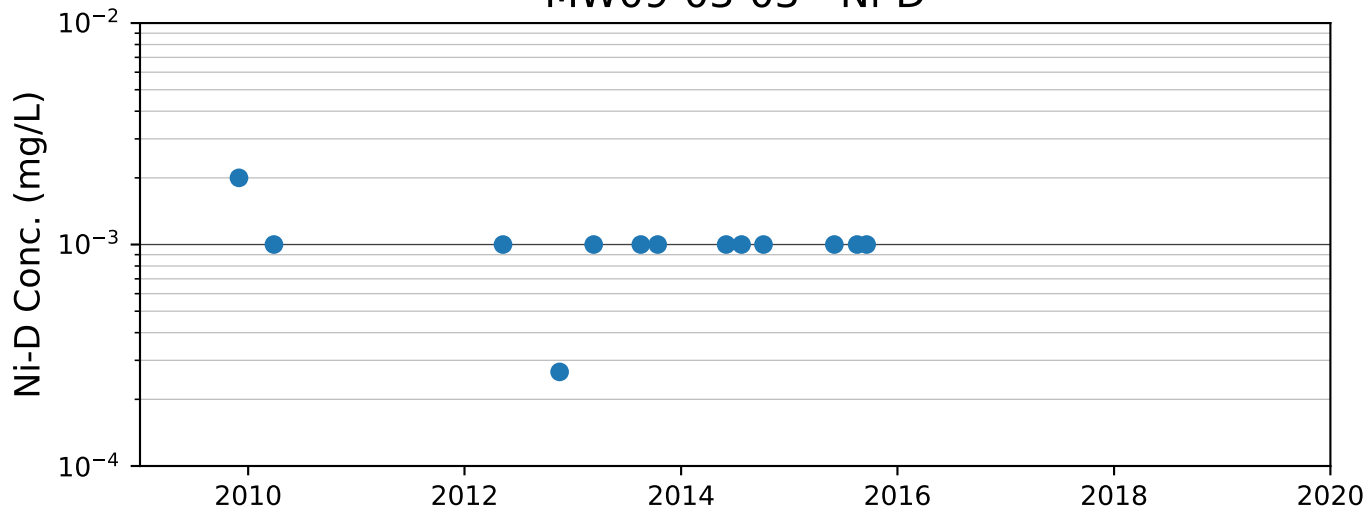
MW09-03-03 - Pb-D



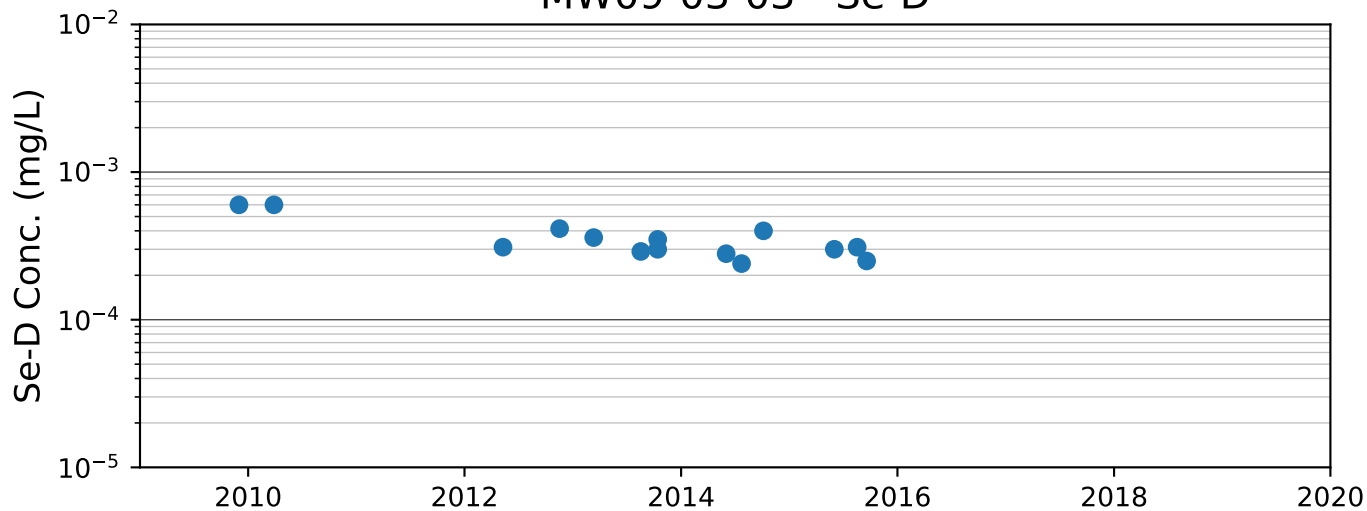
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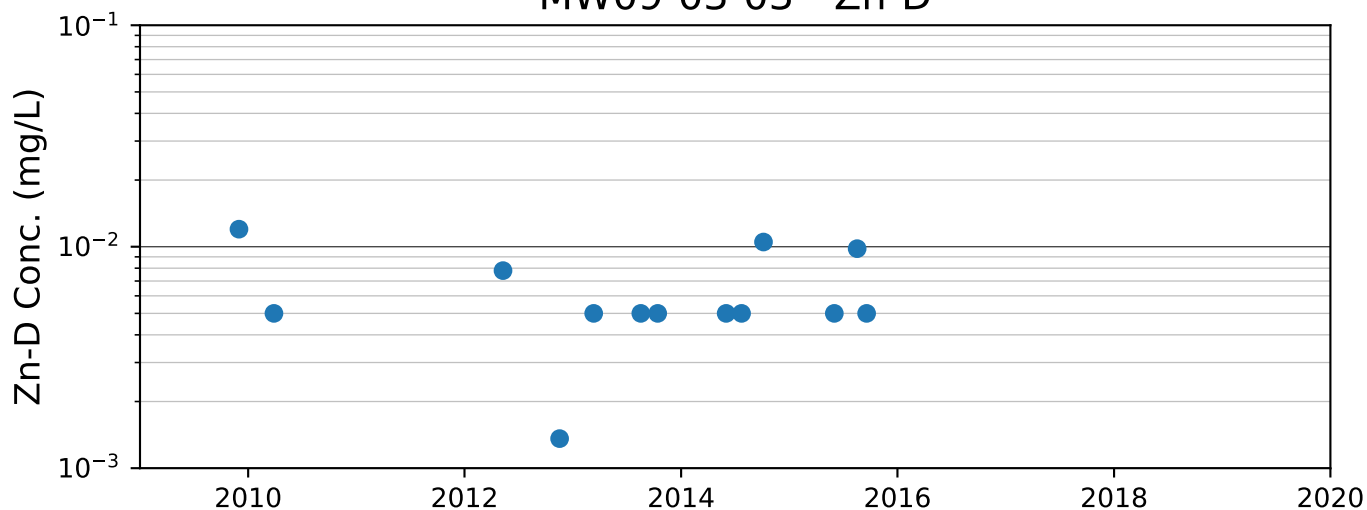
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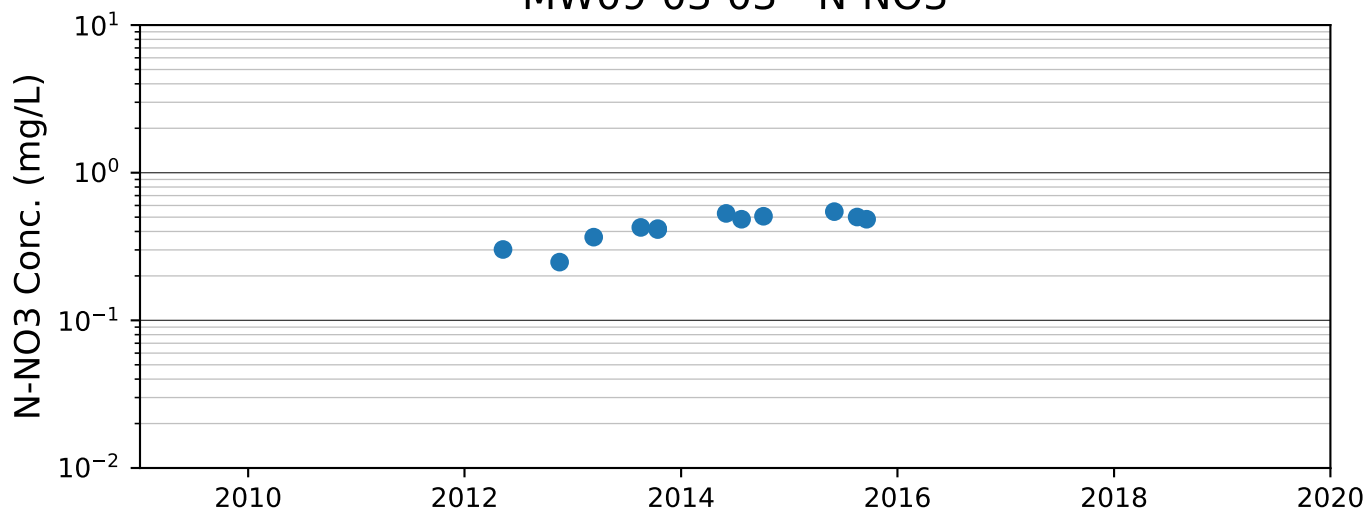
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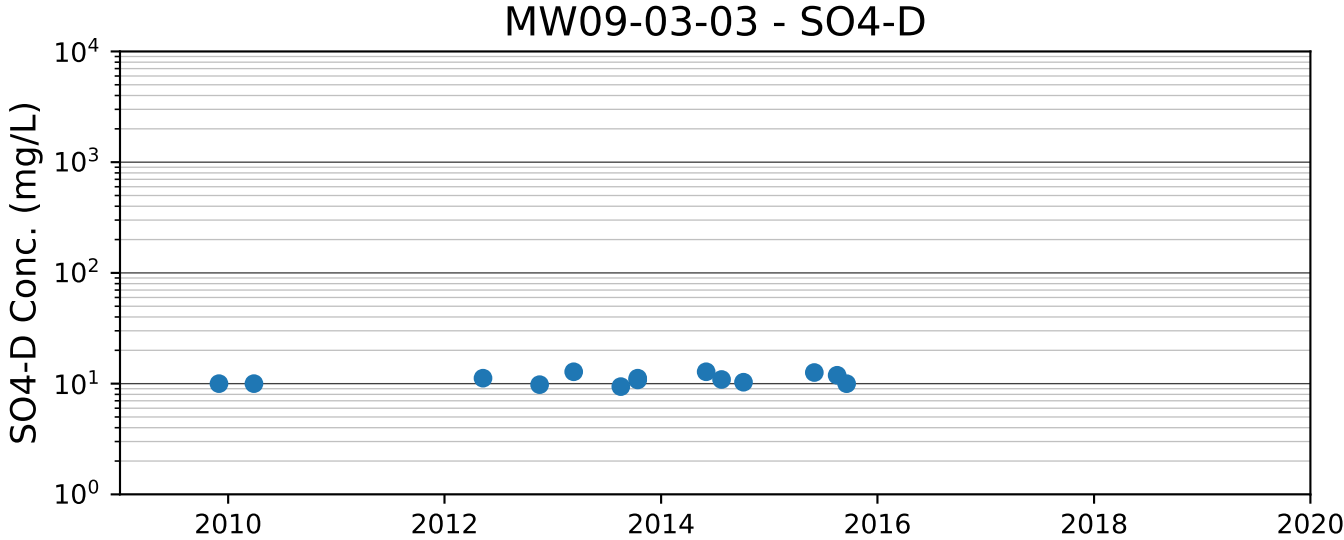


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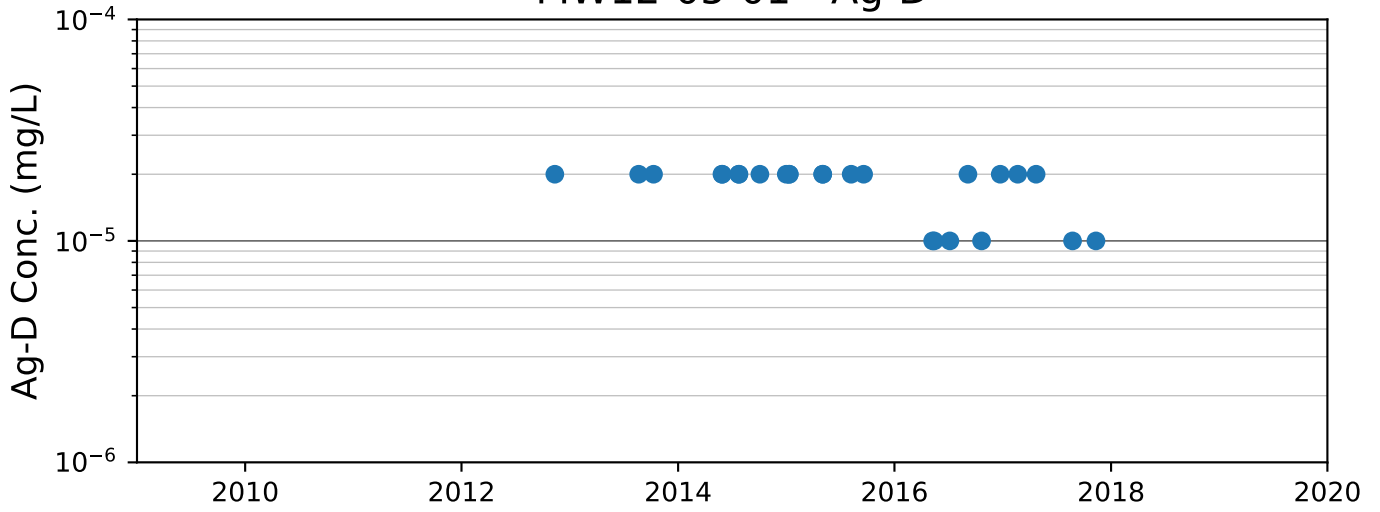


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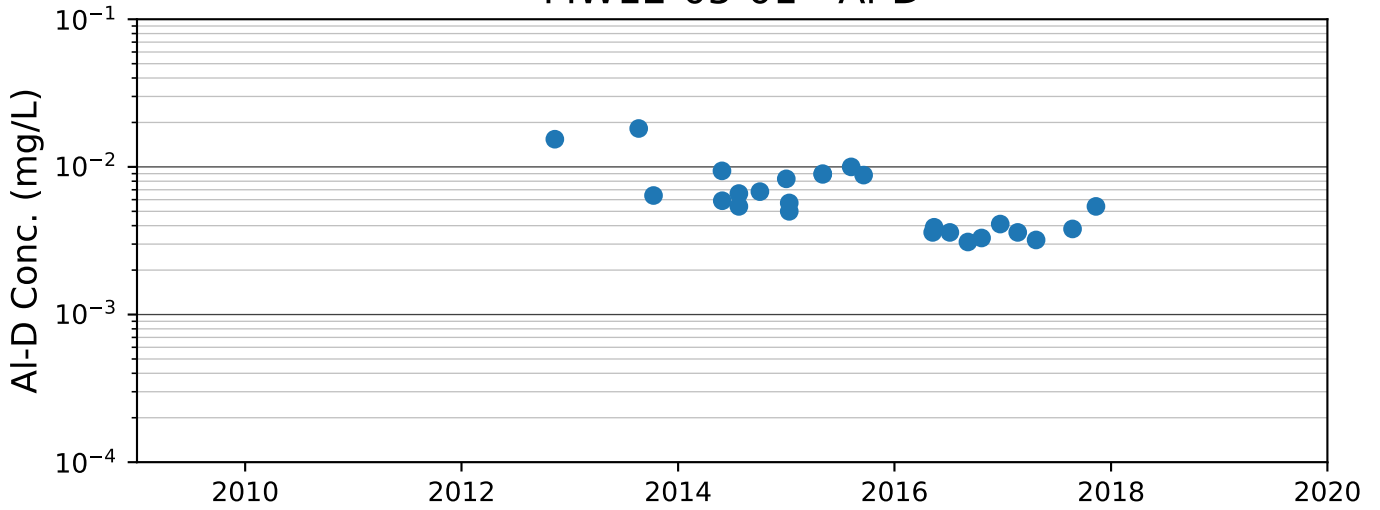




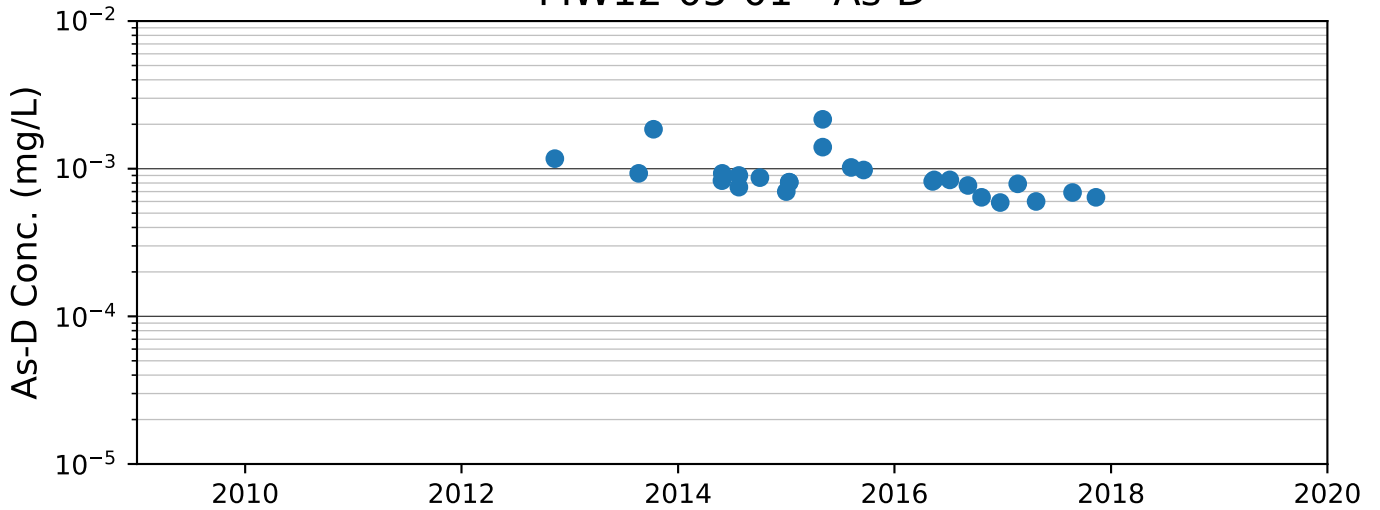
MW12-05-01 - Ag-D



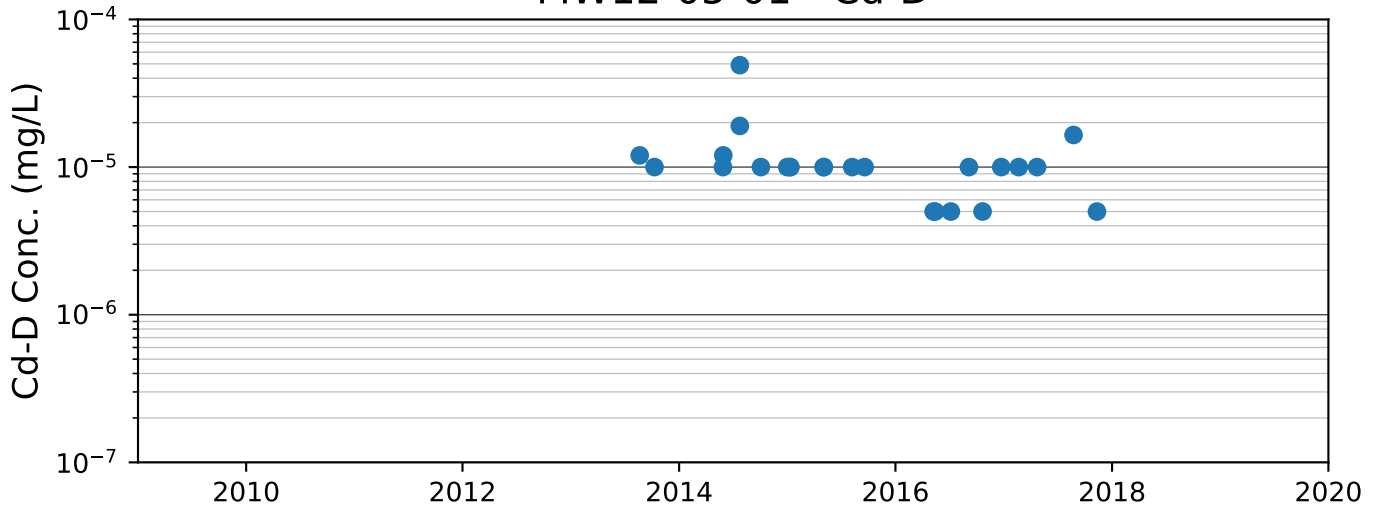
MW12-05-01 - Al-D



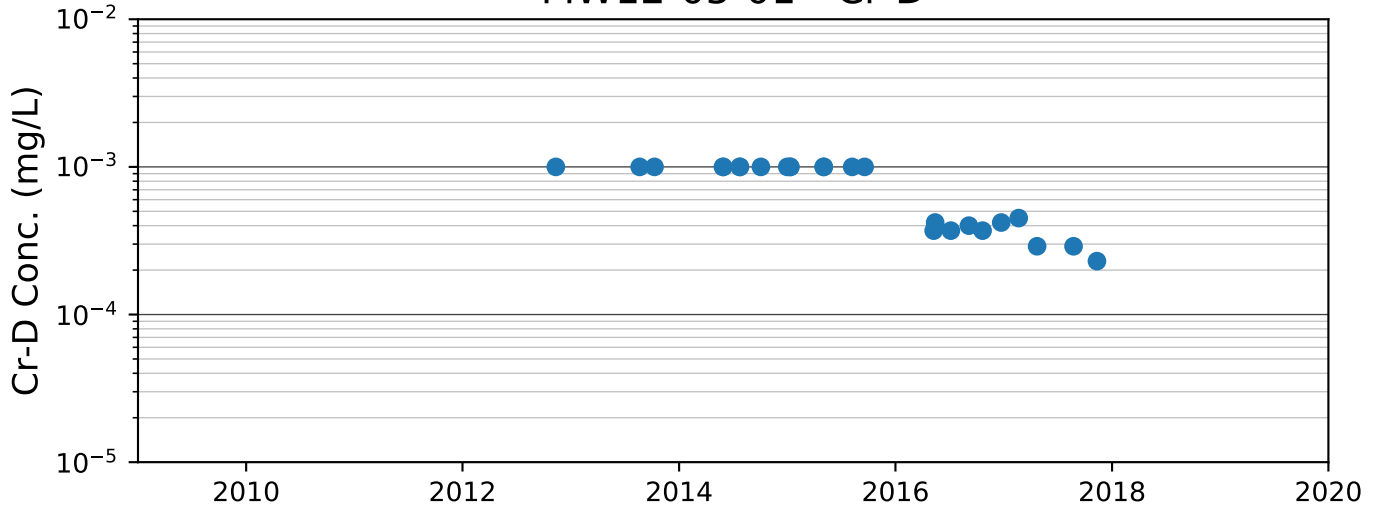
MW12-05-01 - As-D



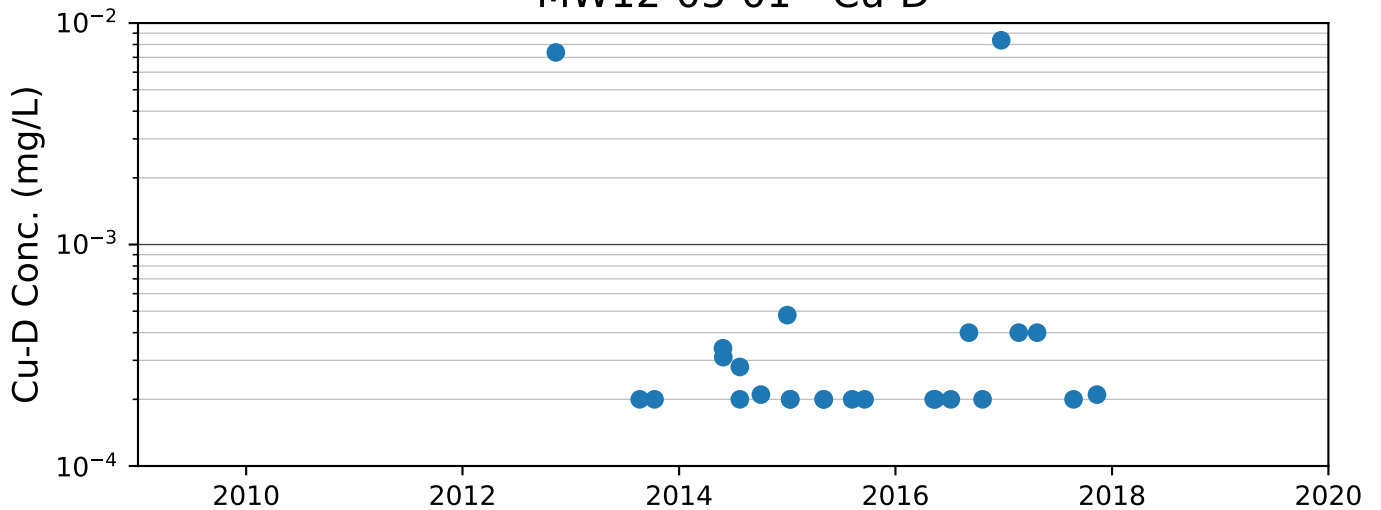
MW12-05-01 - Cd-D



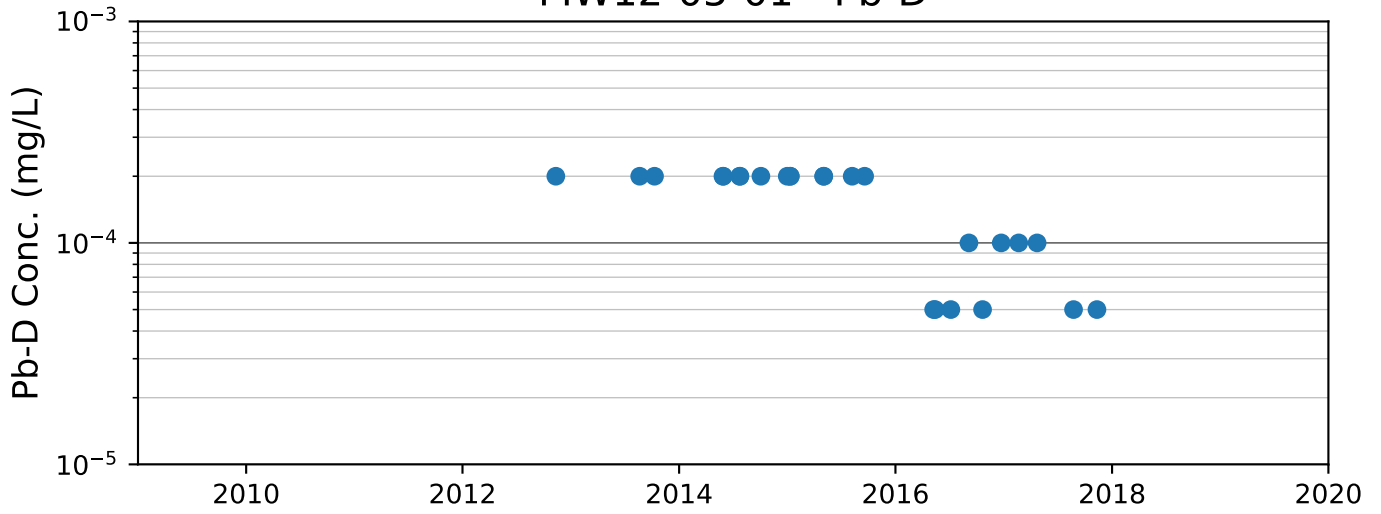
MW12-05-01 - Cr-D



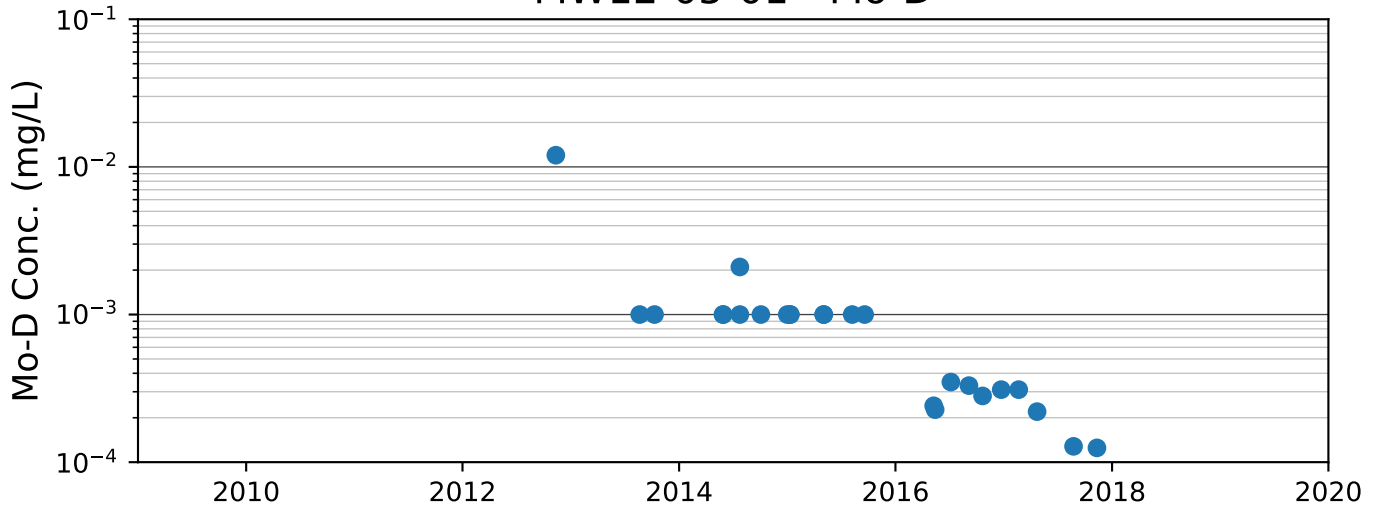
MW12-05-01 - Cu-D



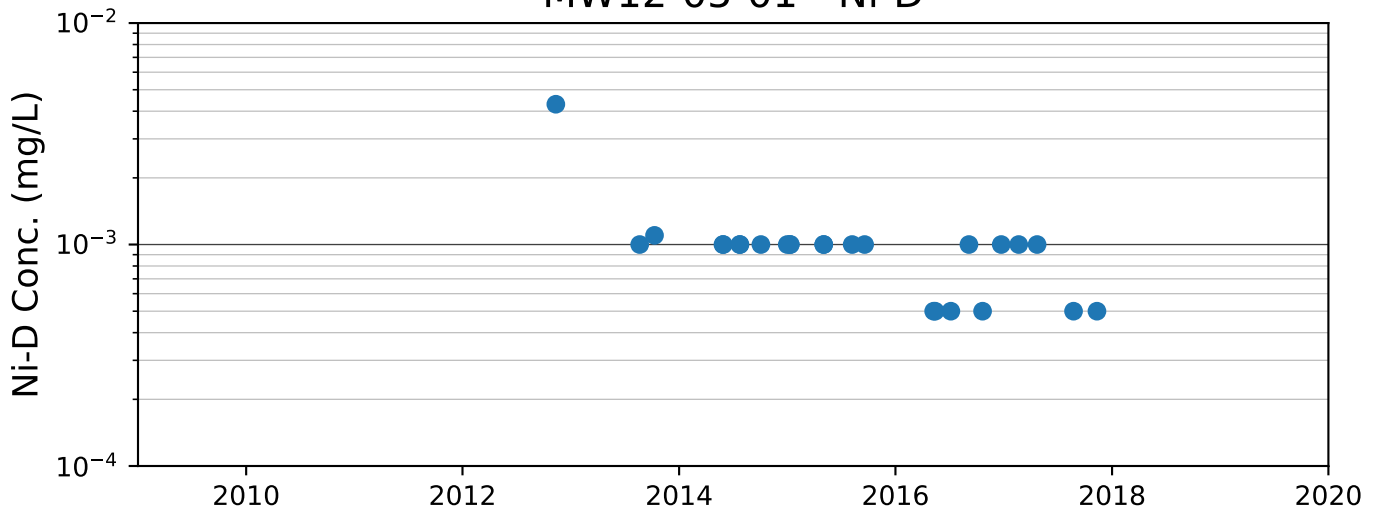
MW12-05-01 - Pb-D



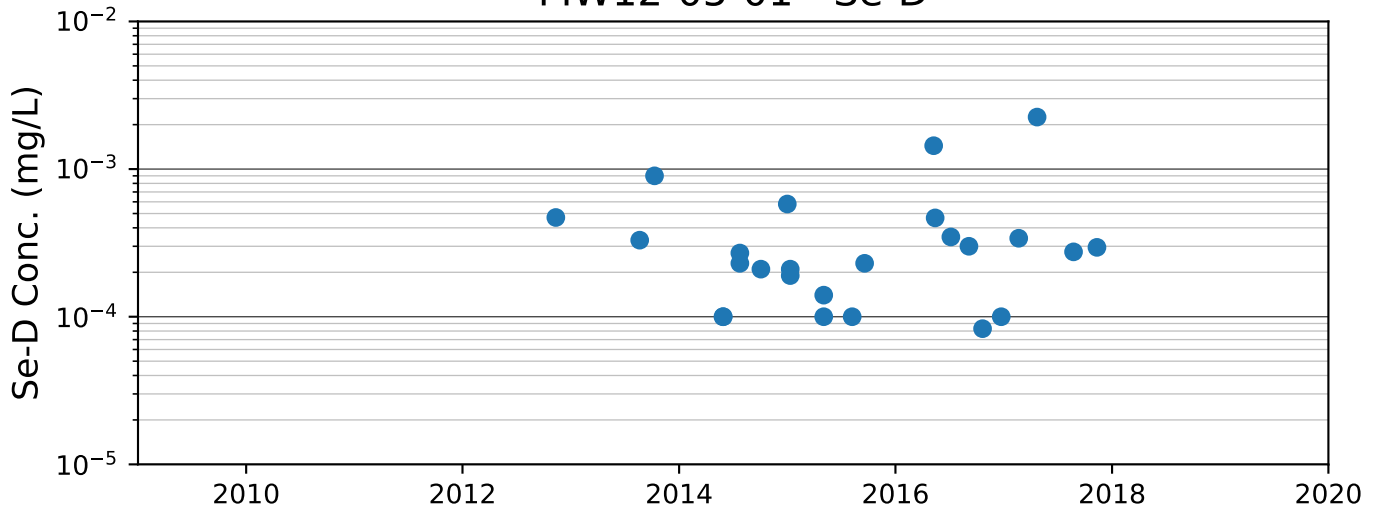
MW12-05-01 - Mo-D



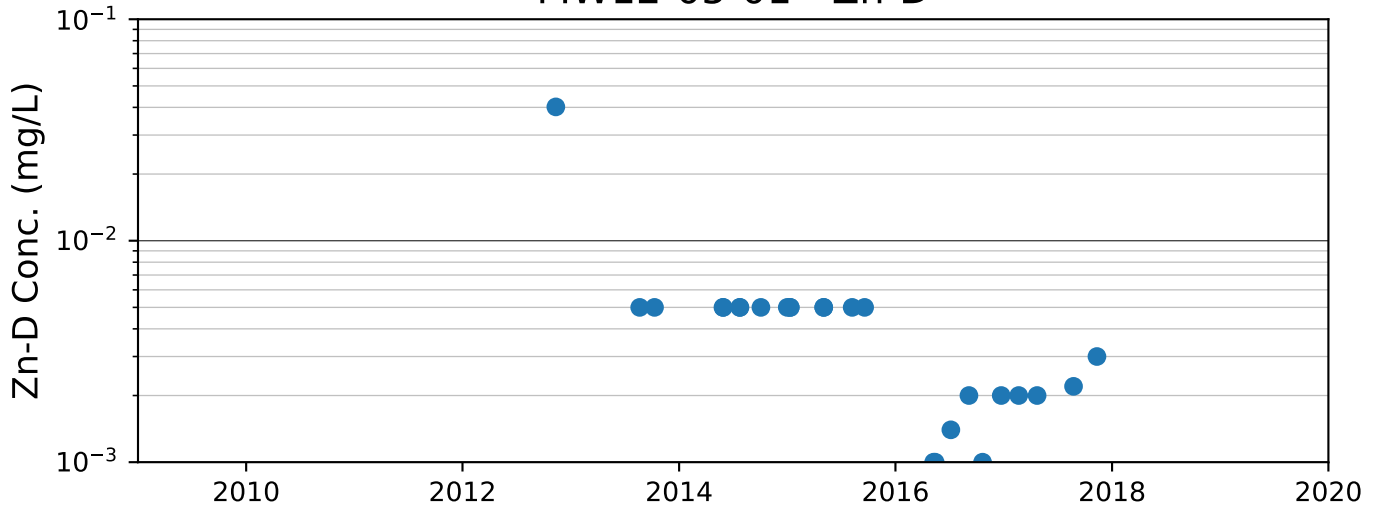
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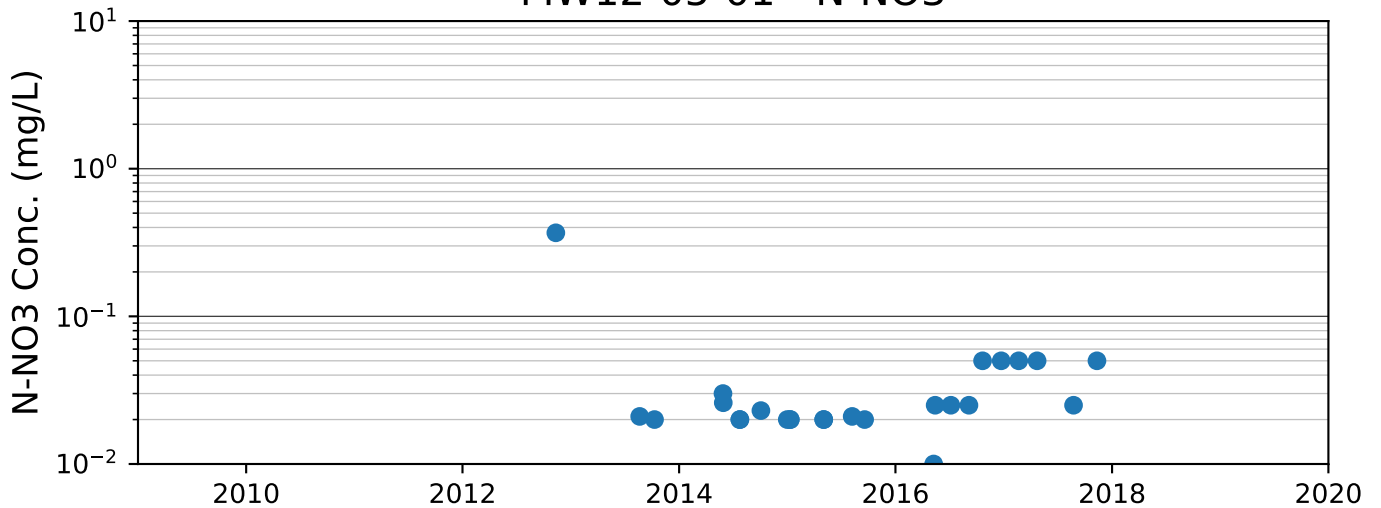
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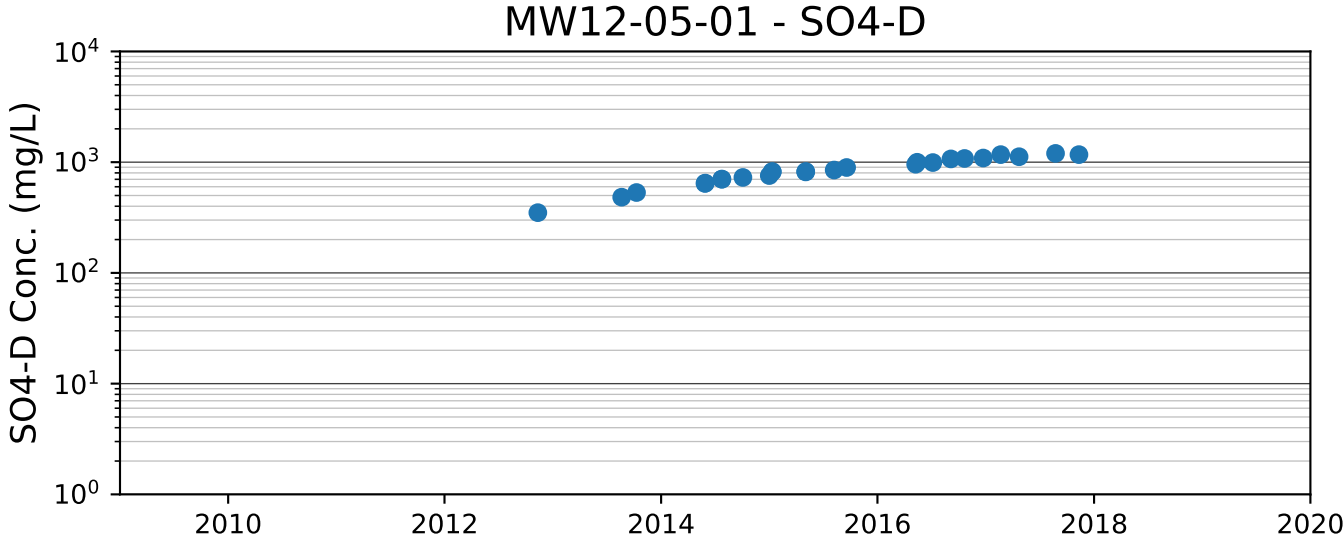


MW12-05-01 - Zn-D

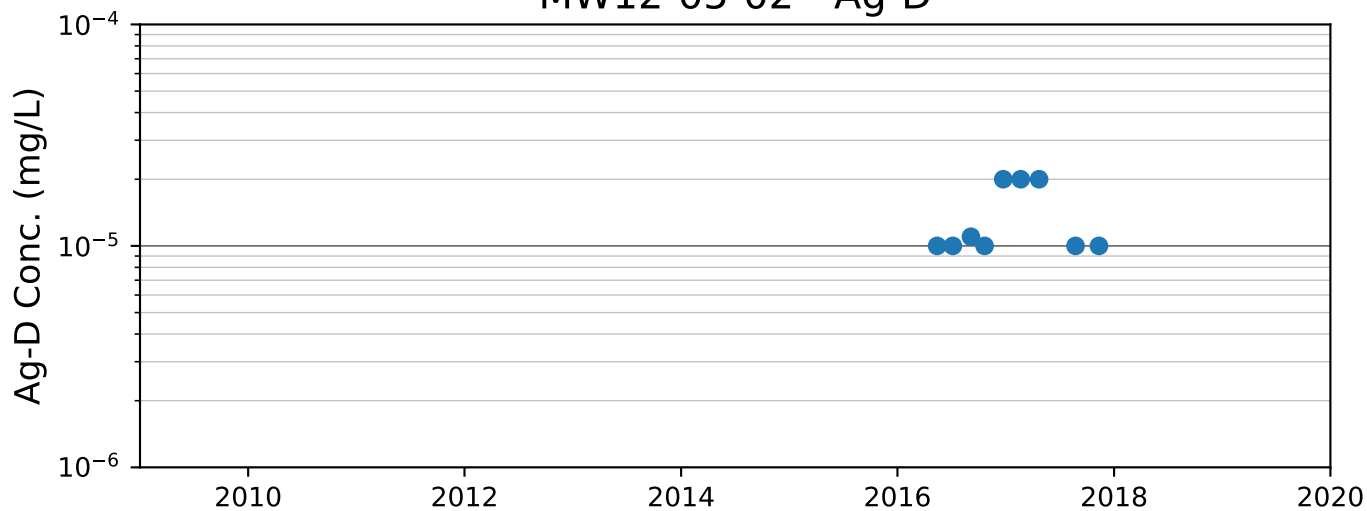


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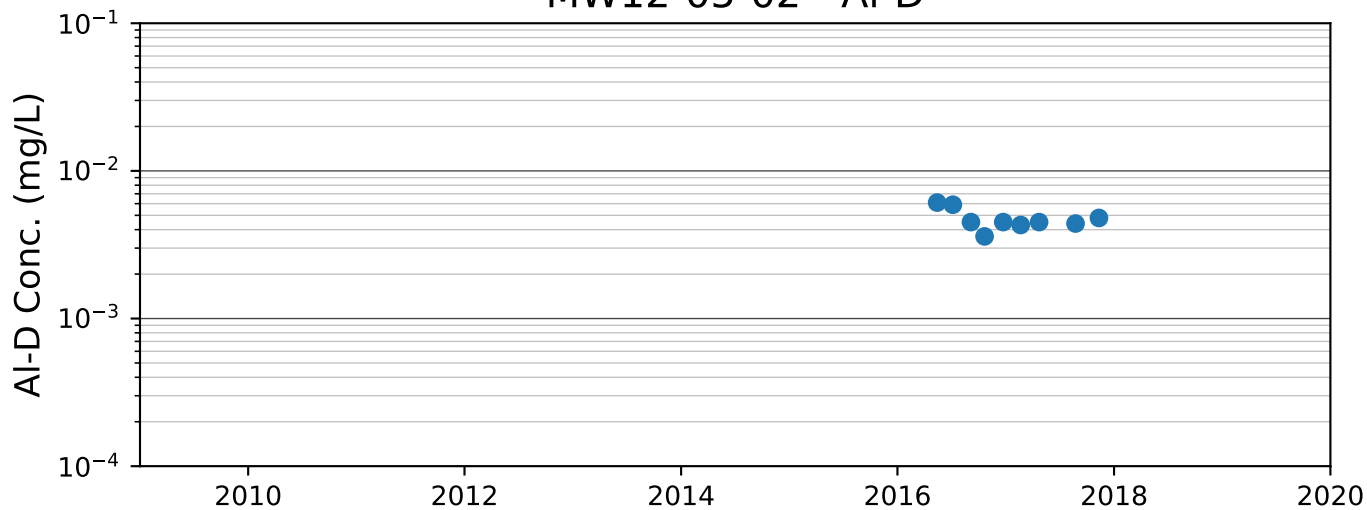




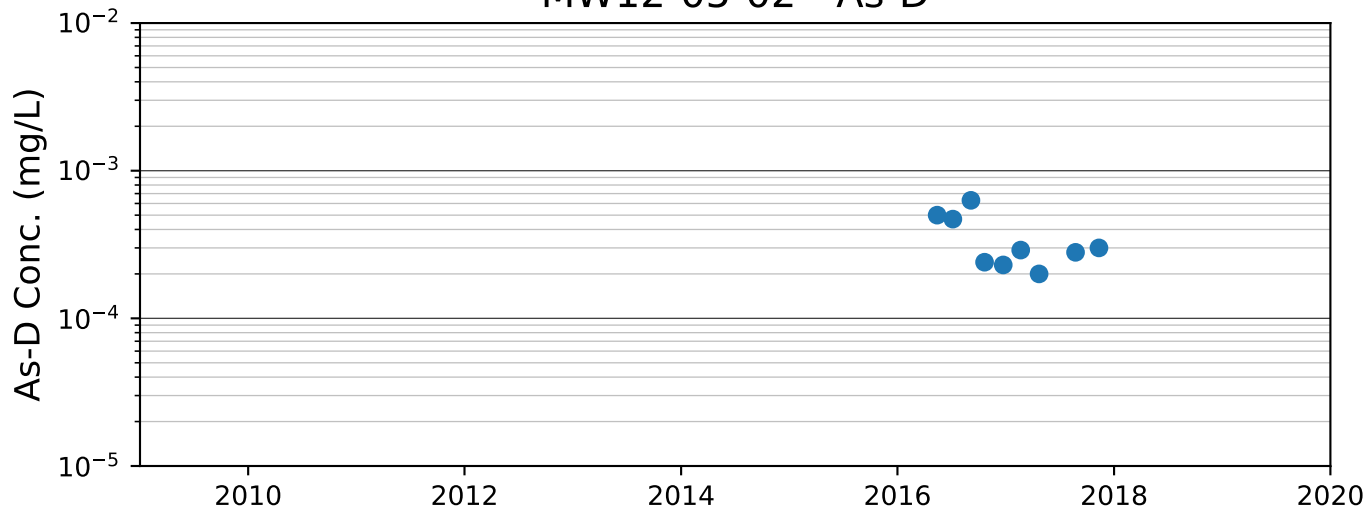
MW12-05-02 - Ag-D



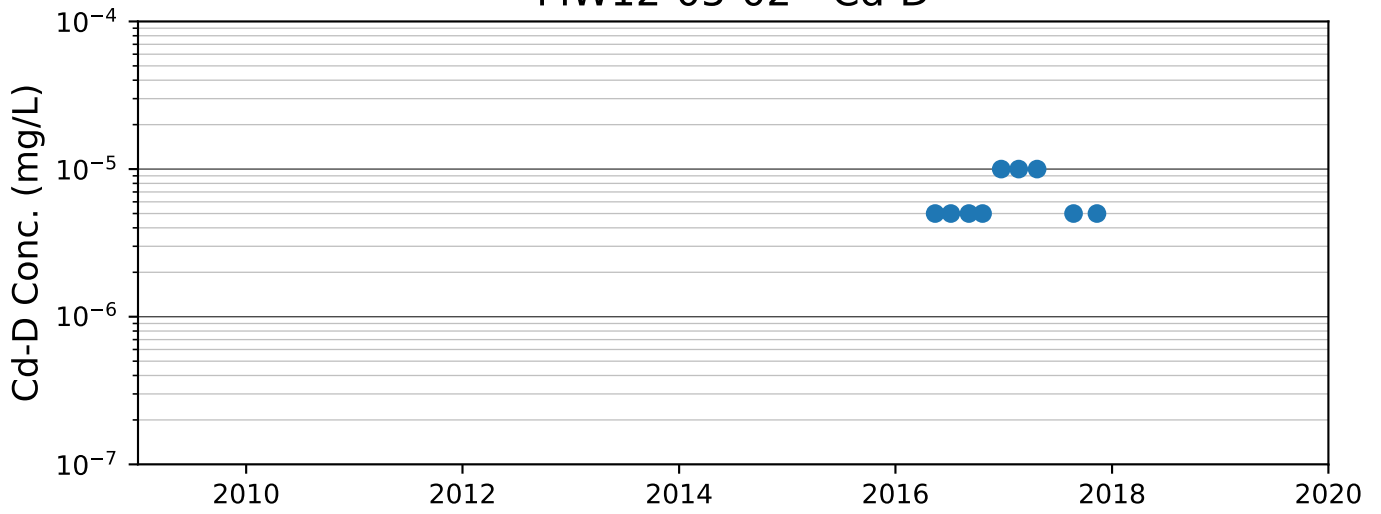
MW12-05-02 - Al-D



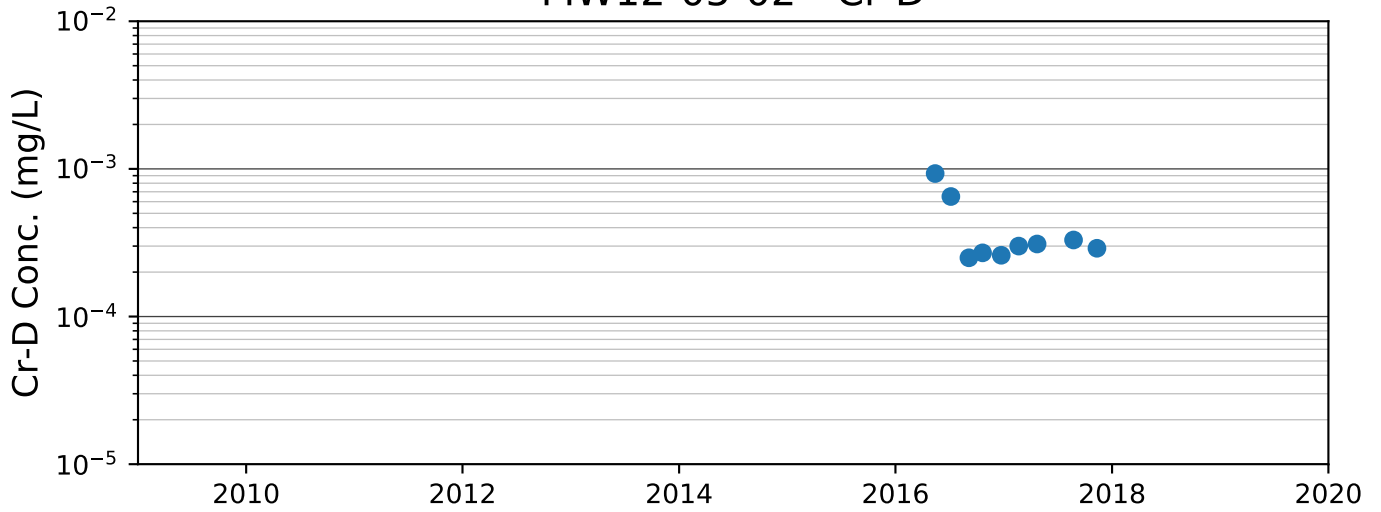
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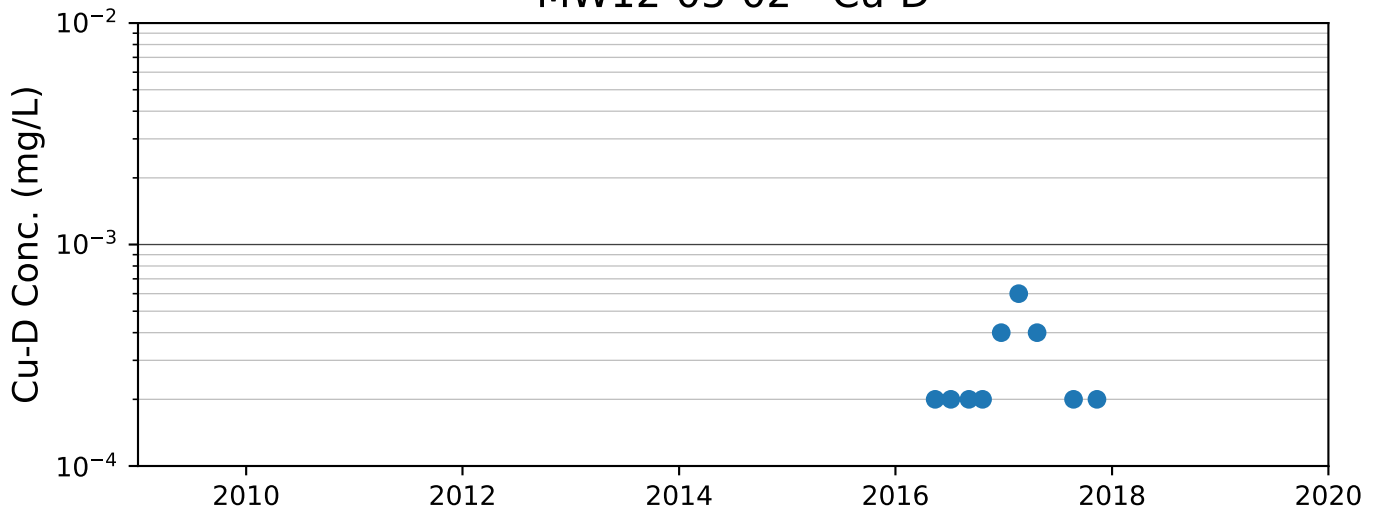
MW12-05-02 - Cd-D



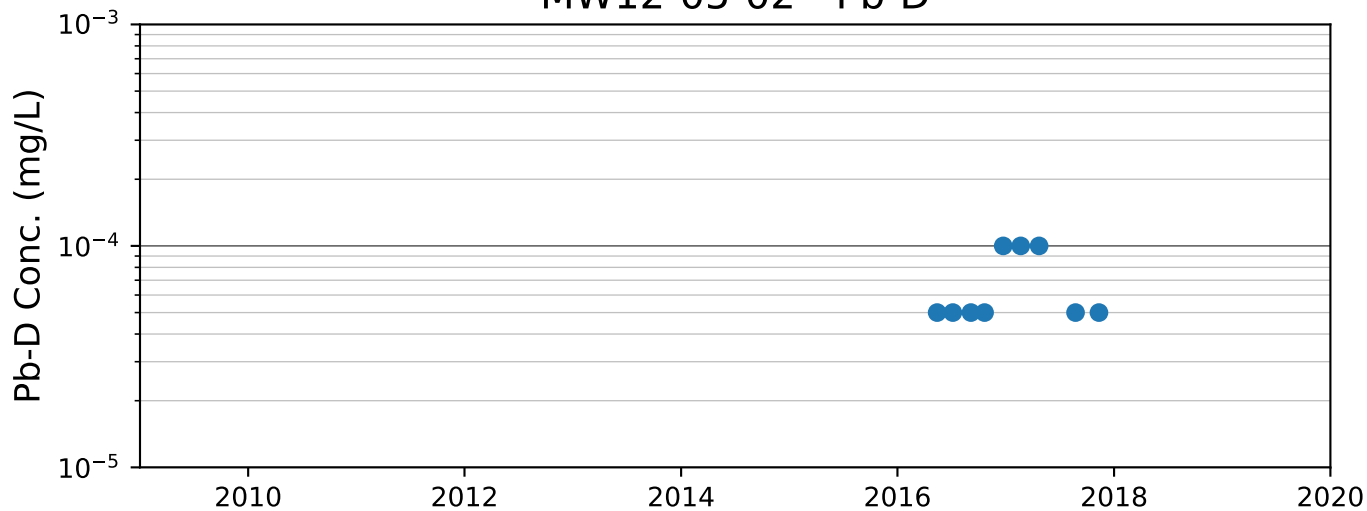
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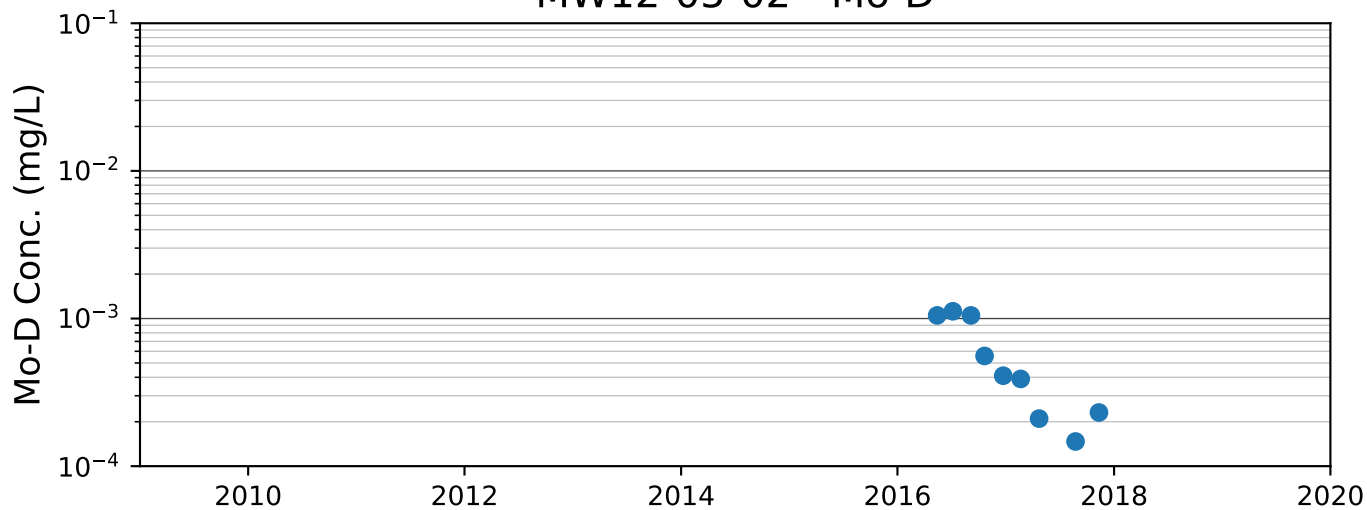
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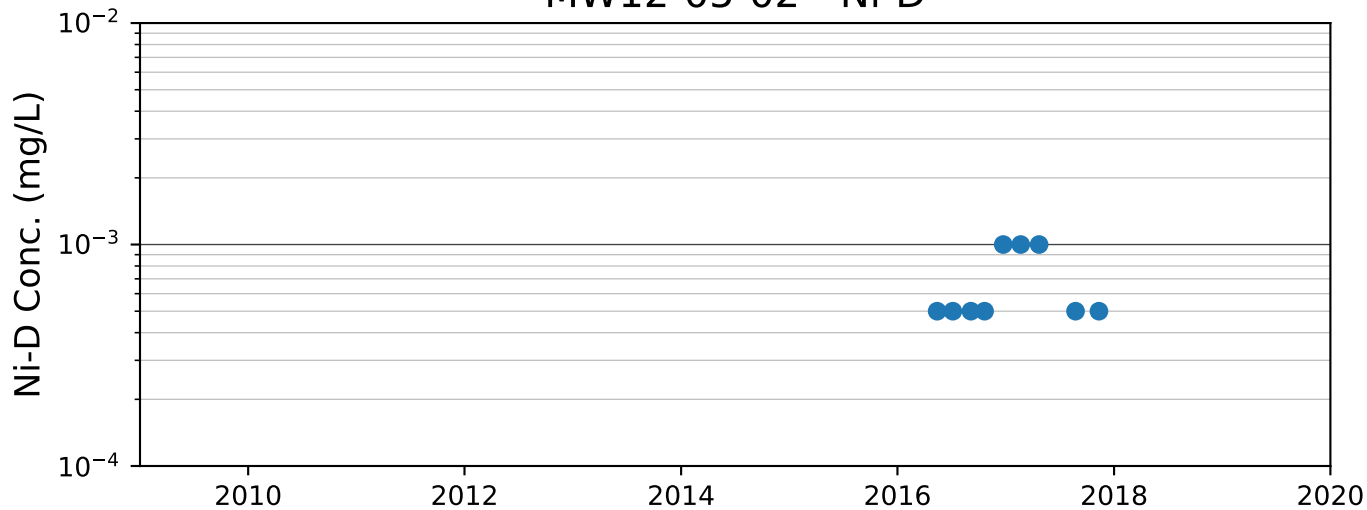
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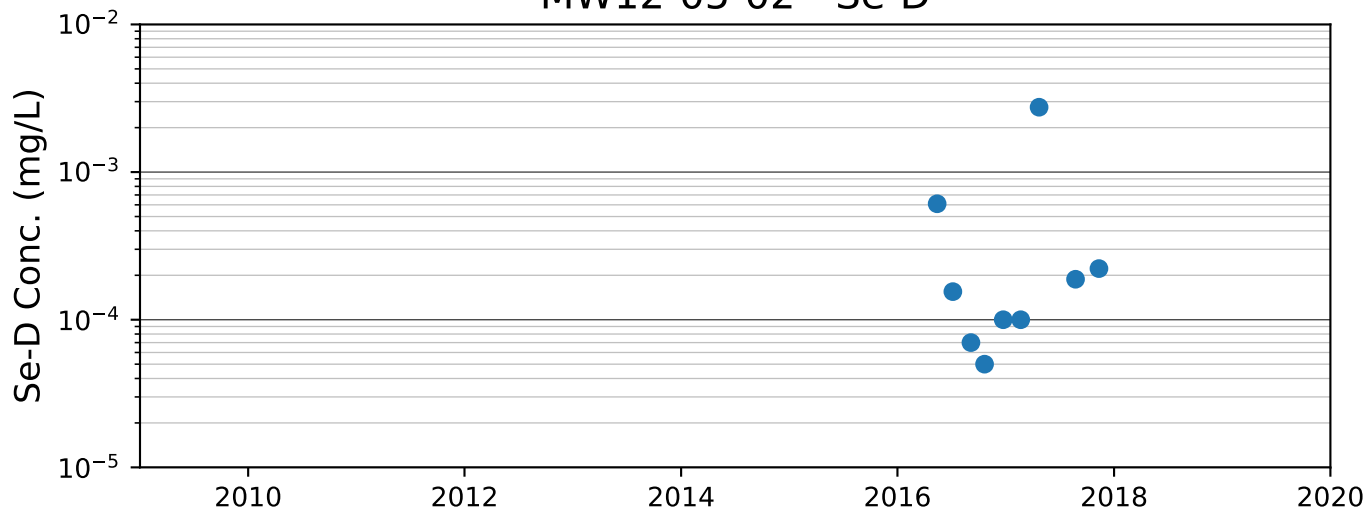
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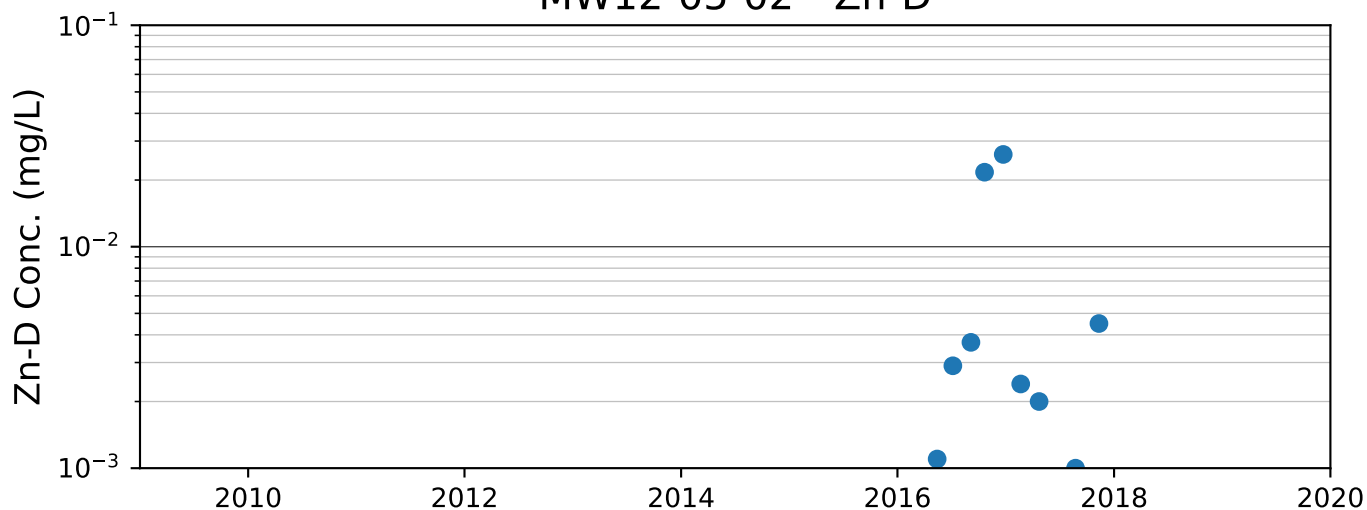
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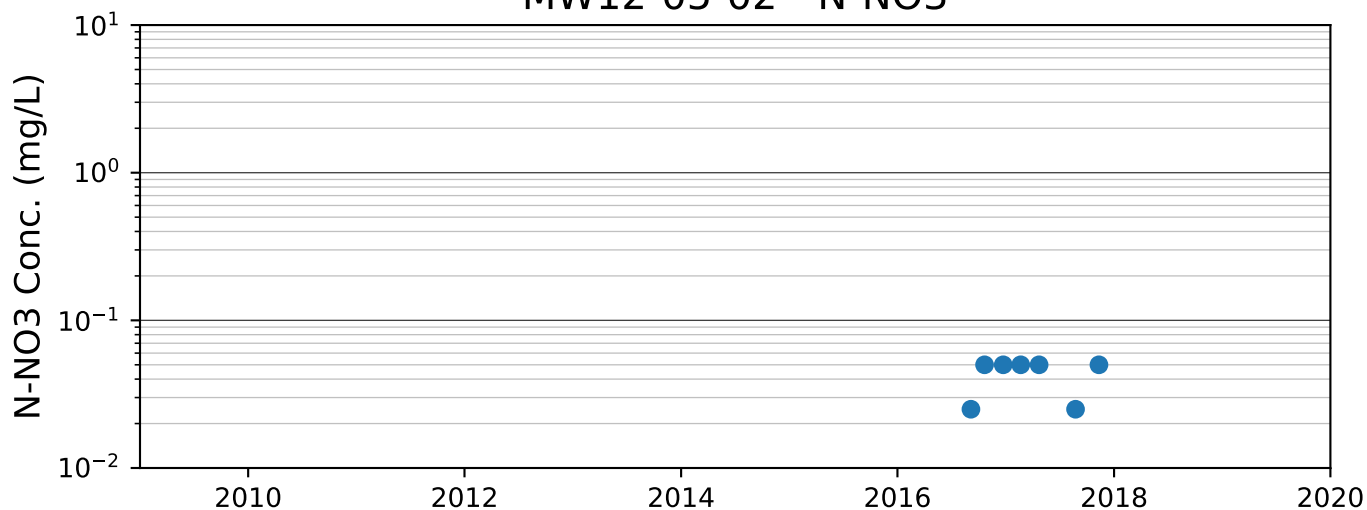
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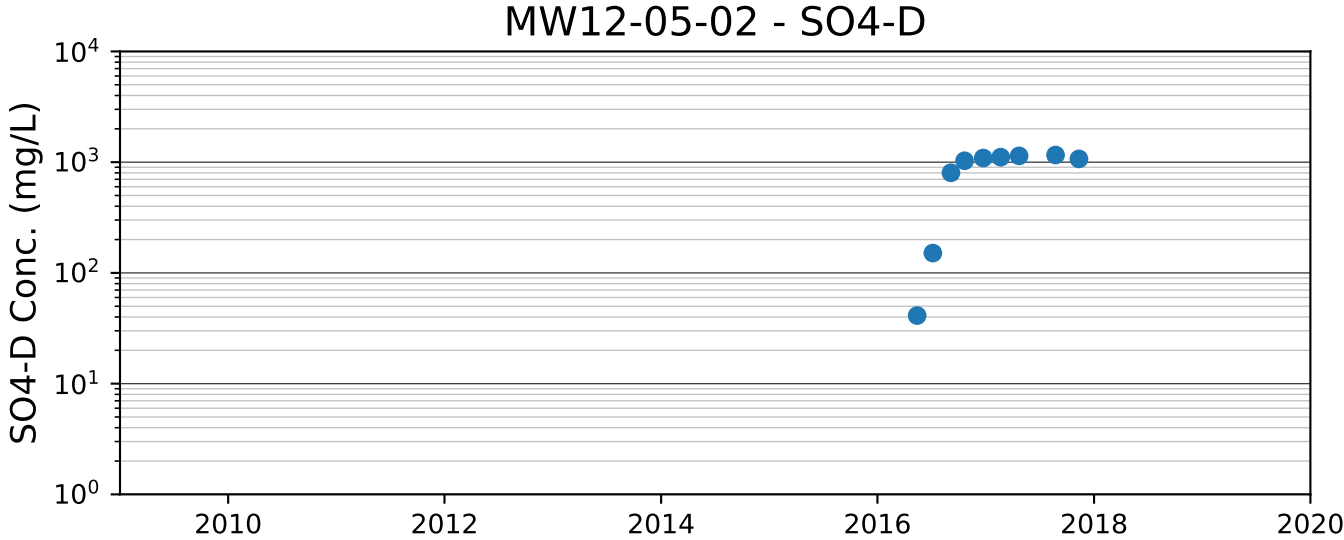


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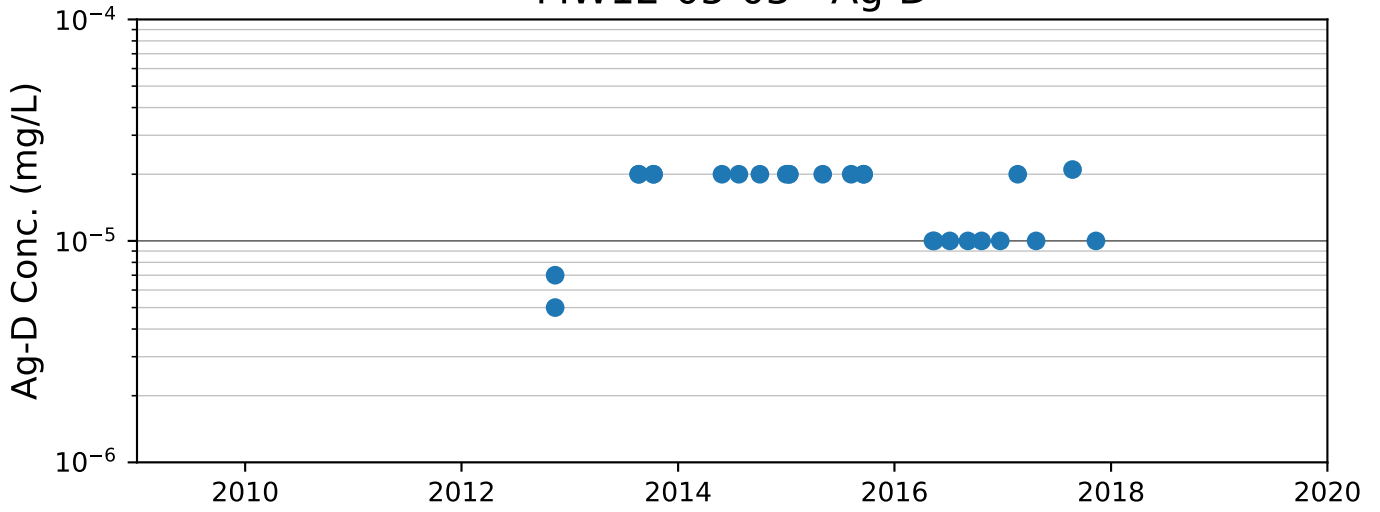


MW12-05-02 - N-NO3

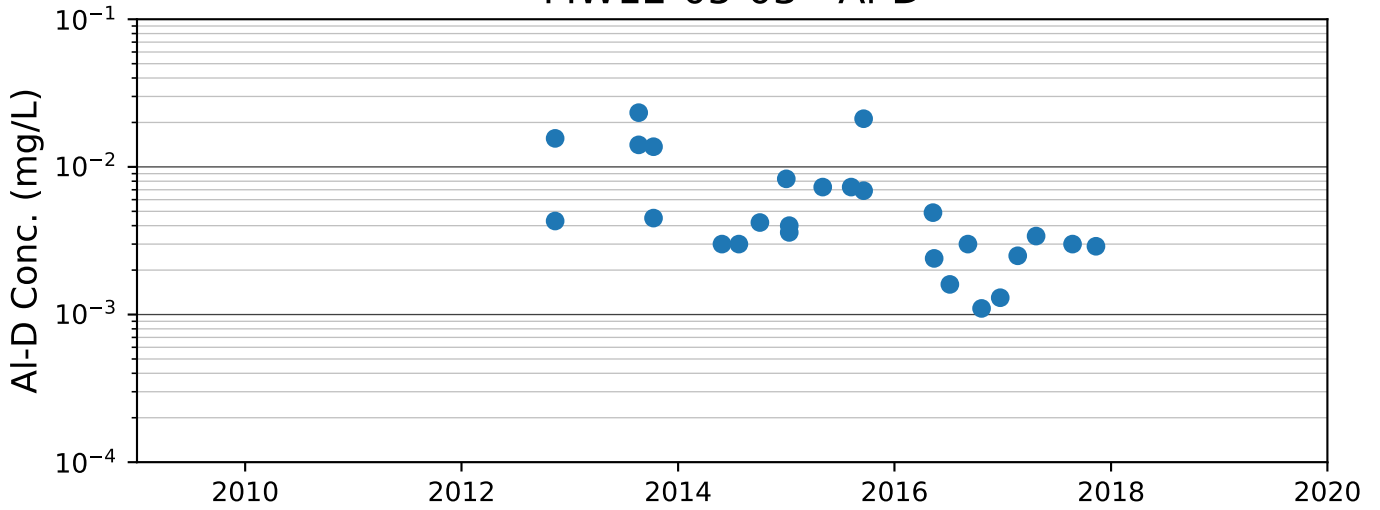




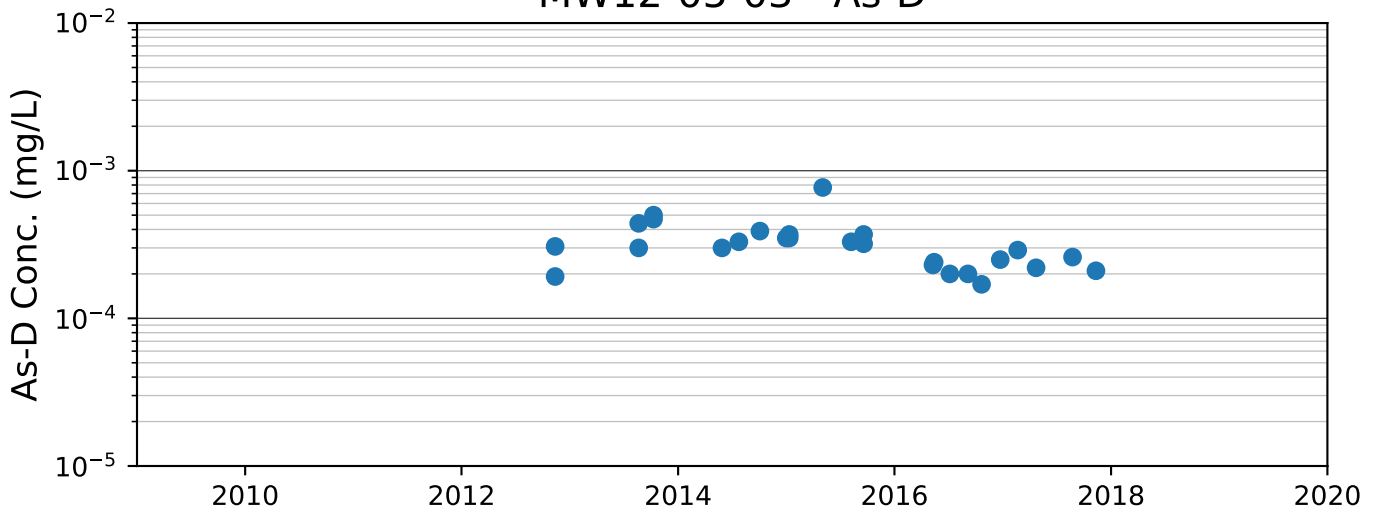
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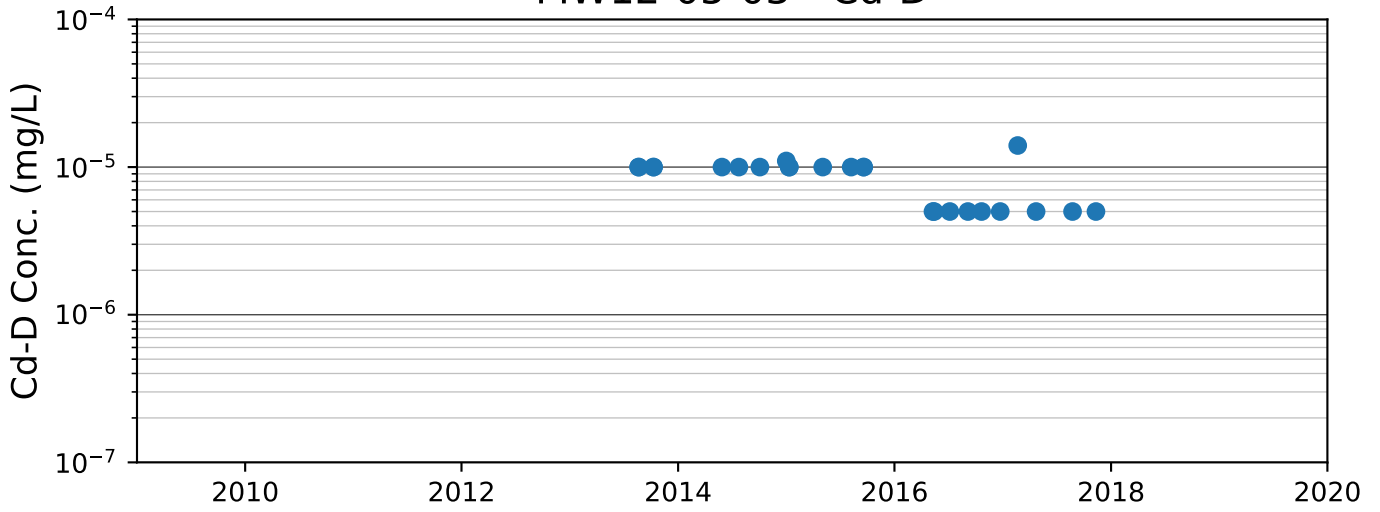
MW12-05-03 - Al-D



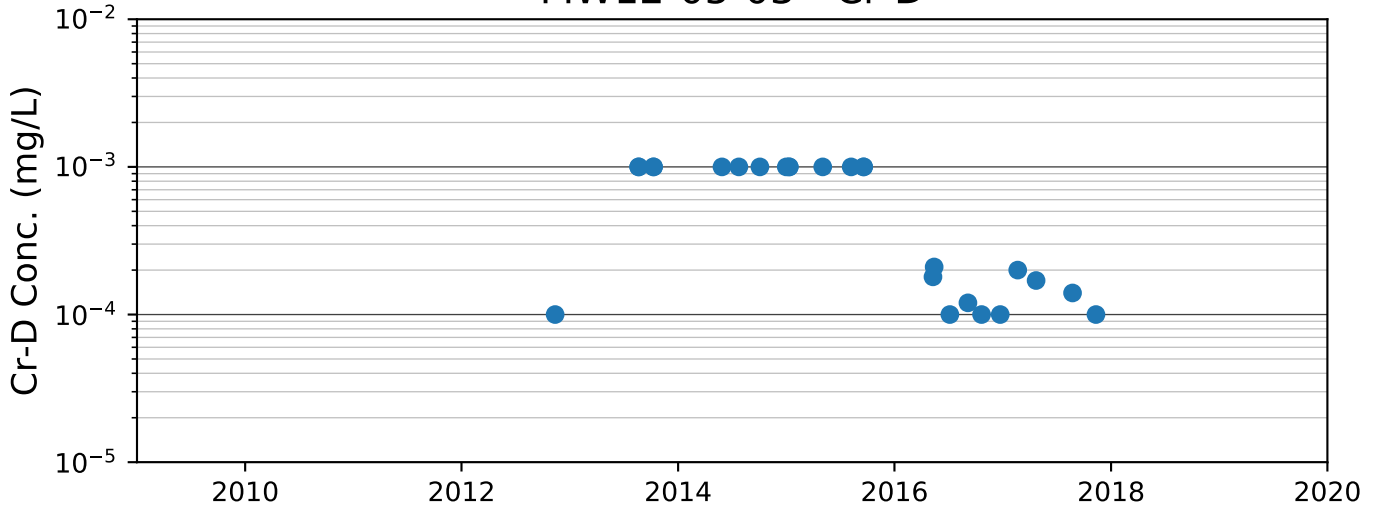
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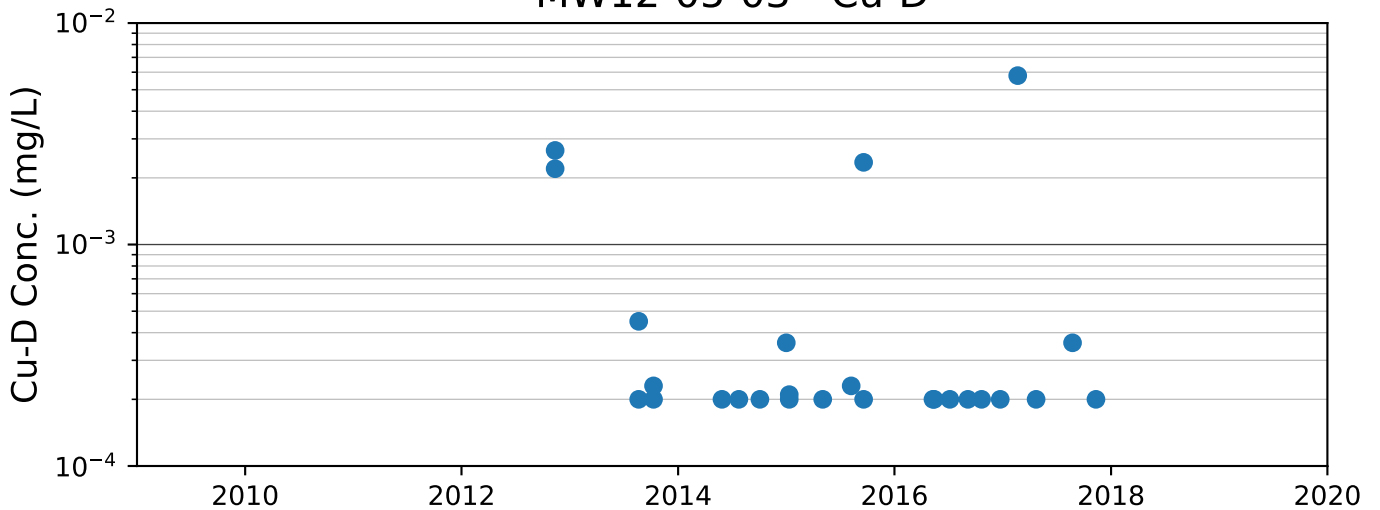
MW12-05-03 - Cd-D



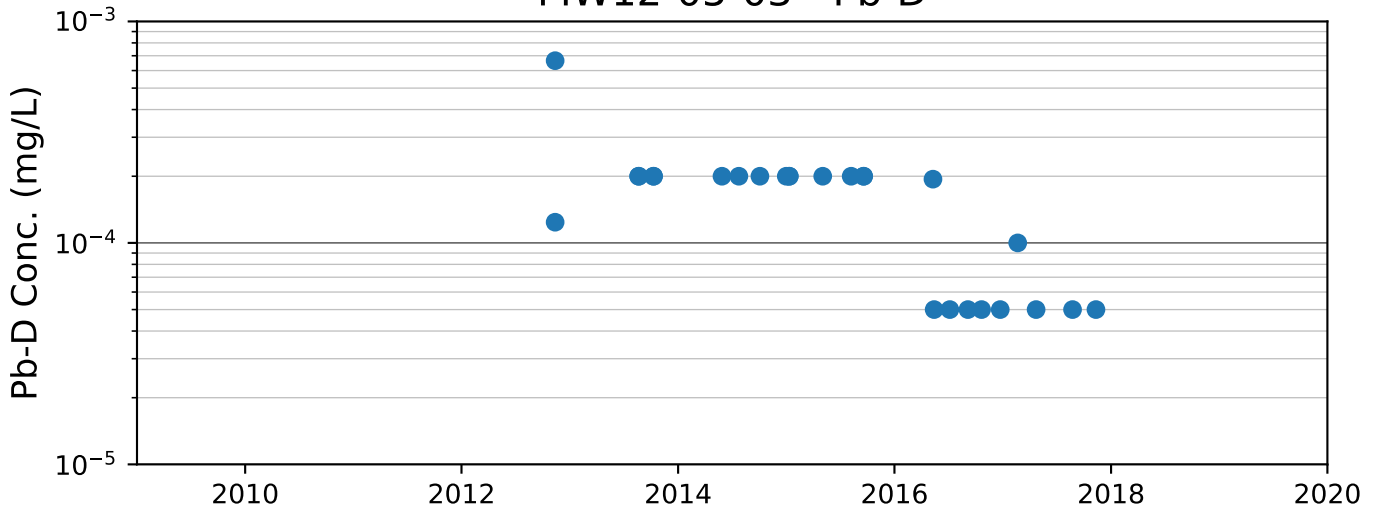
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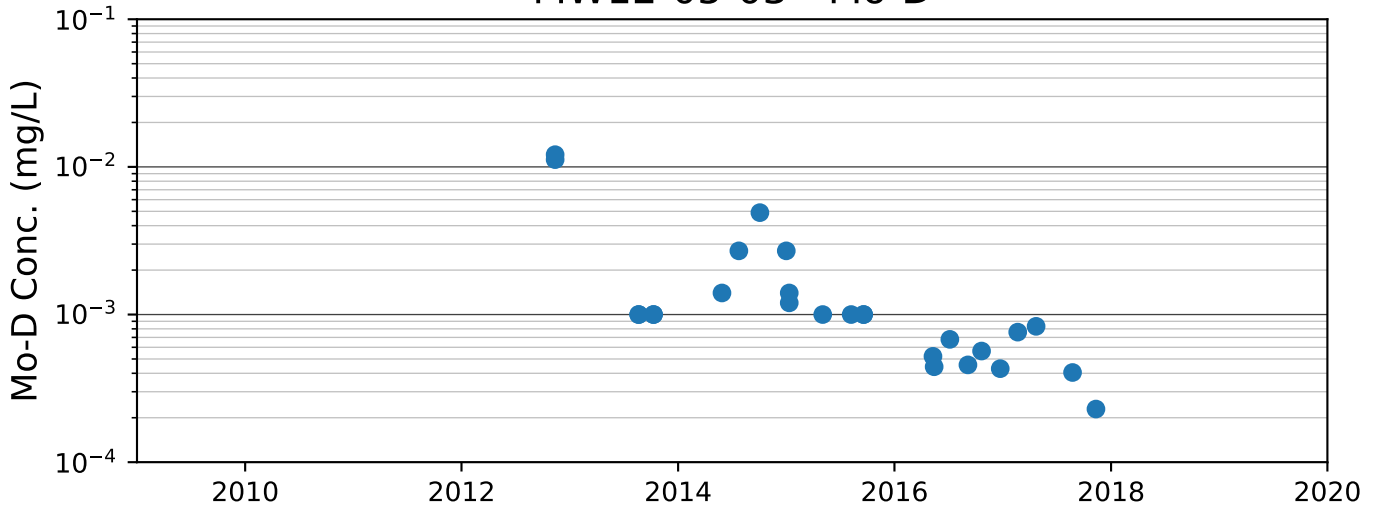
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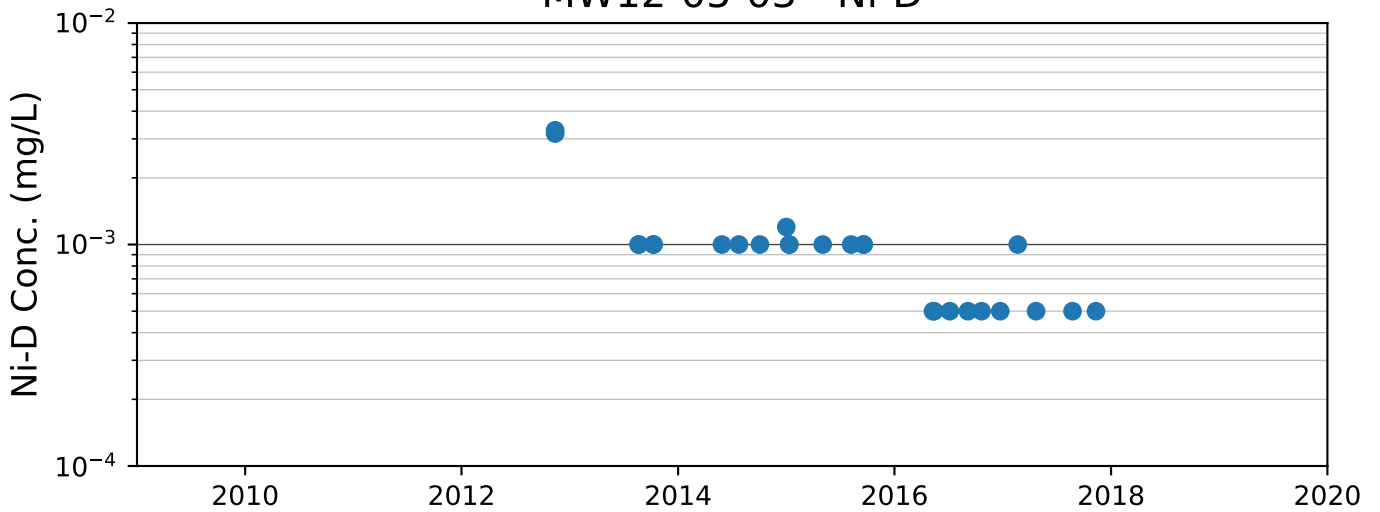
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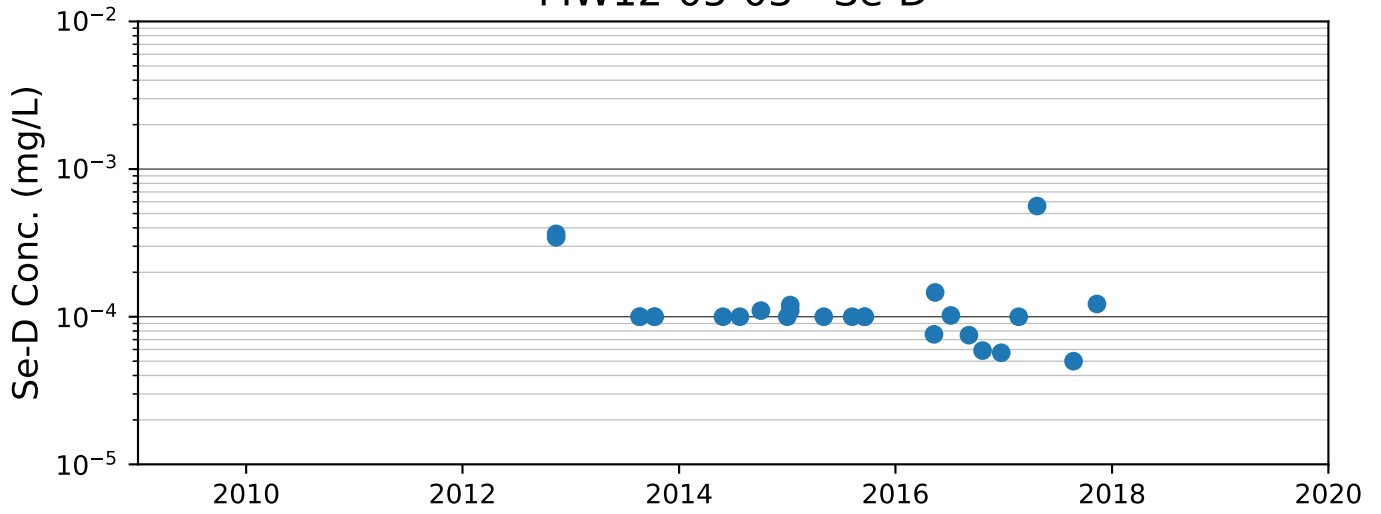
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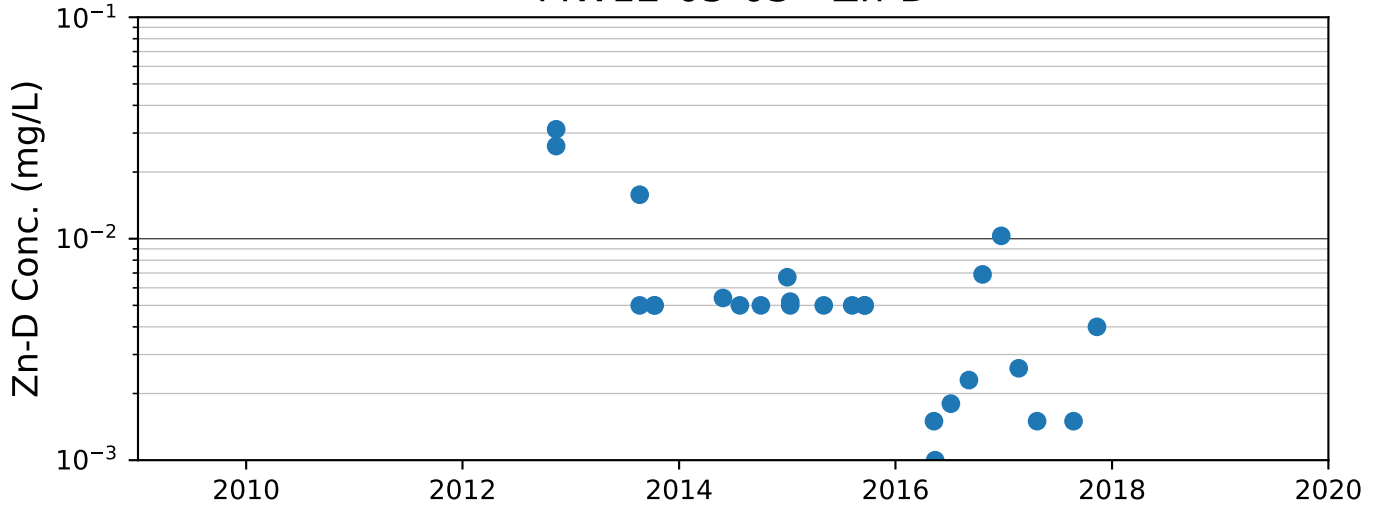
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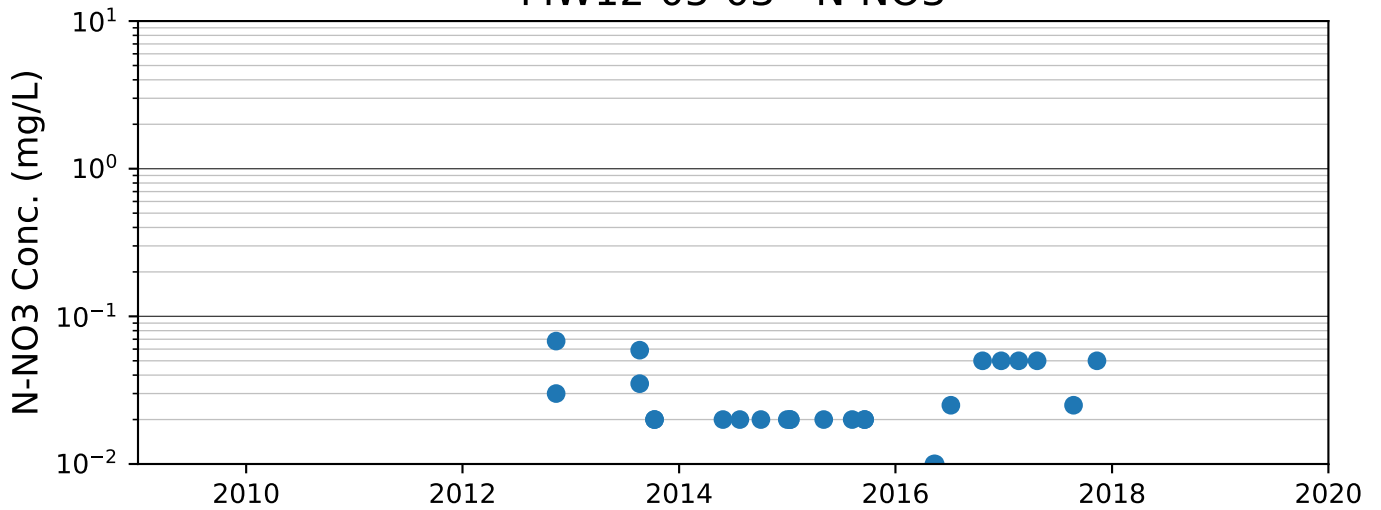
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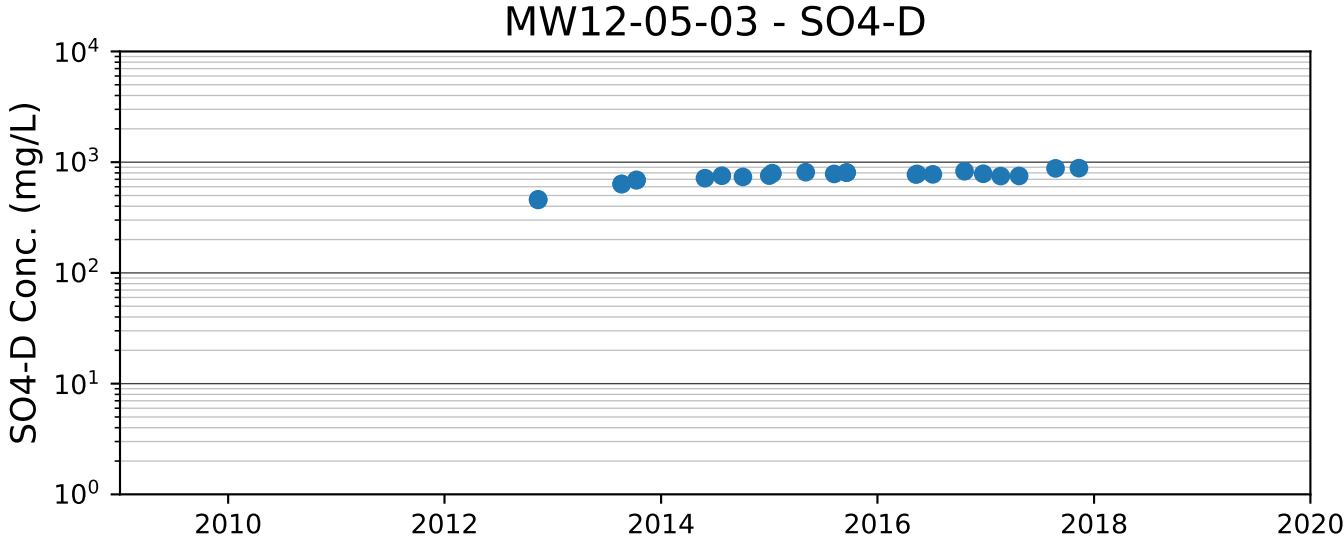


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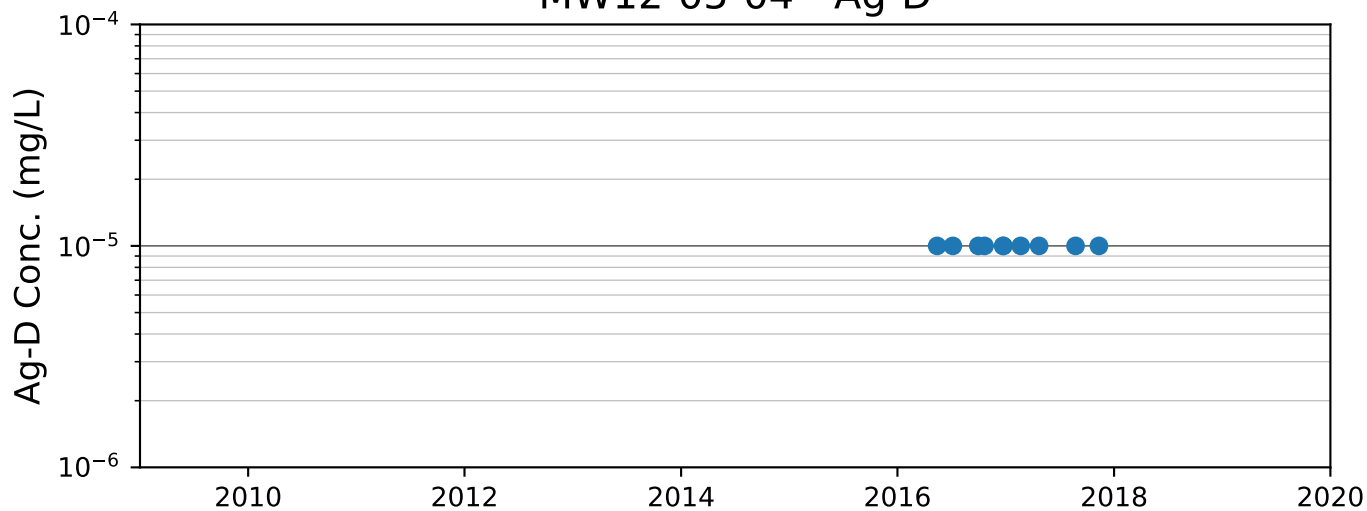


MW12-05-03 - N-NO3

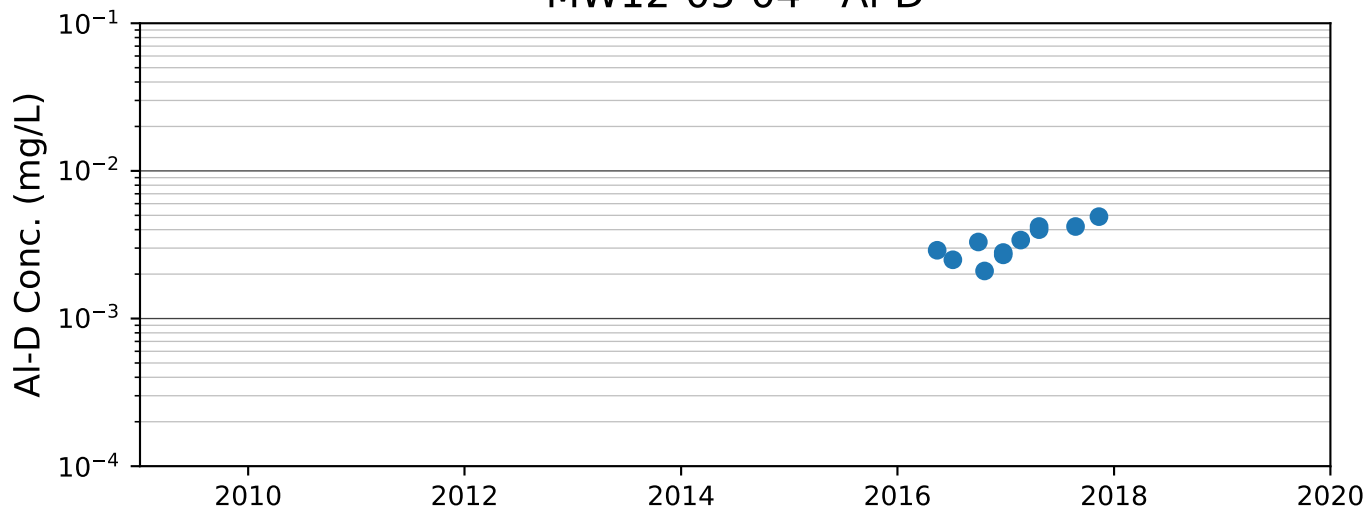




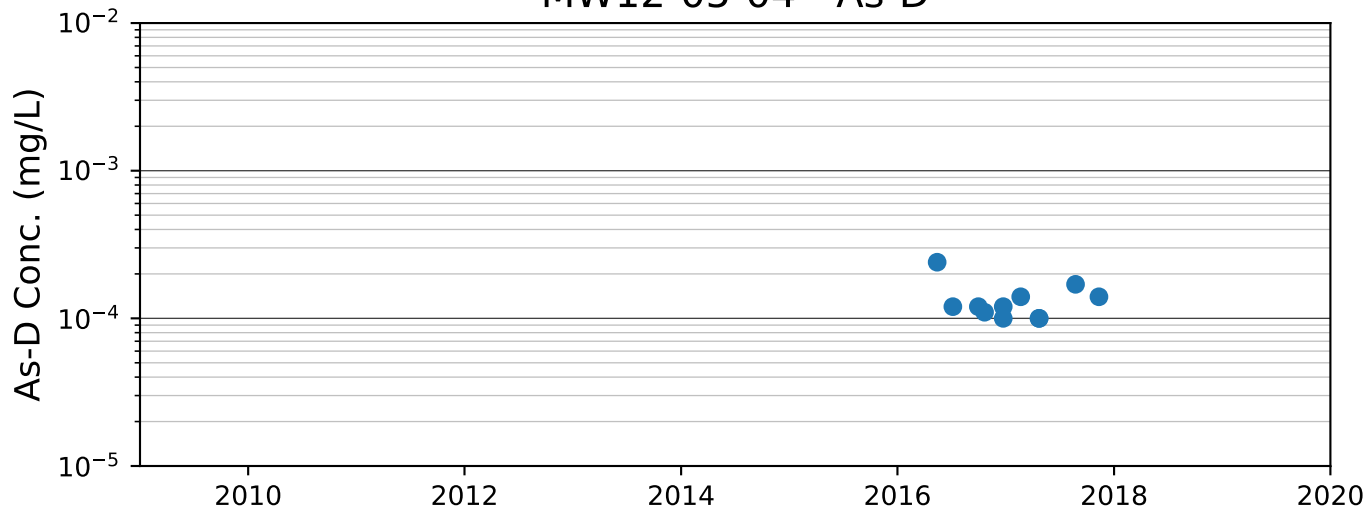
MW12-05-04 - Ag-D



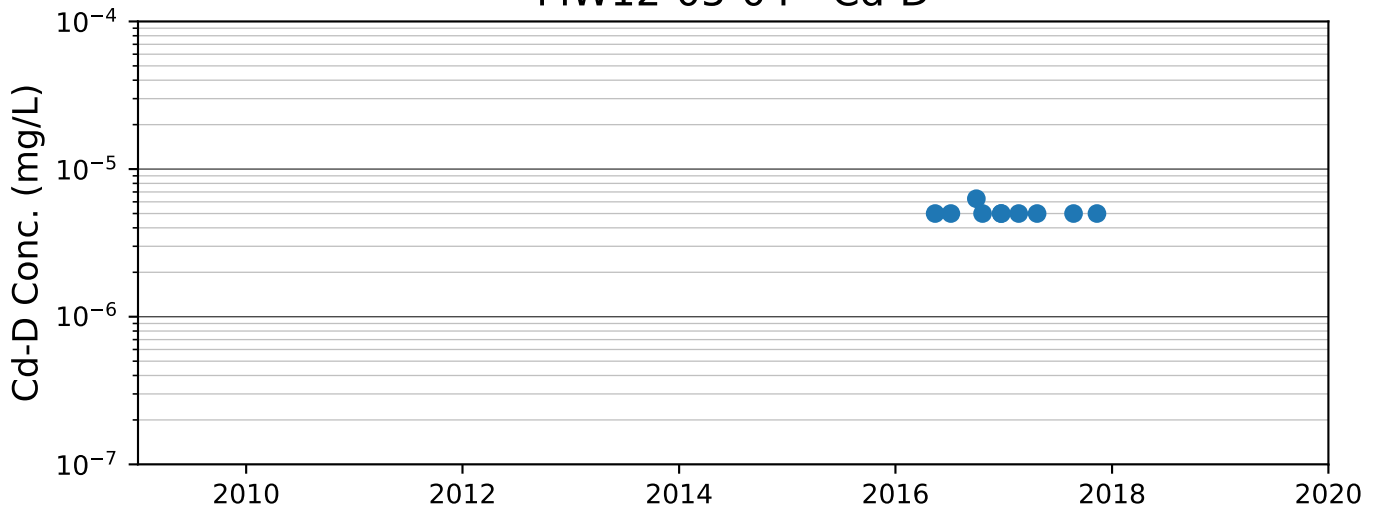
MW12-05-04 - Al-D



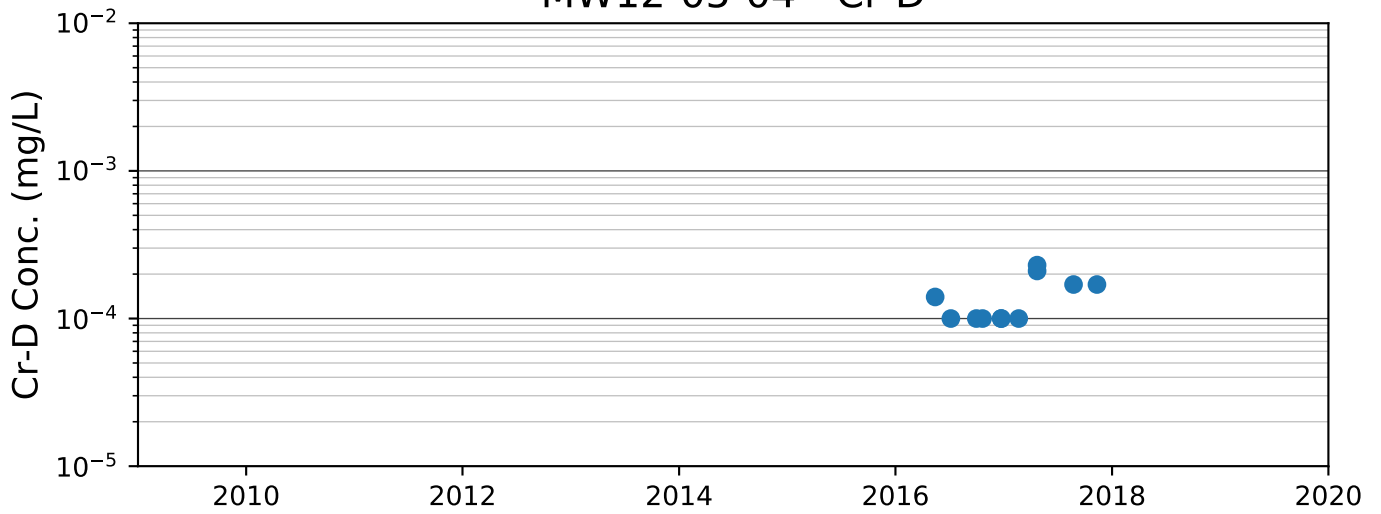
MW12-05-04 - As-D



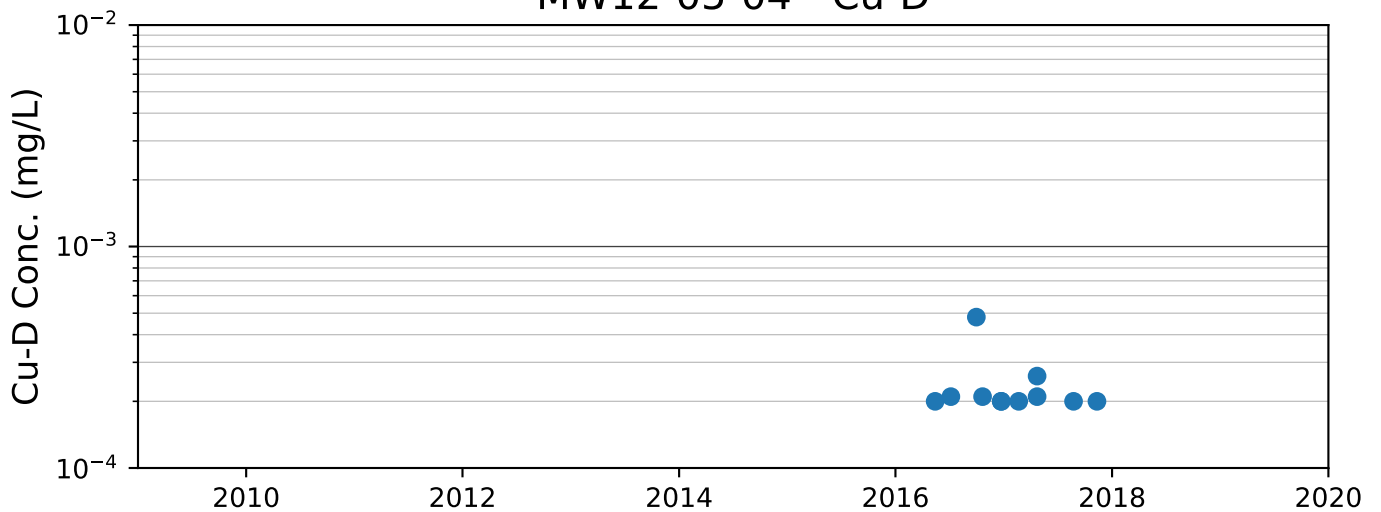
MW12-05-04 - Cd-D



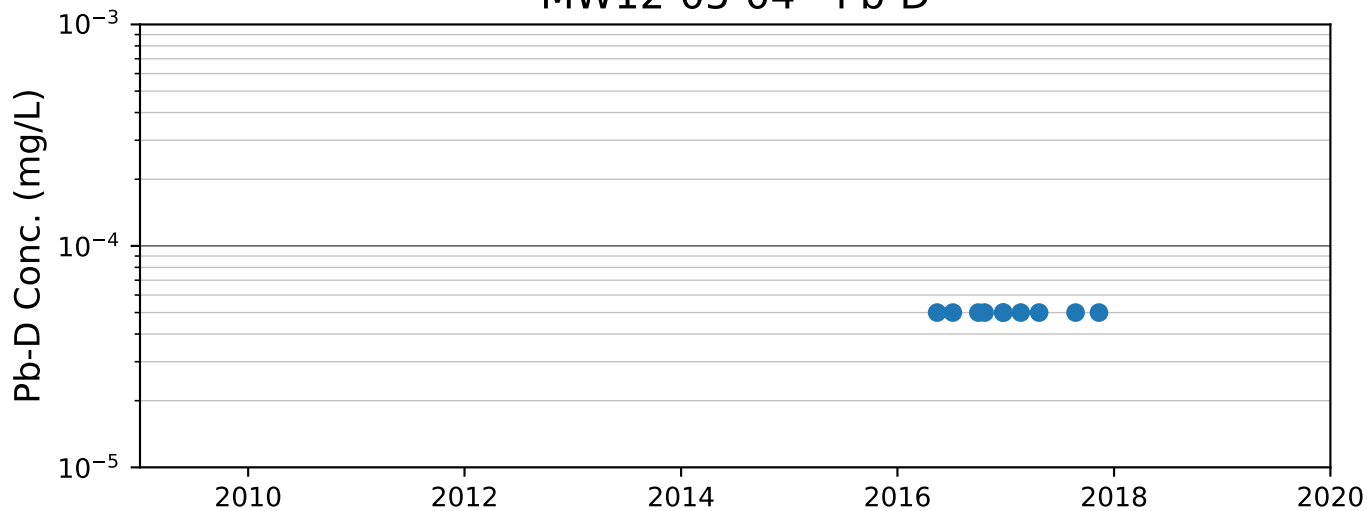
MW12-05-04 - Cr-D



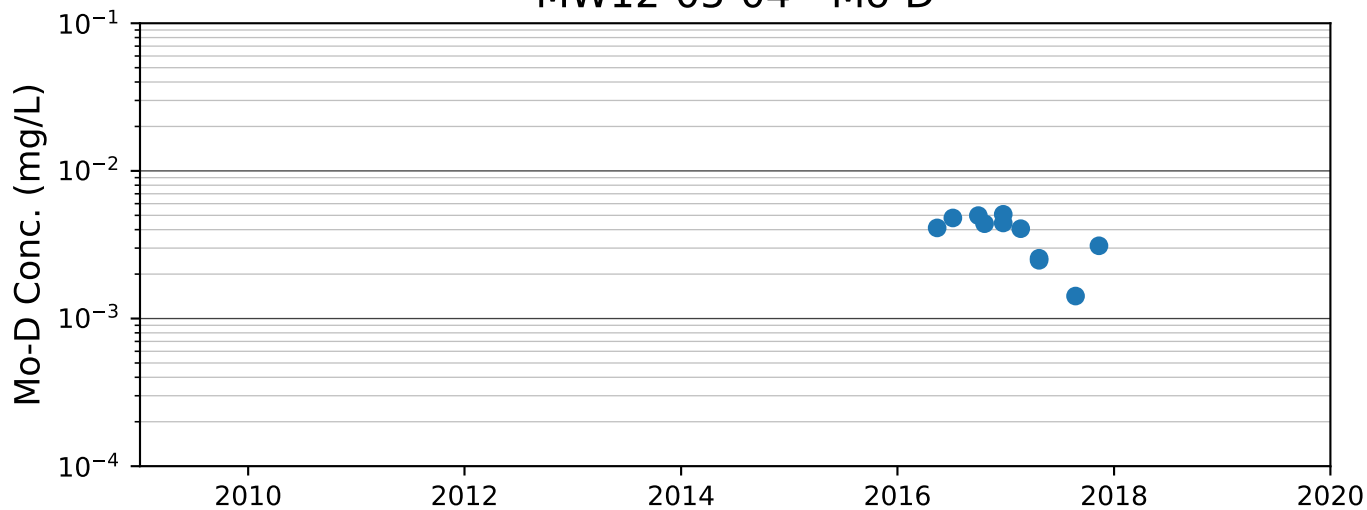
MW12-05-04 - Cu-D



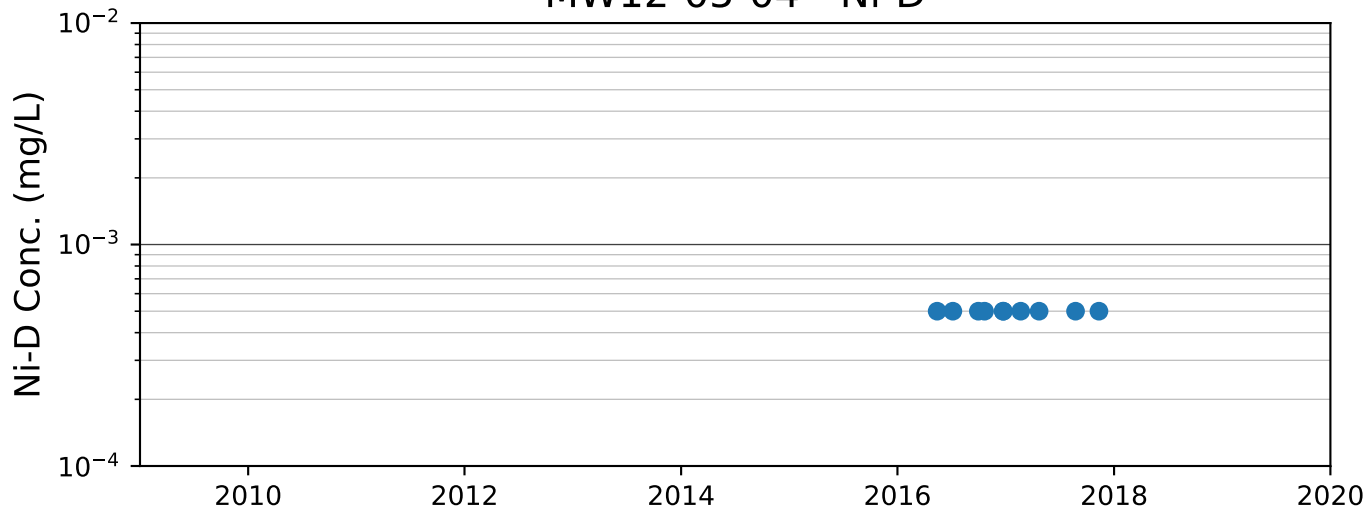
MW12-05-04 - Pb-D



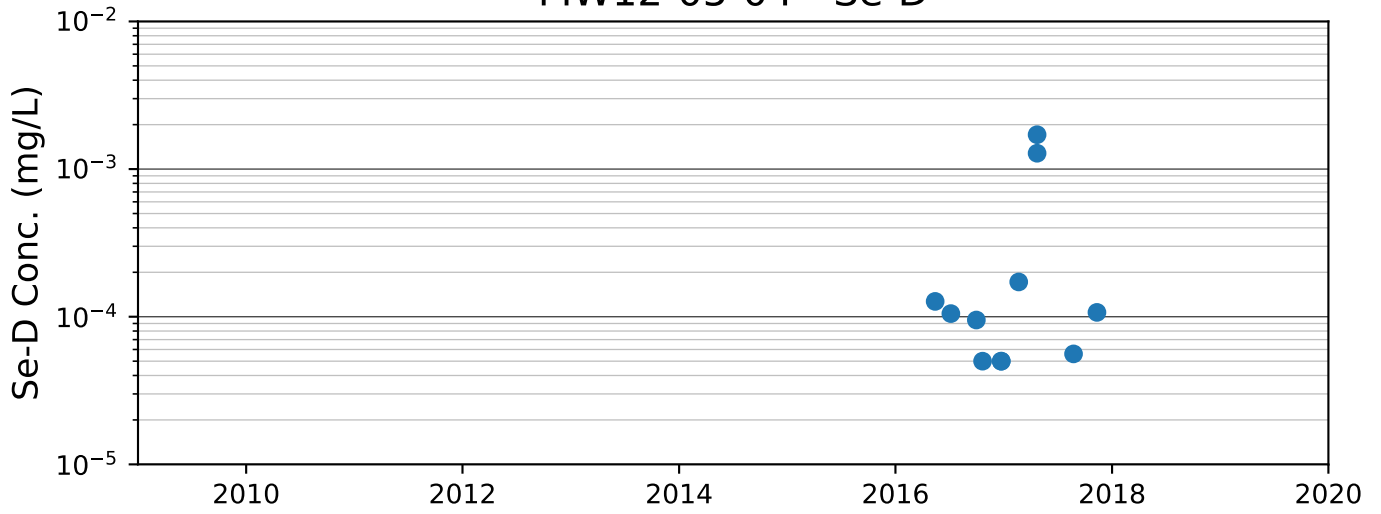
MW12-05-04 - Mo-D



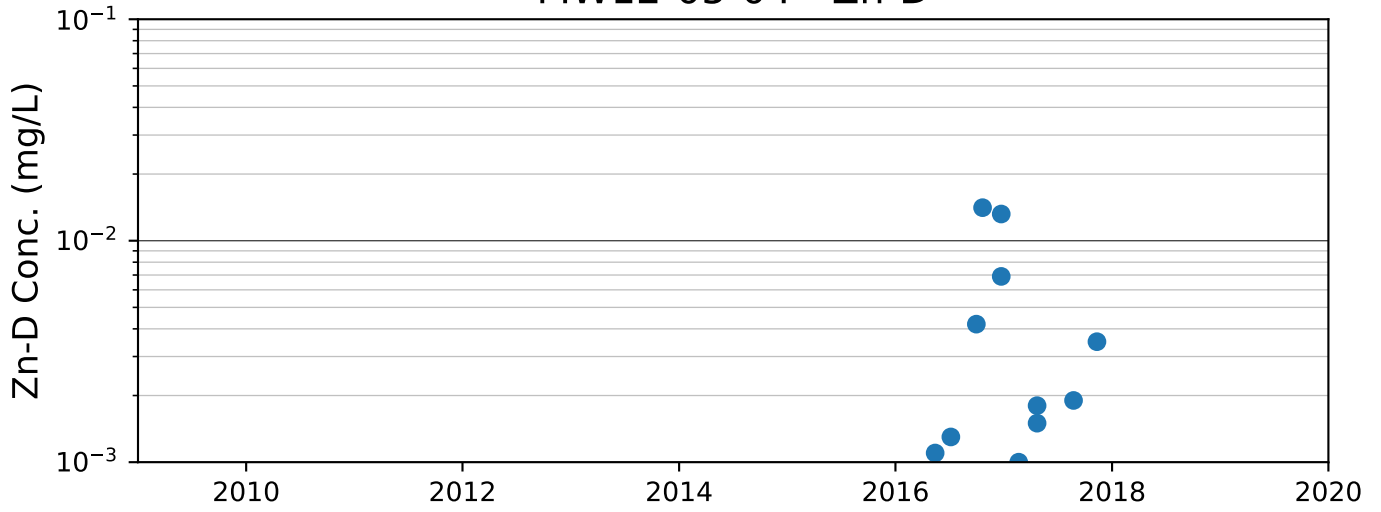
MW12-05-04 - Ni-D



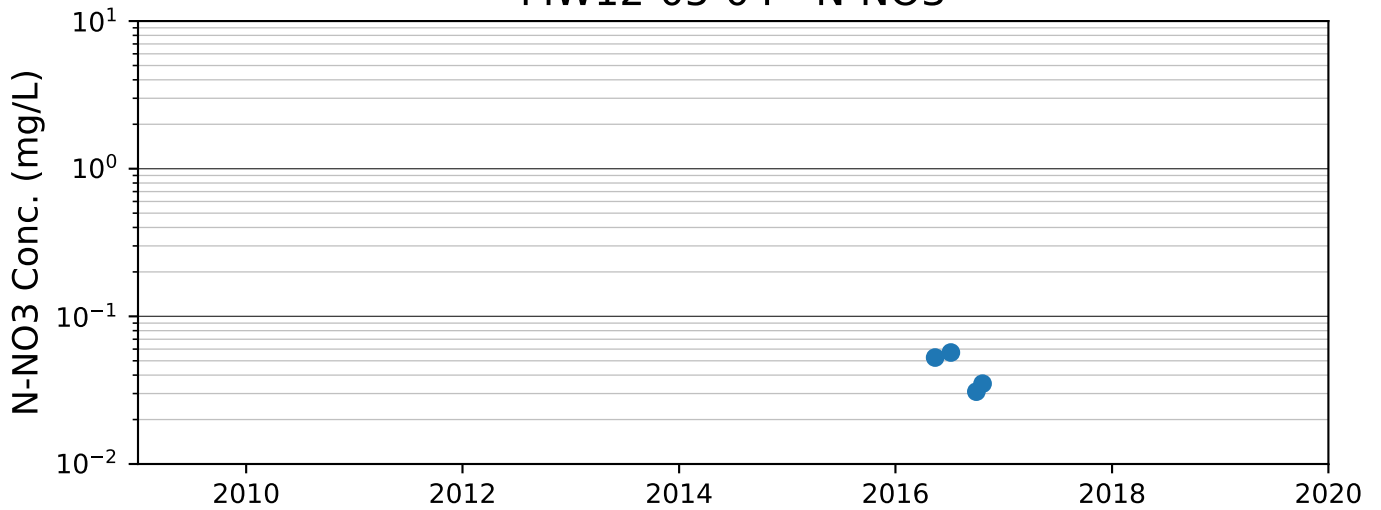
MW12-05-04 - Se-D

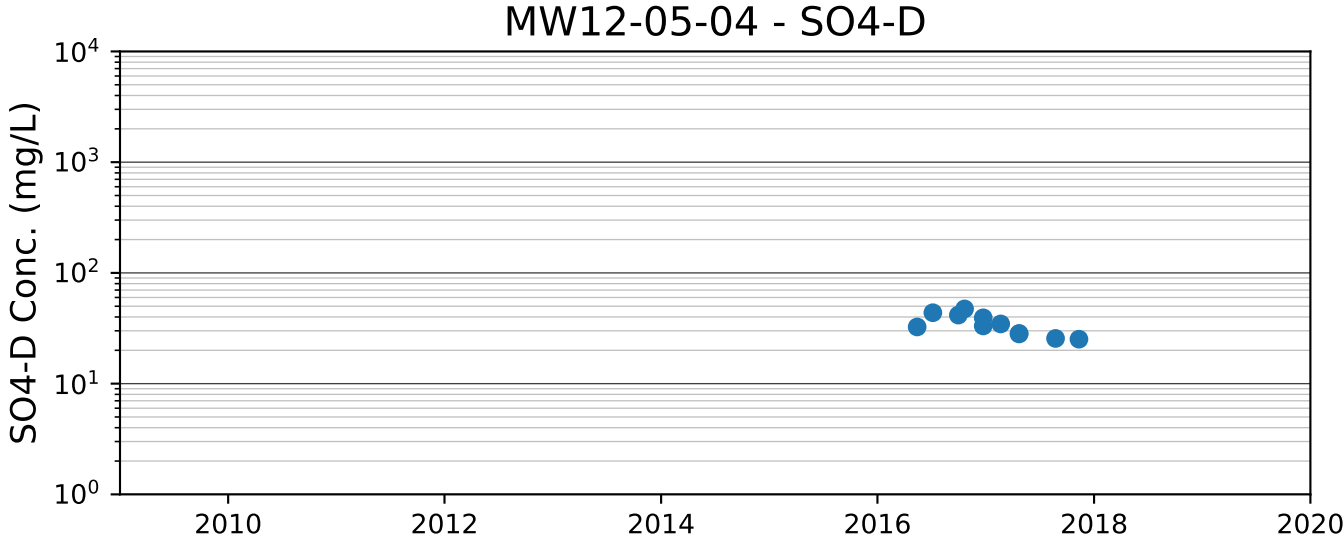


MW12-05-04 - Zn-D

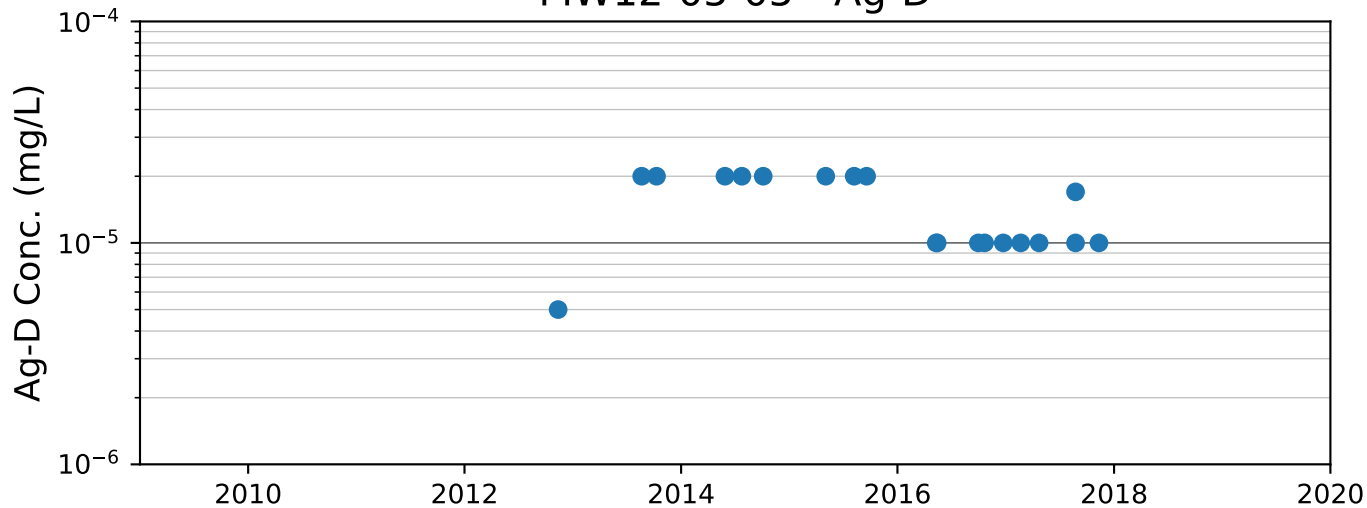


MW12-05-04 - N-NO3

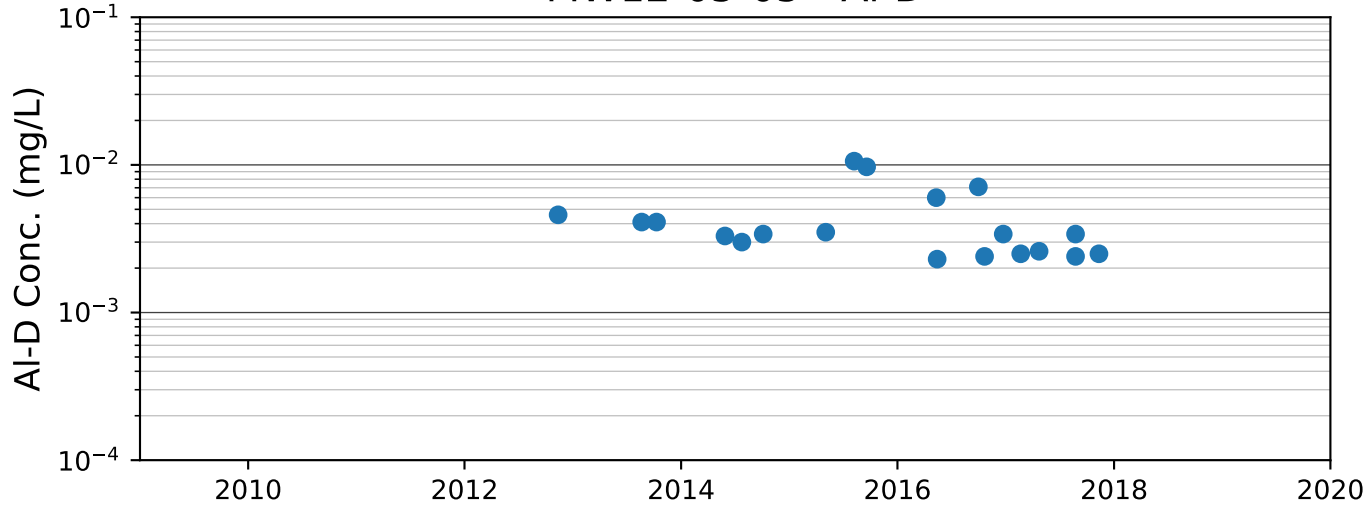




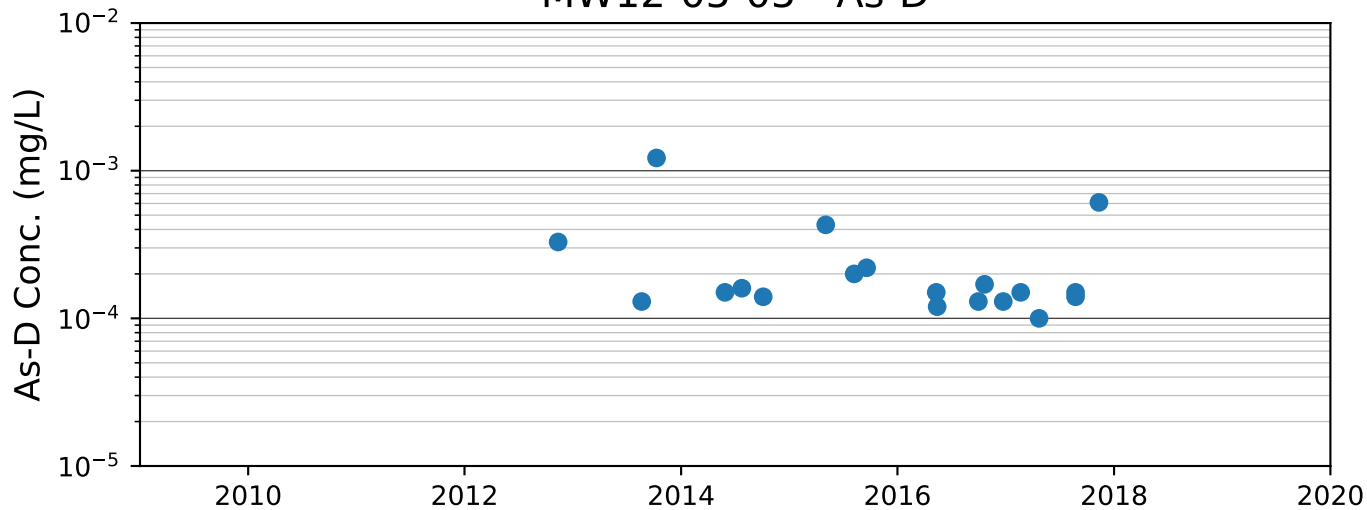
MW12-05-05 - Ag-D



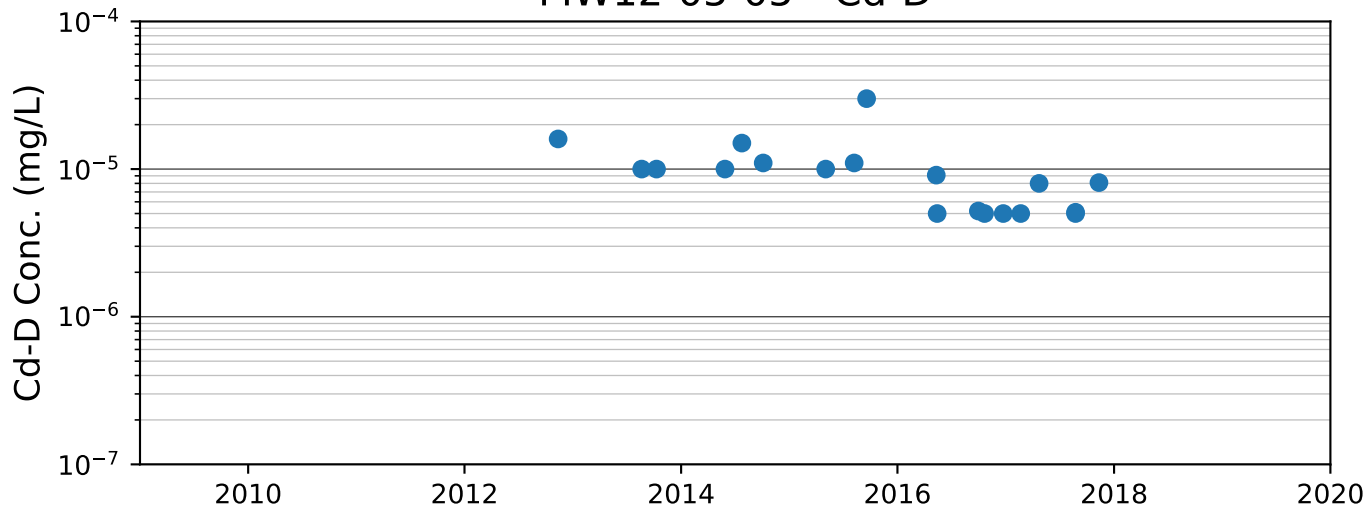
MW12-05-05 - Al-D



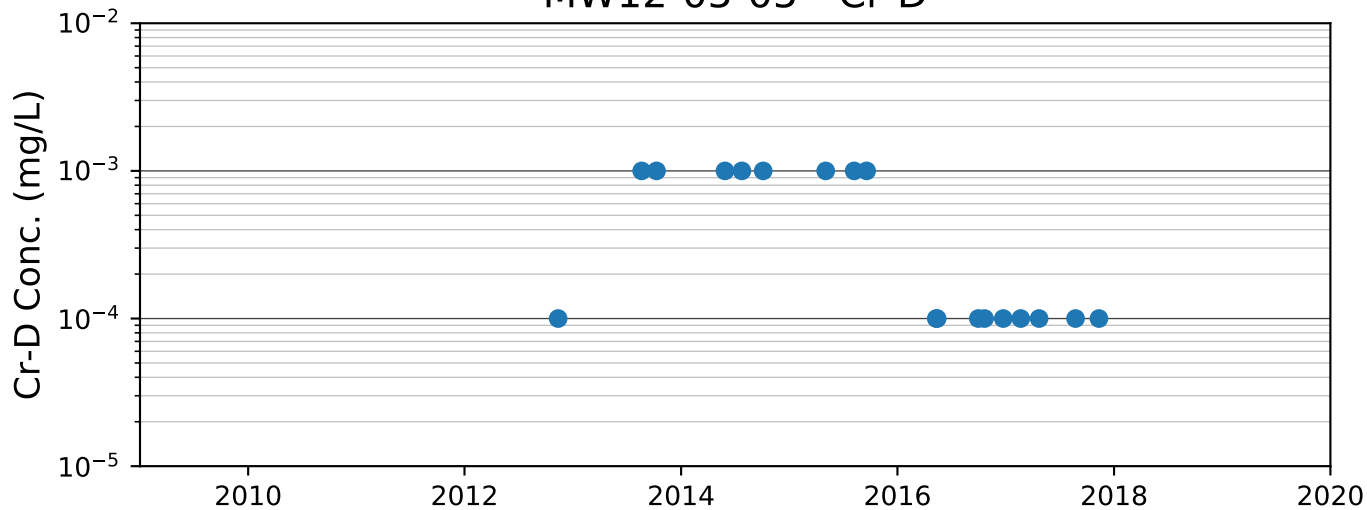
MW12-05-05 - As-D



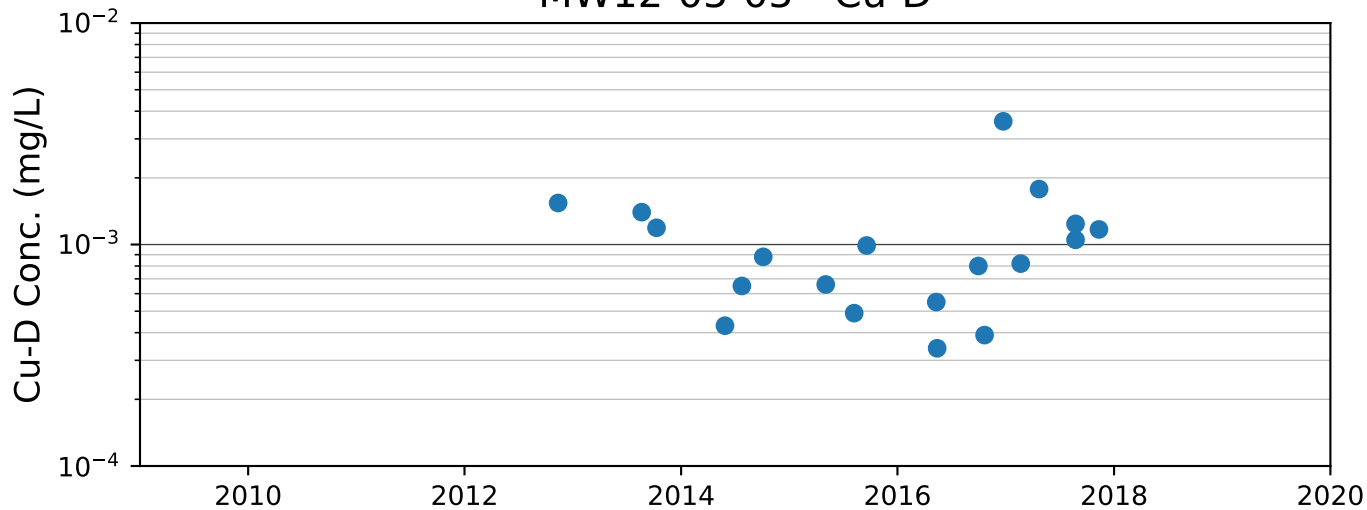
MW12-05-05 - Cd-D



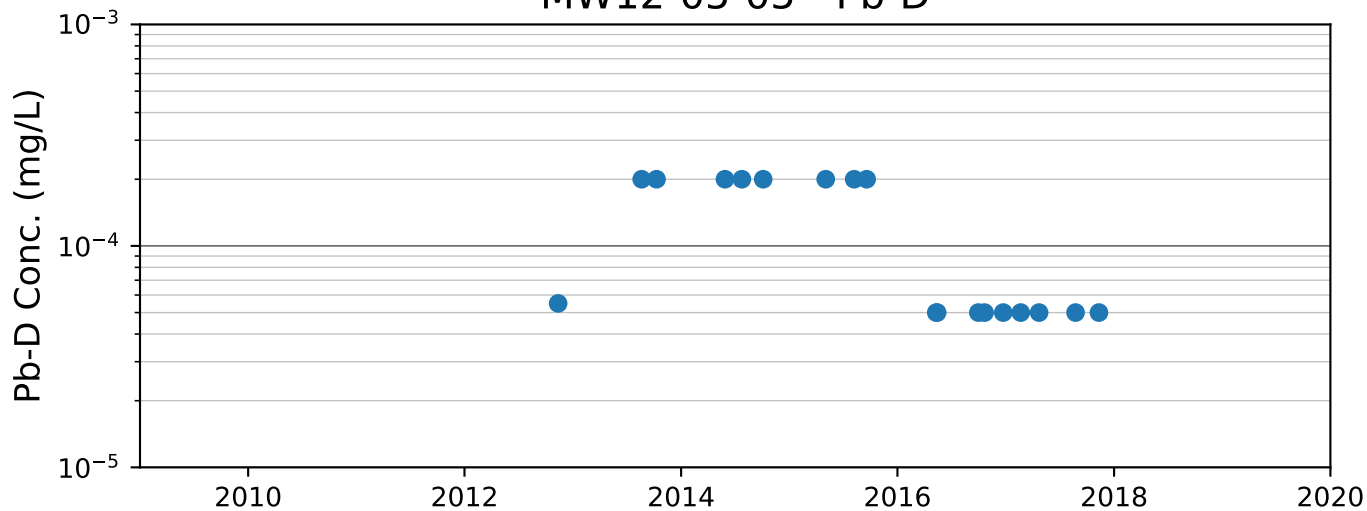
MW12-05-05 - Cr-D



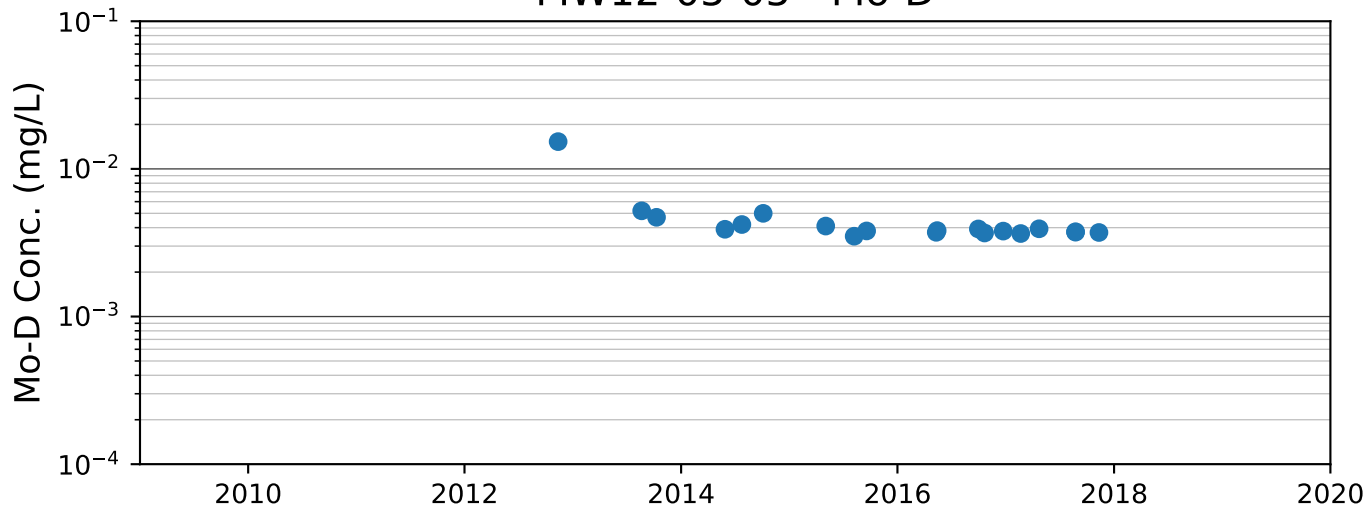
MW12-05-05 - Cu-D



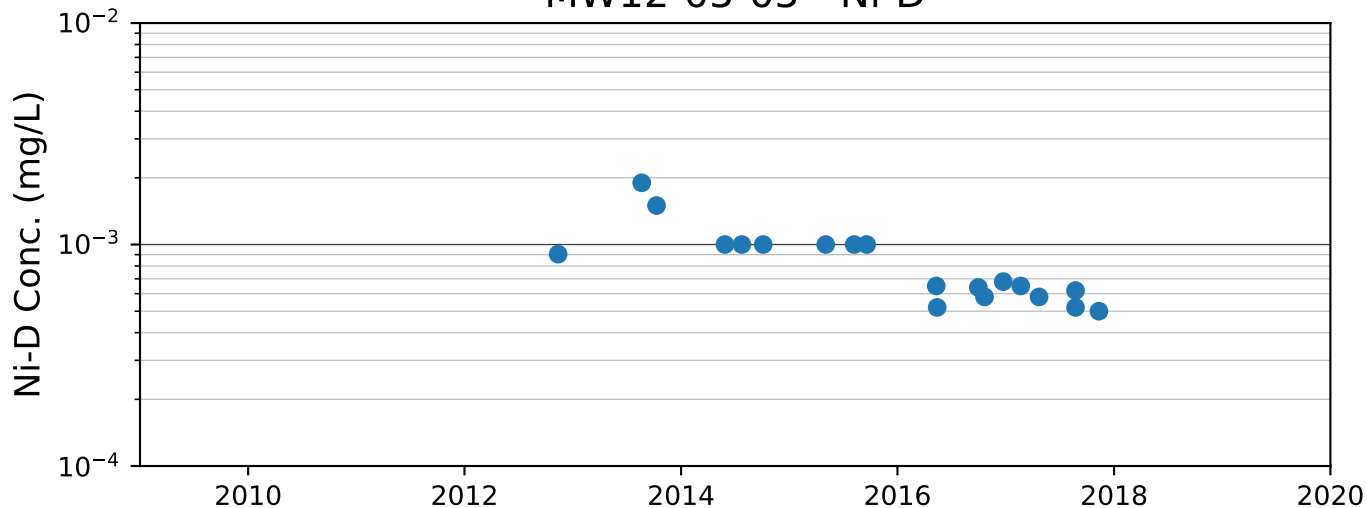
MW12-05-05 - Pb-D



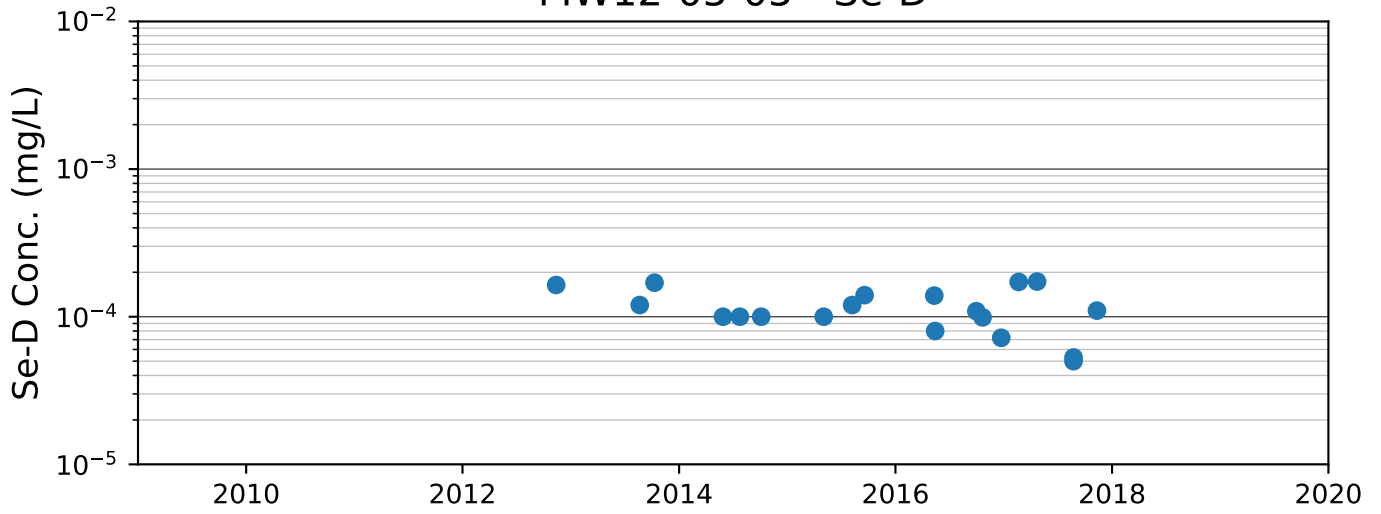
MW12-05-05 - Mo-D



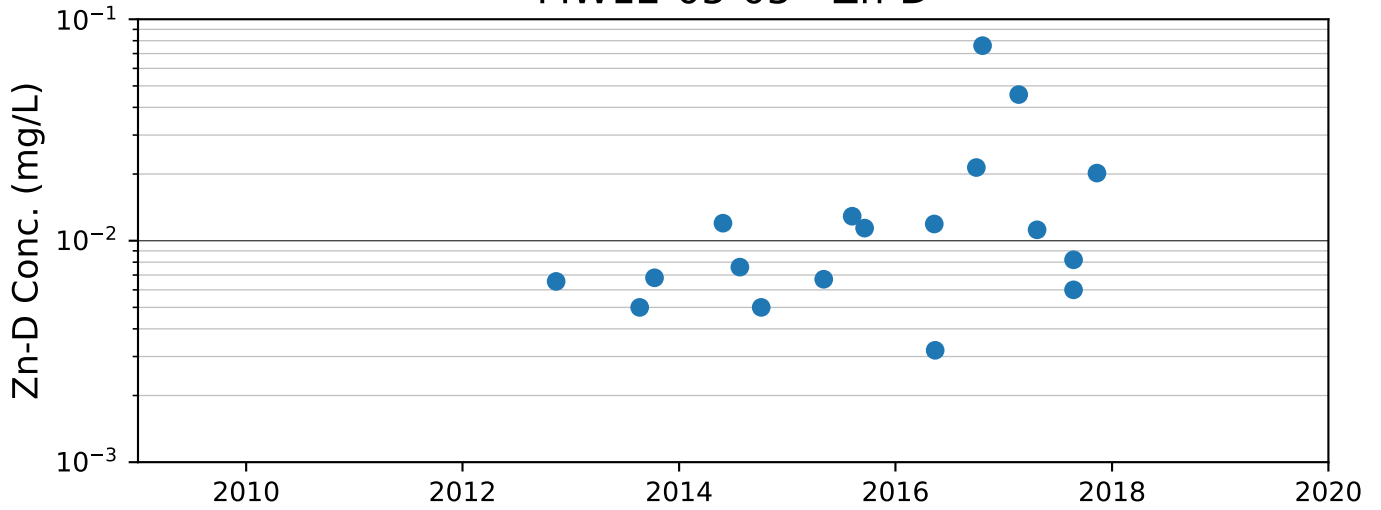
MW12-05-05 - Ni-D



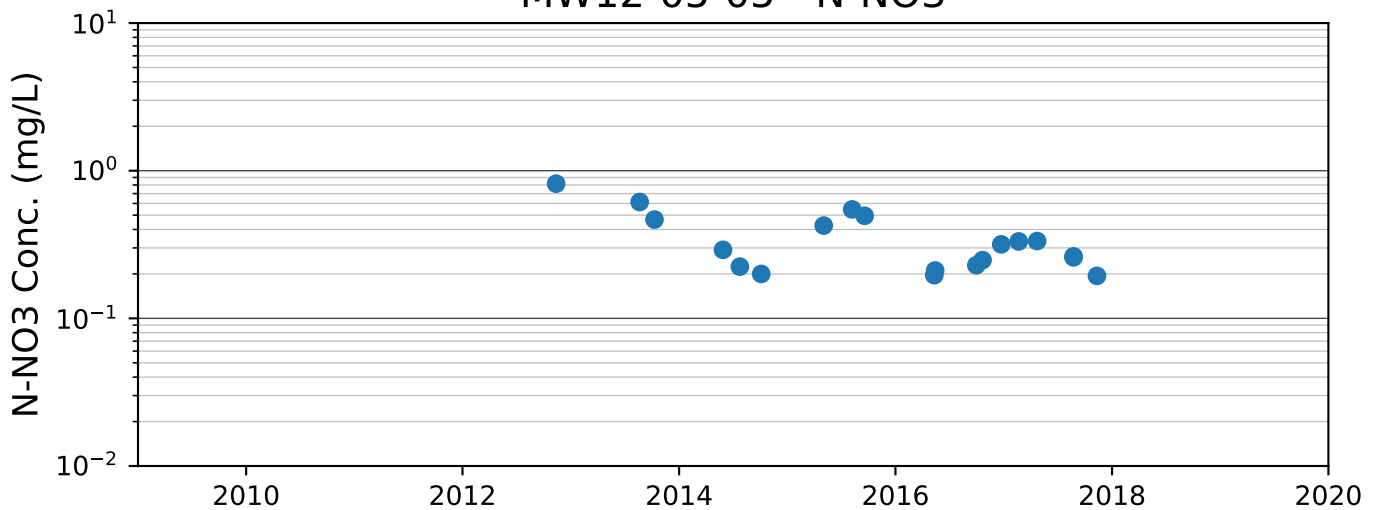
MW12-05-05 - Se-D

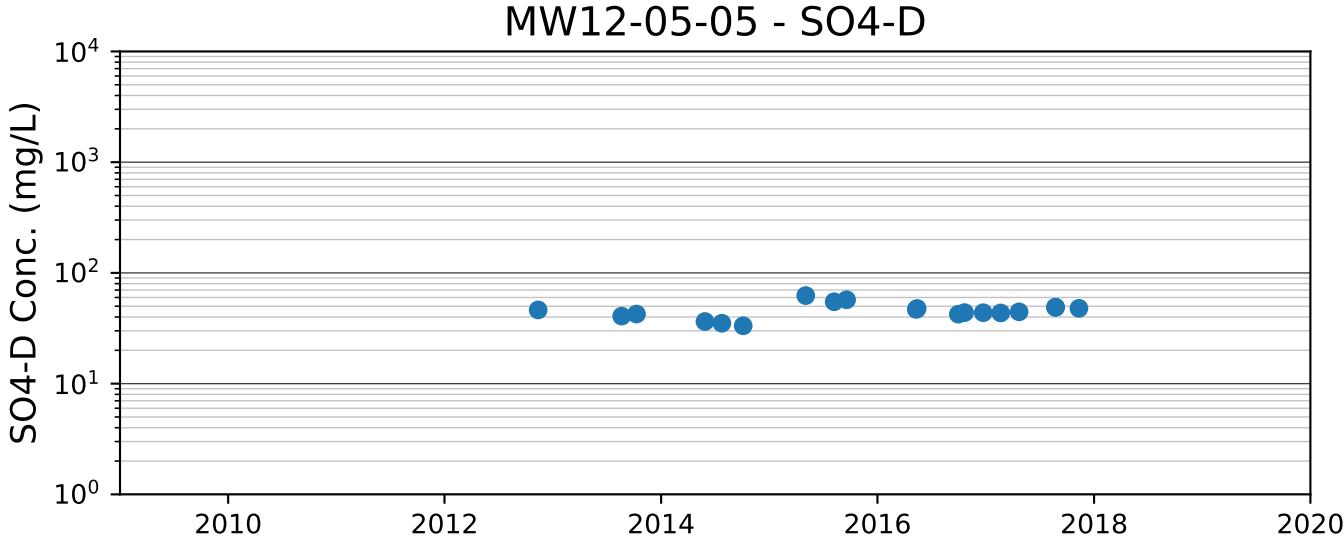


MW12-05-05 - Zn-D

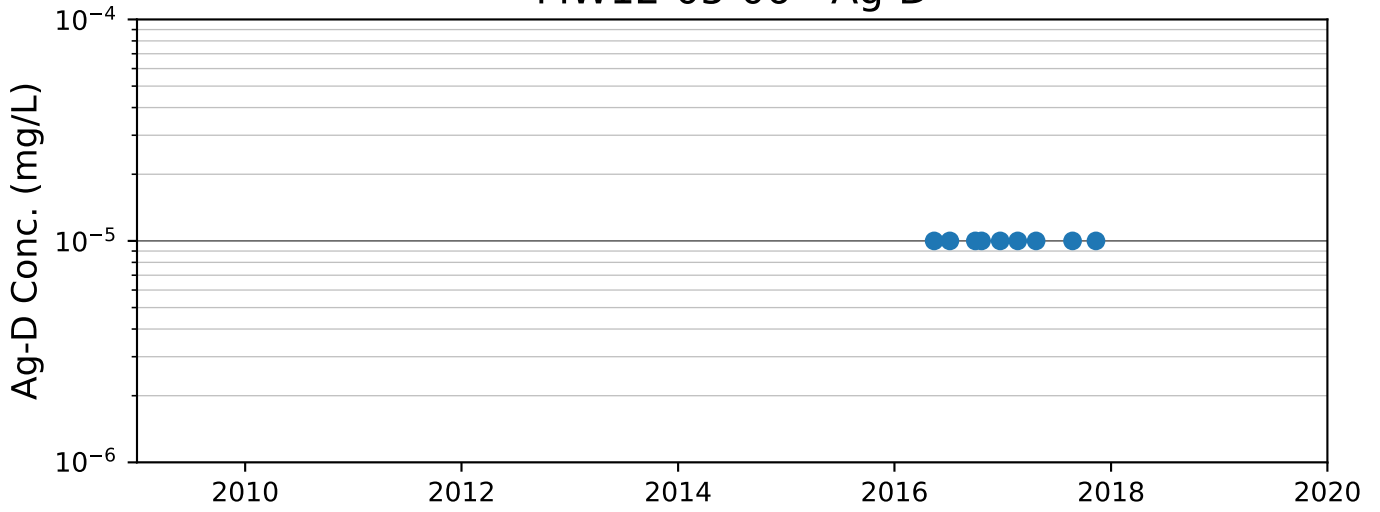


MW12-05-05 - N-NO3

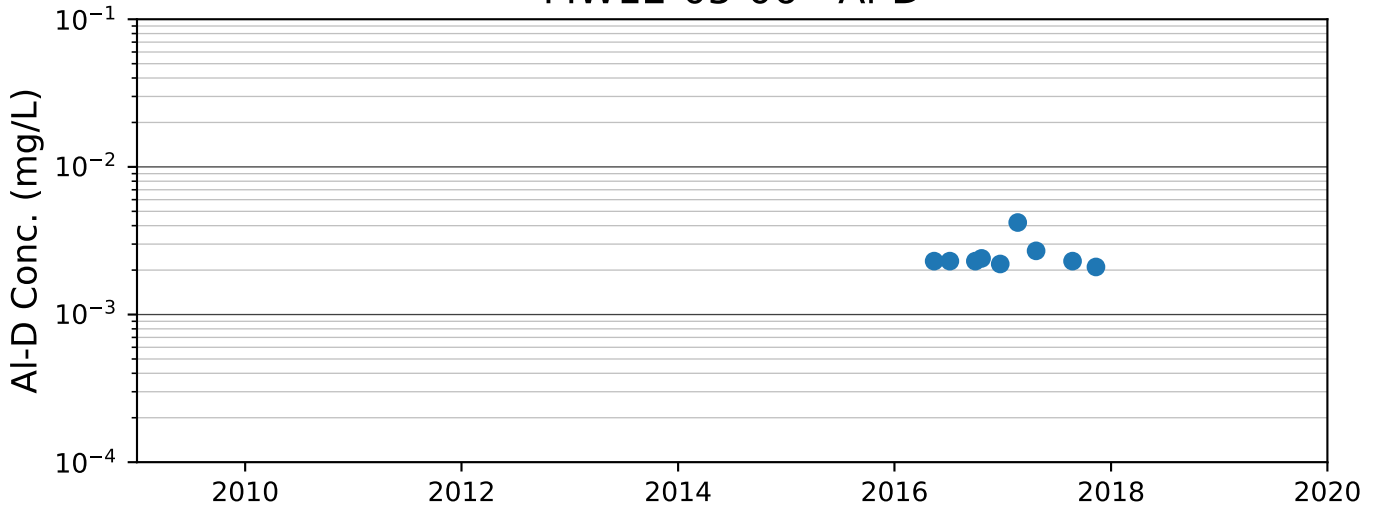




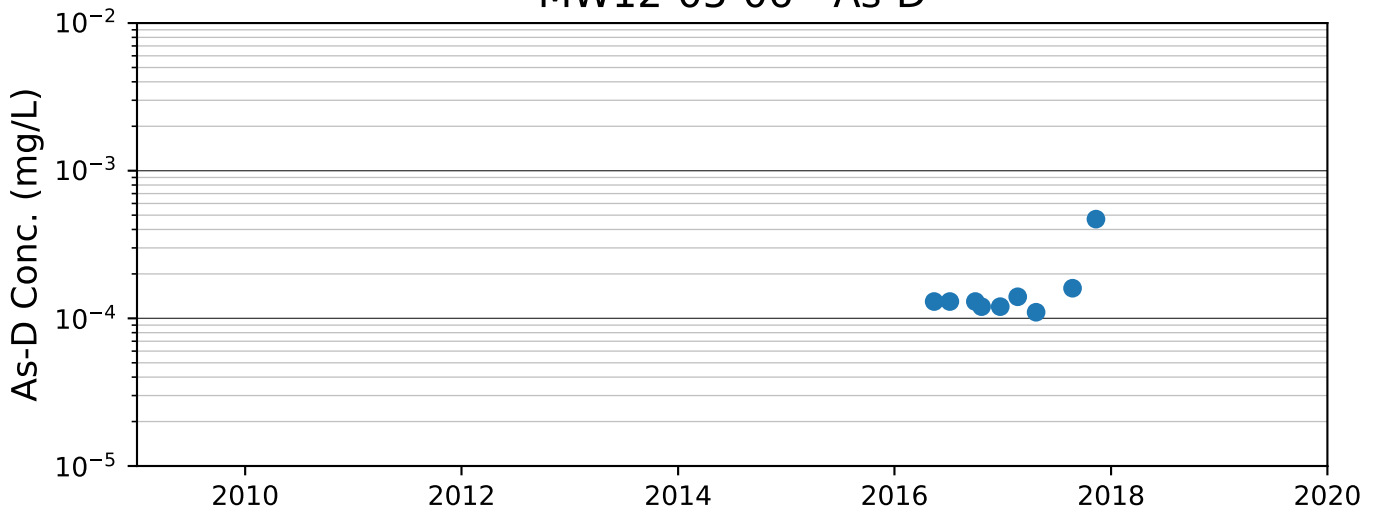
MW12-05-06 - Ag-D



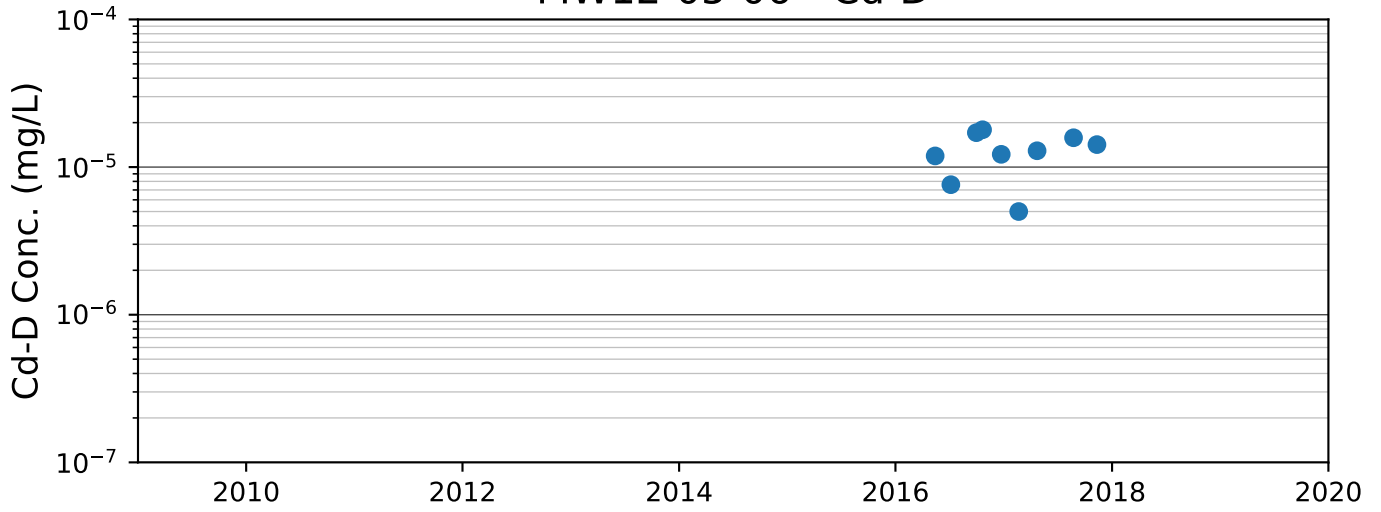
MW12-05-06 - Al-D



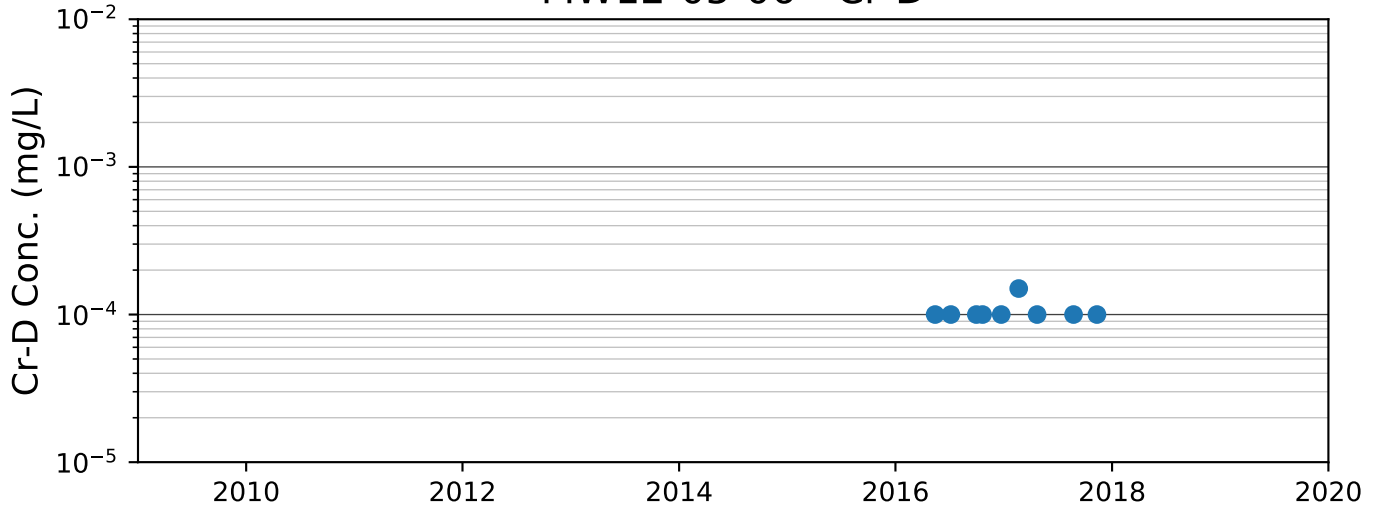
MW12-05-06 - As-D



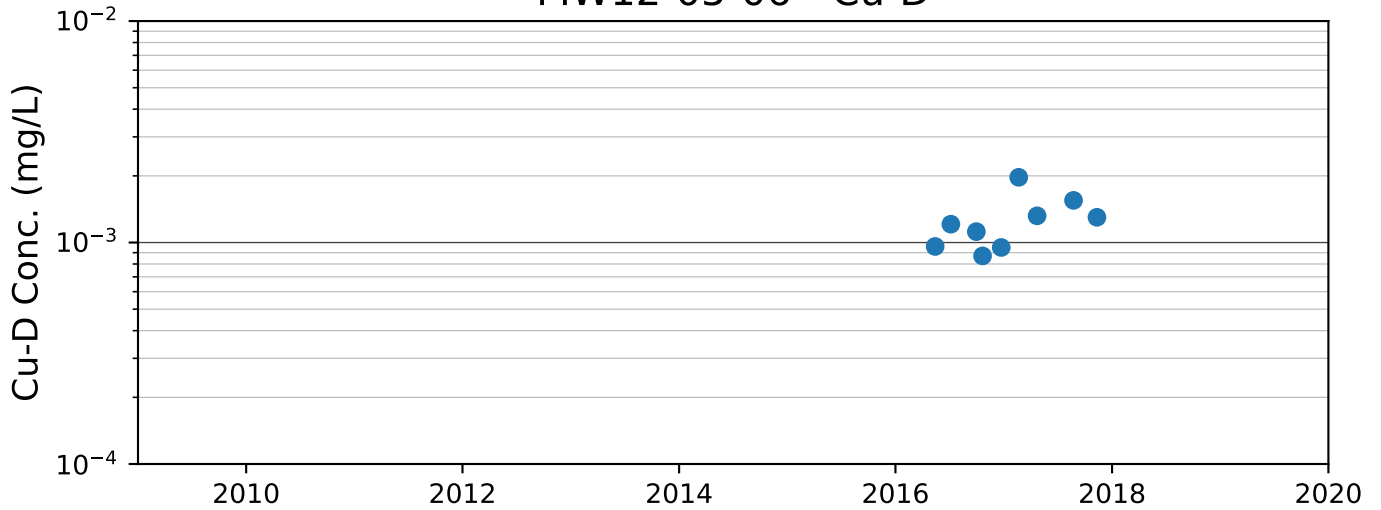
MW12-05-06 - Cd-D



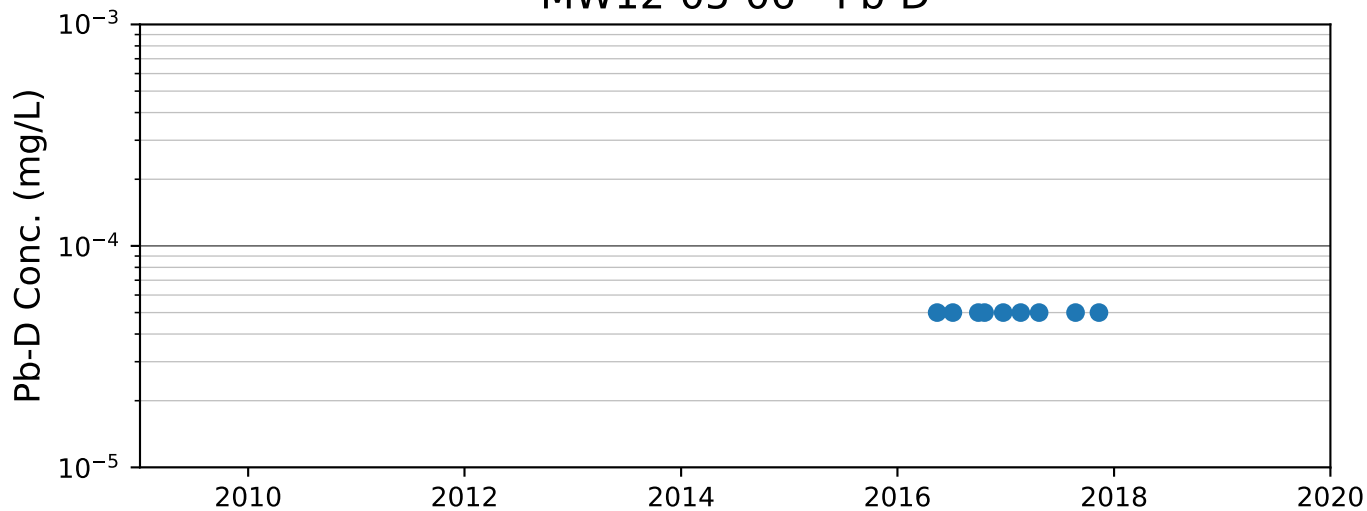
MW12-05-06 - Cr-D



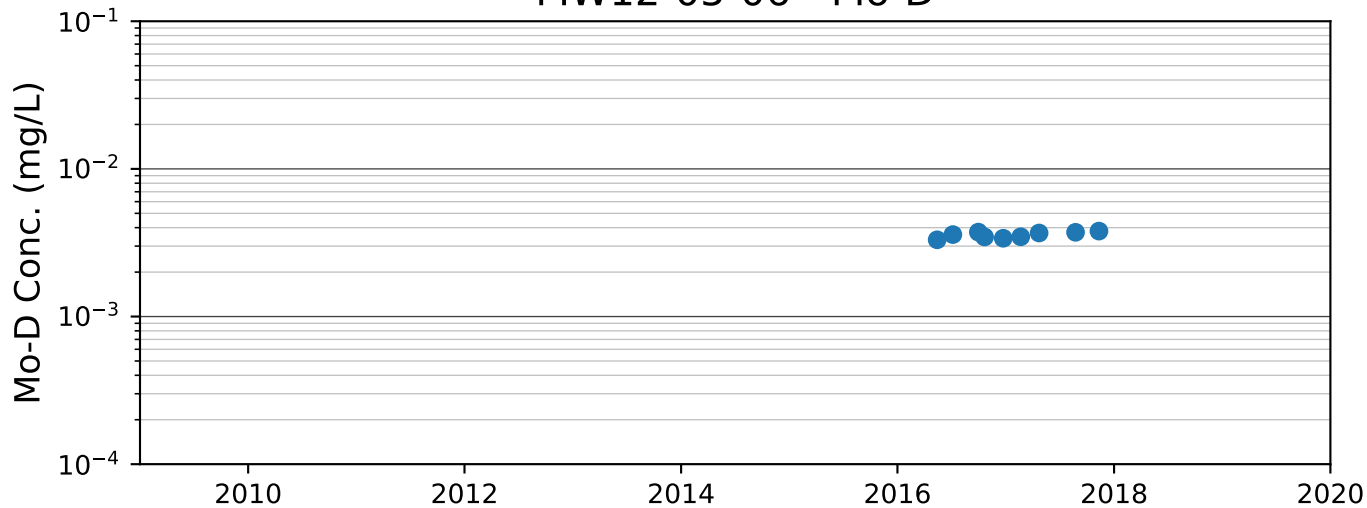
MW12-05-06 - Cu-D



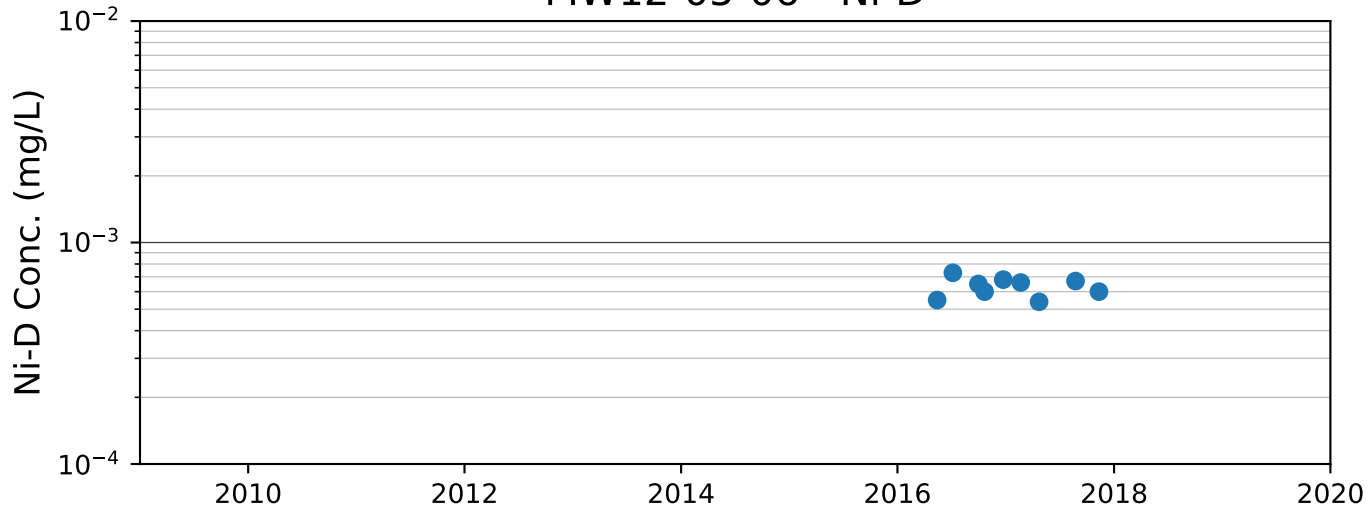
MW12-05-06 - Pb-D



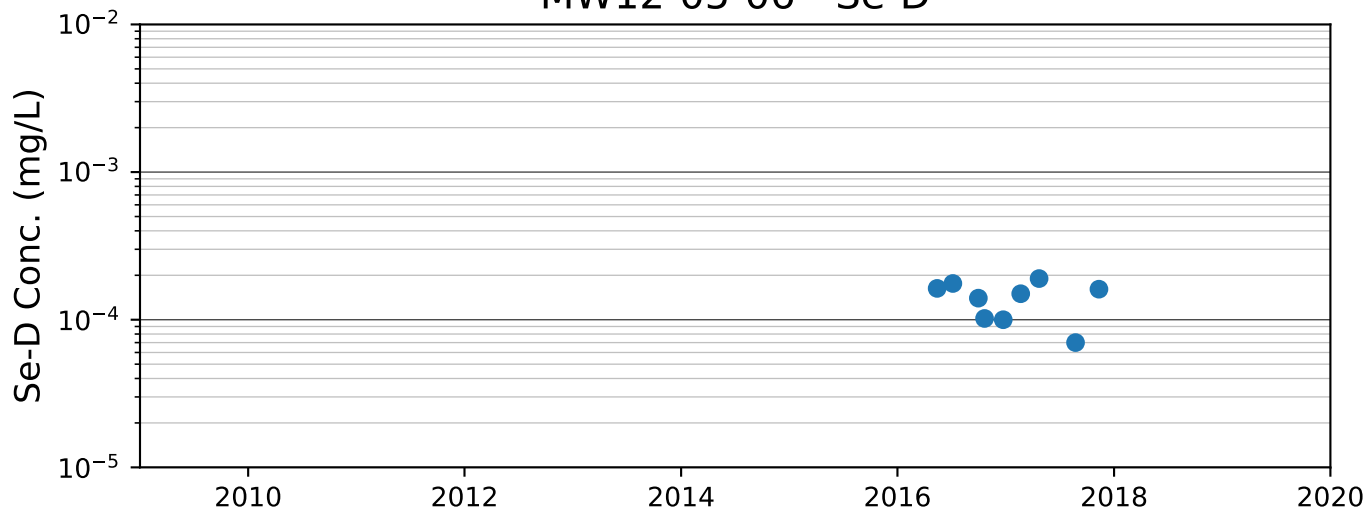
MW12-05-06 - Mo-D



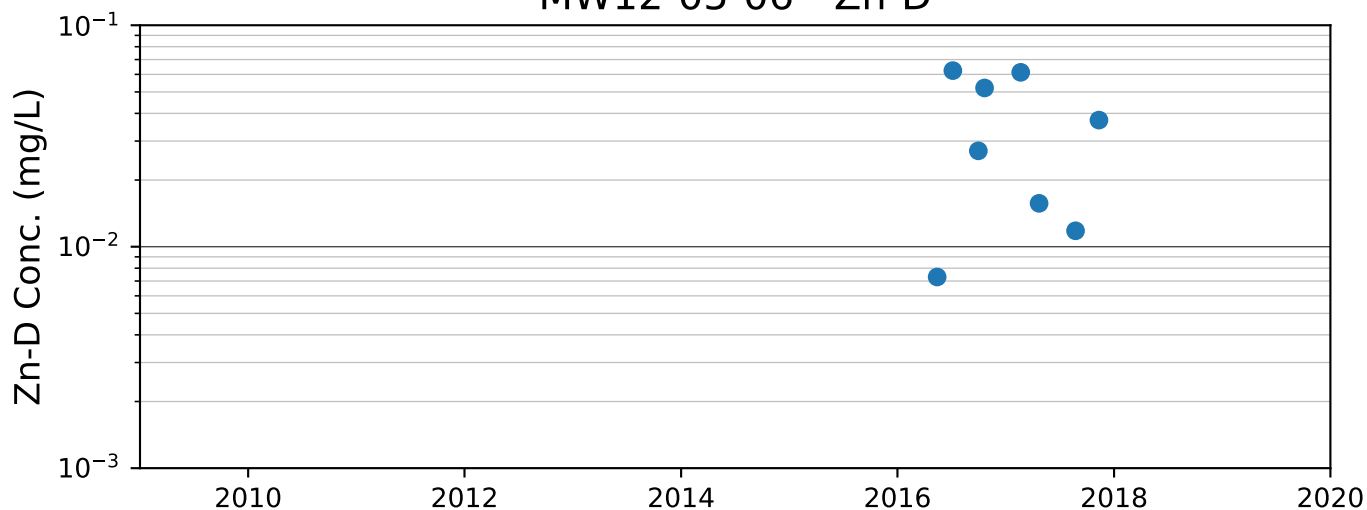
MW12-05-06 - Ni-D



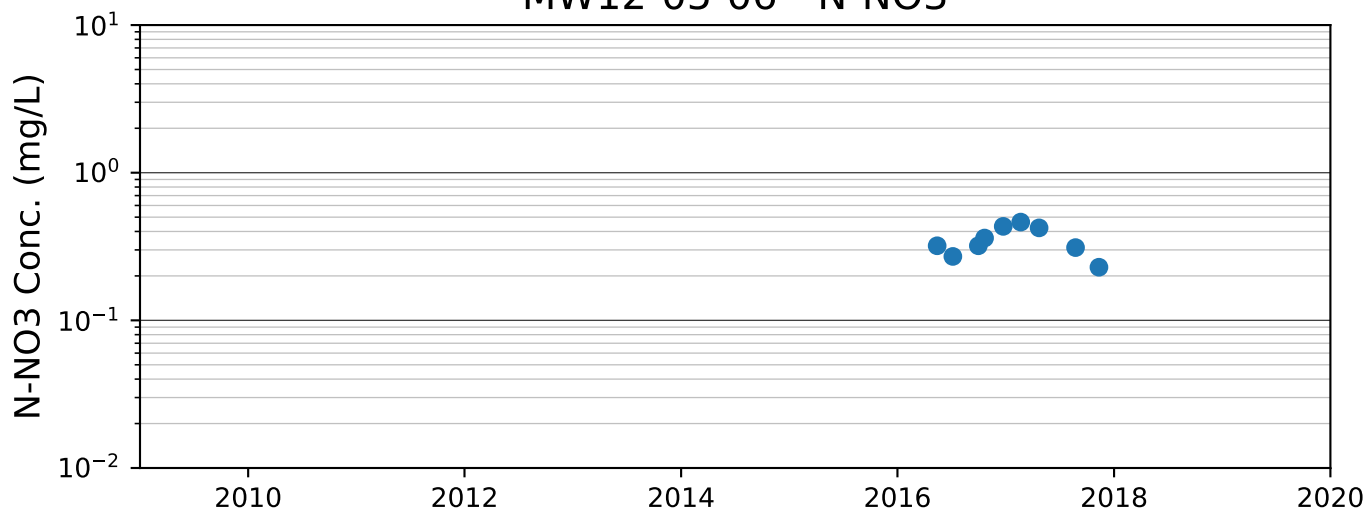
MW12-05-06 - Se-D

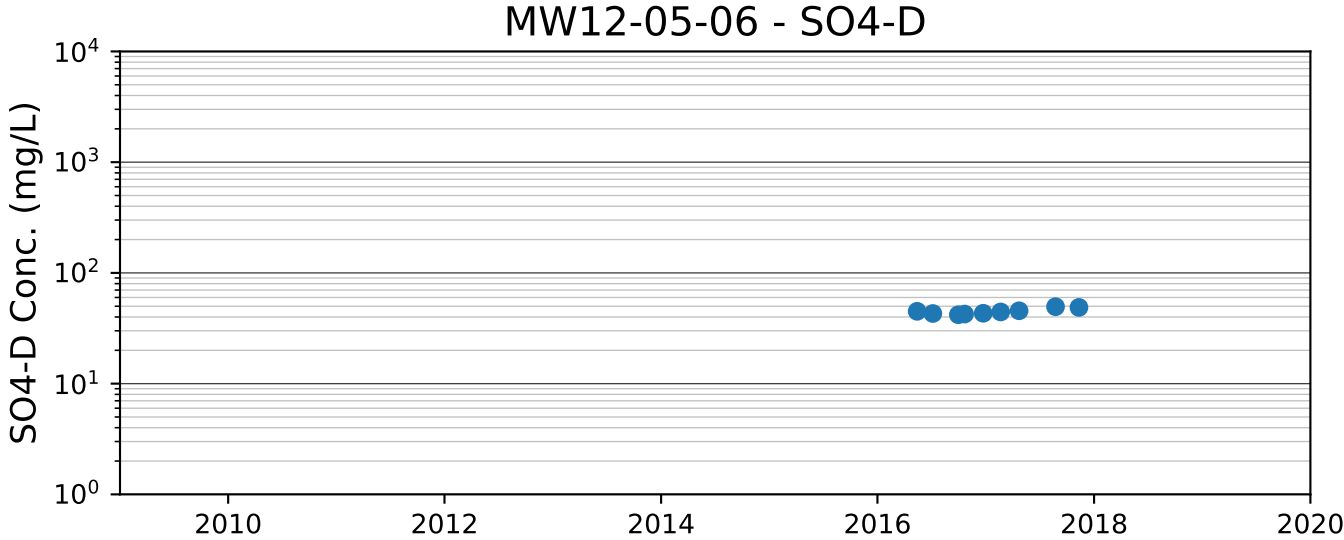


MW12-05-06 - Zn-D

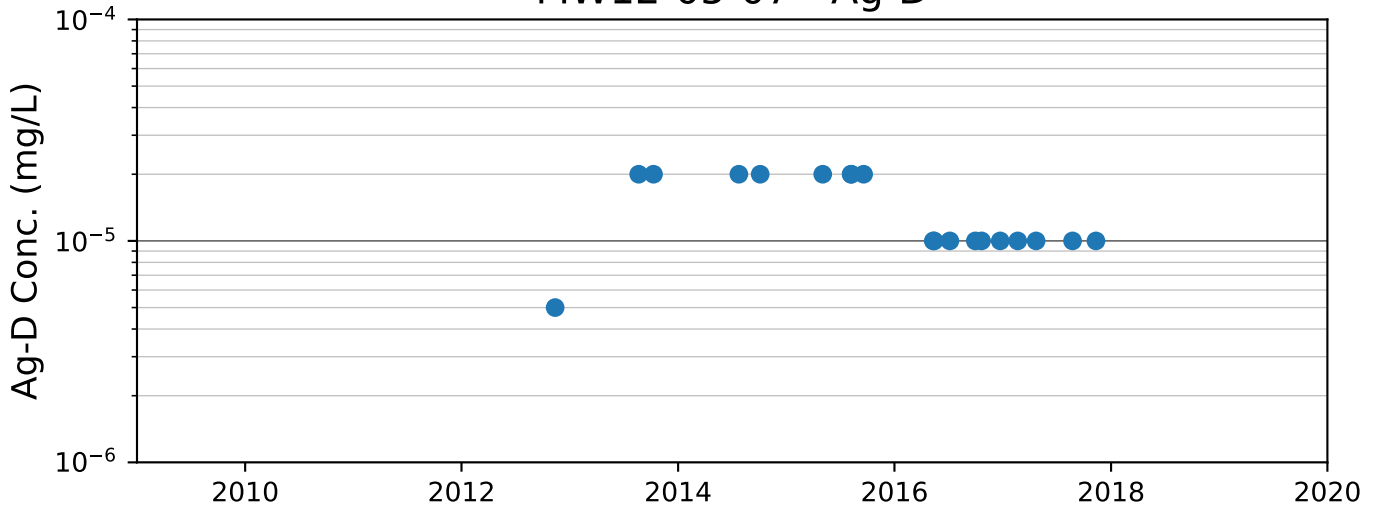


MW12-05-06 - N-NO3

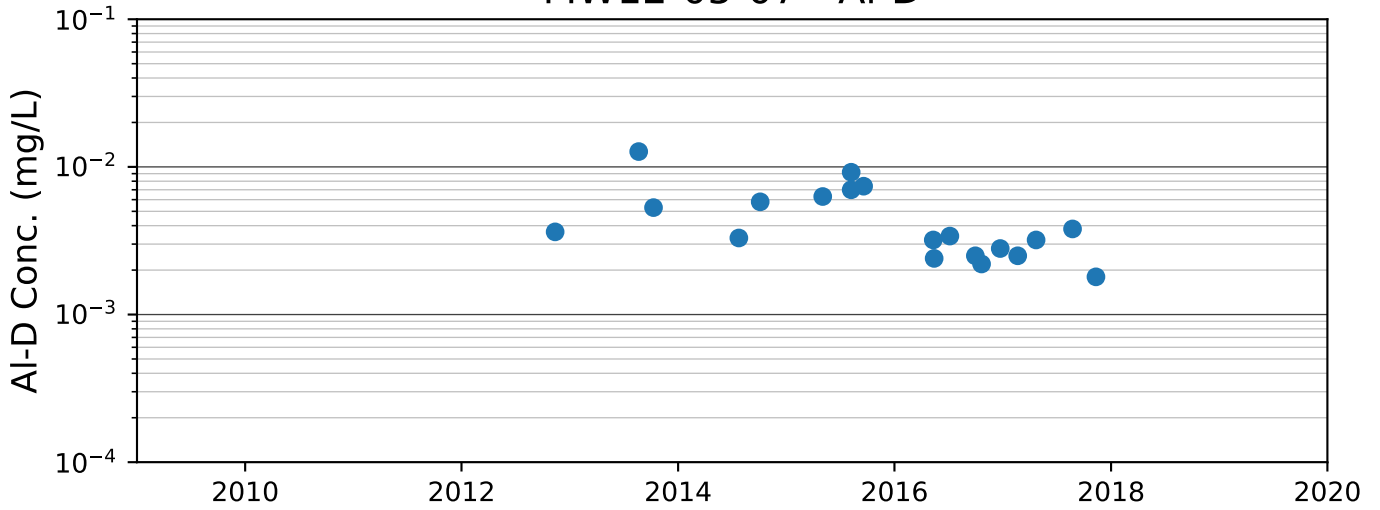




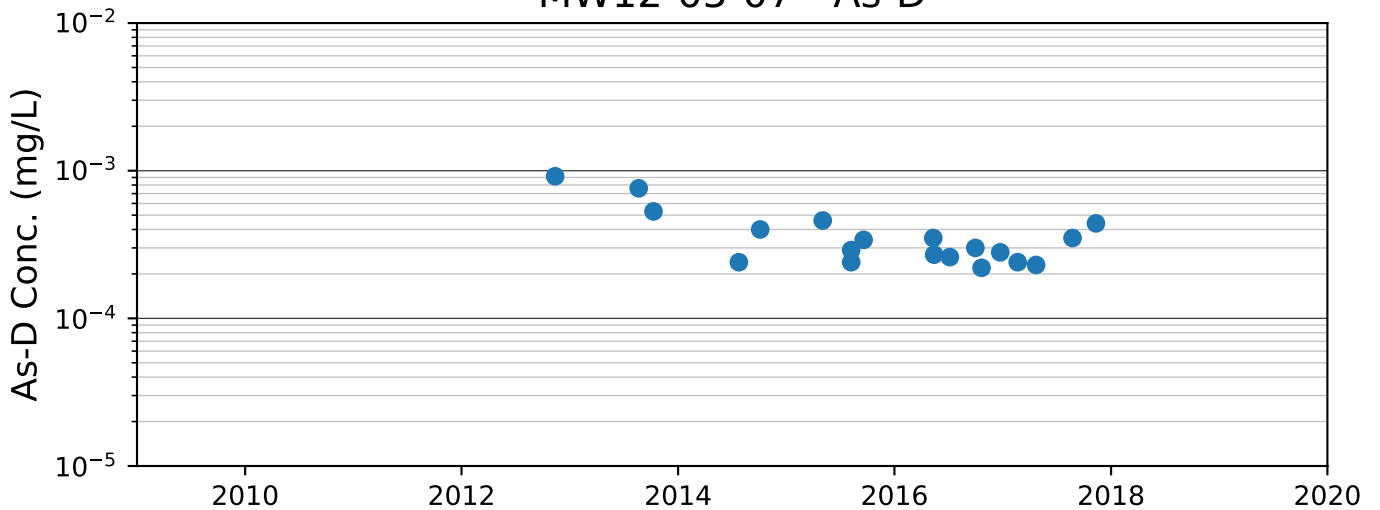
MW12-05-07 - Ag-D



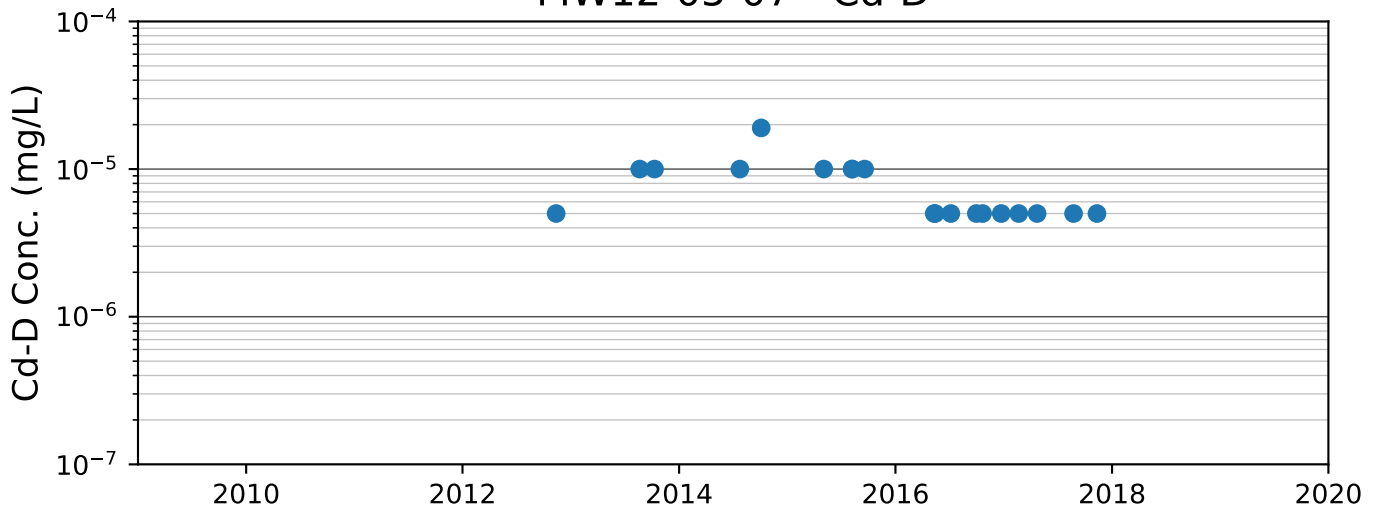
MW12-05-07 - Al-D



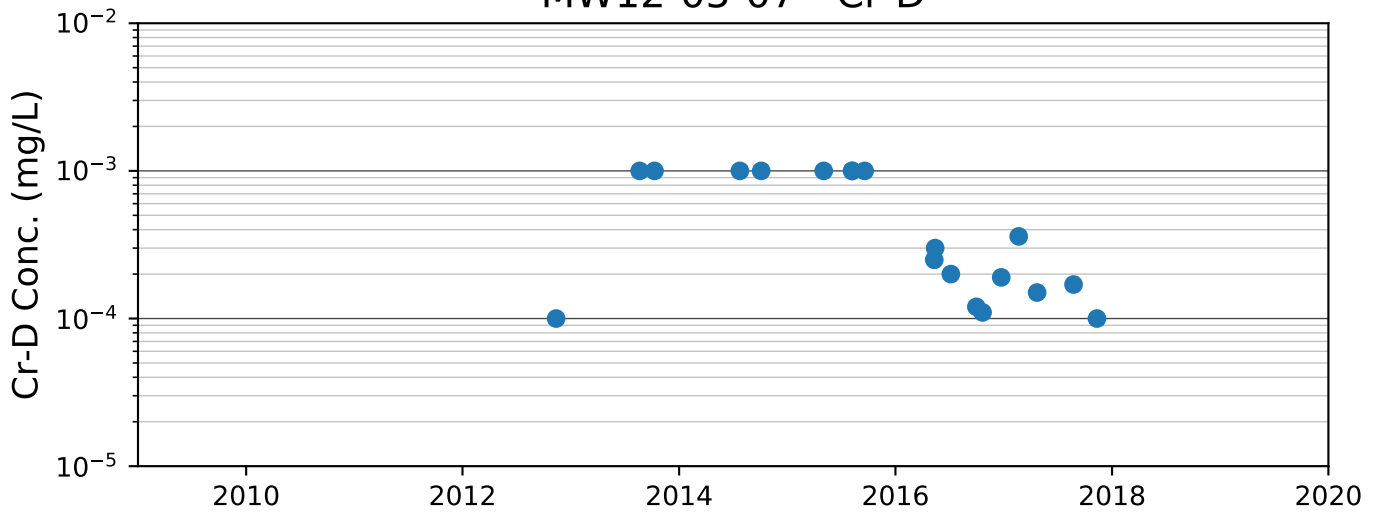
MW12-05-07 - As-D



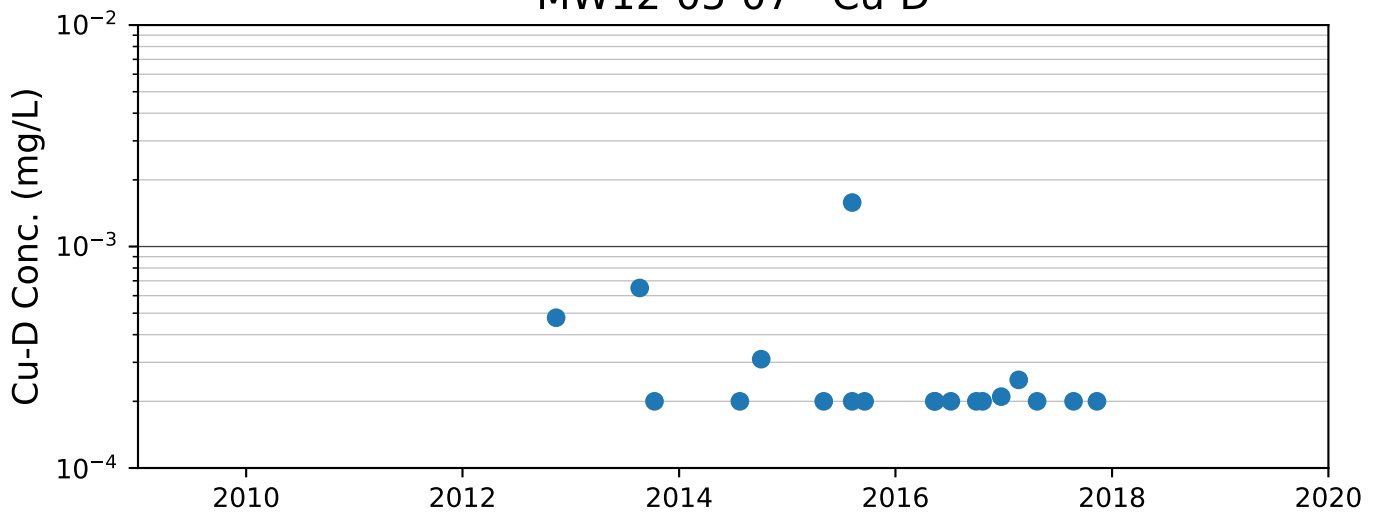
MW12-05-07 - Cd-D



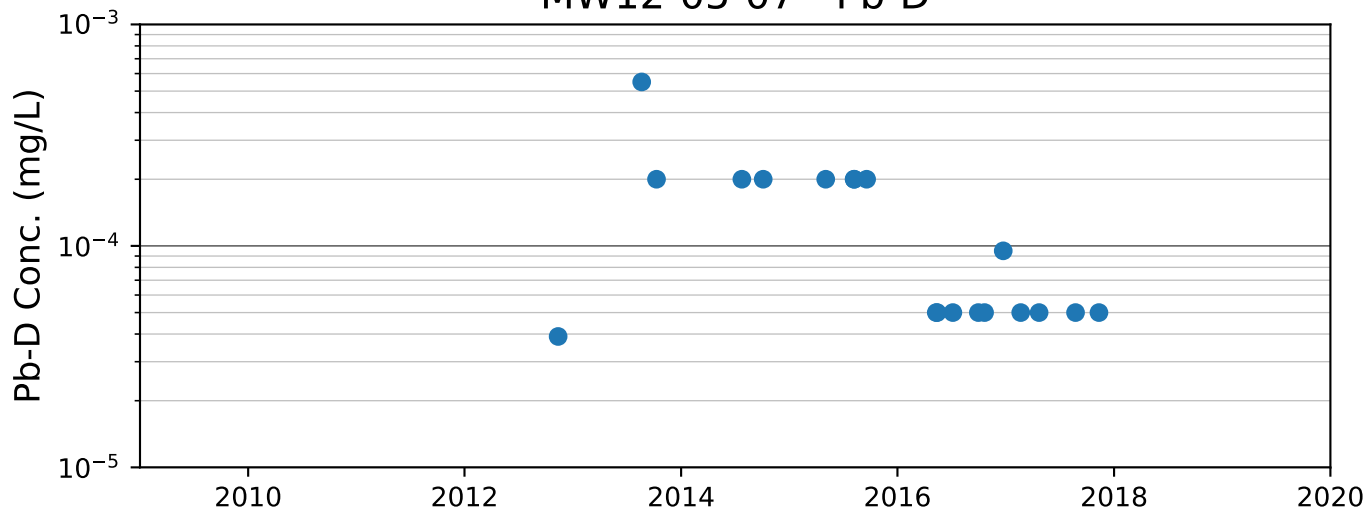
MW12-05-07 - Cr-D



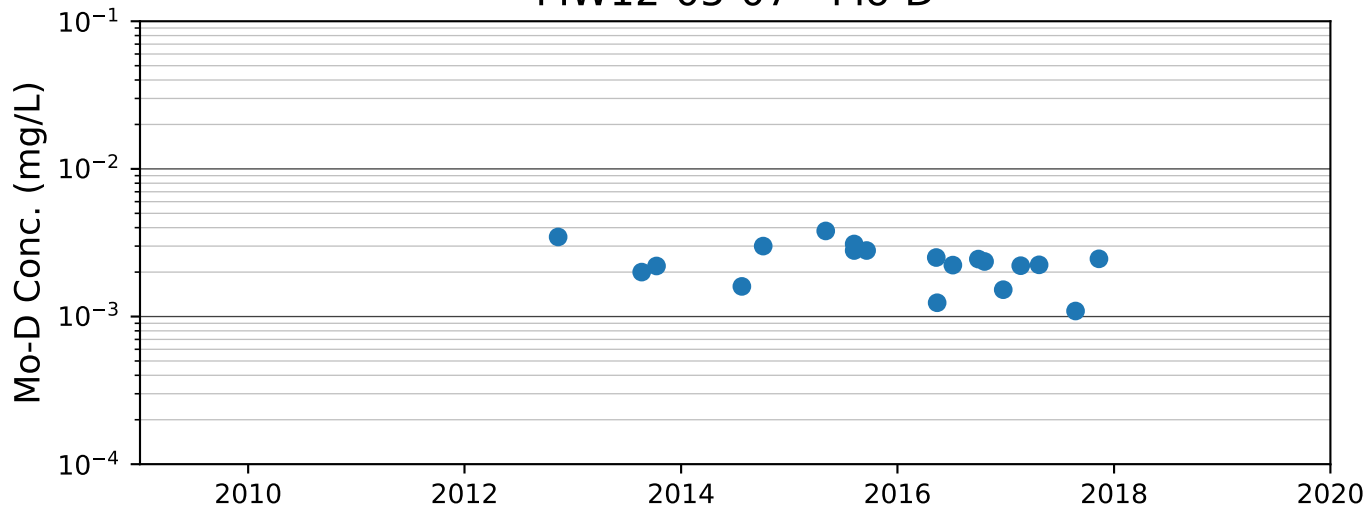
MW12-05-07 - Cu-D



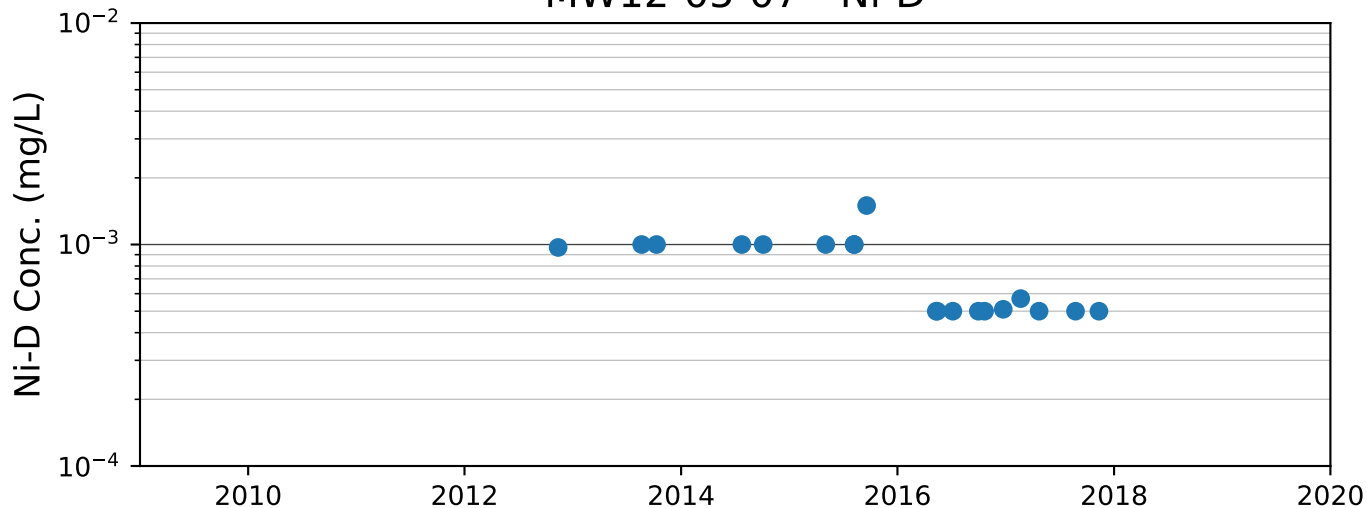
MW12-05-07 - Pb-D



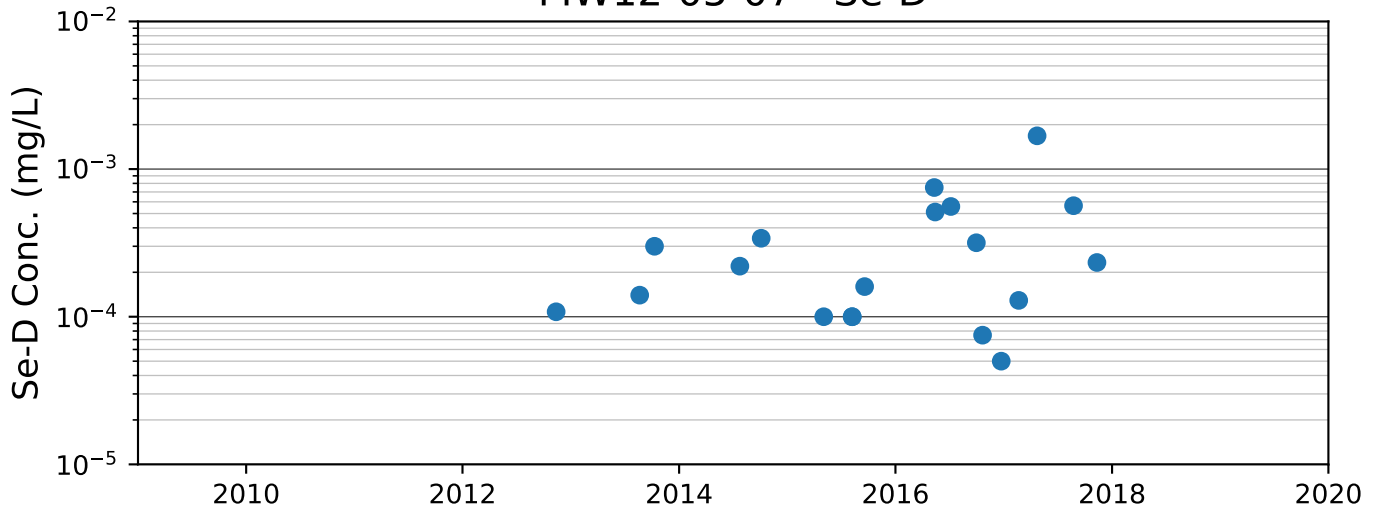
MW12-05-07 - Mo-D



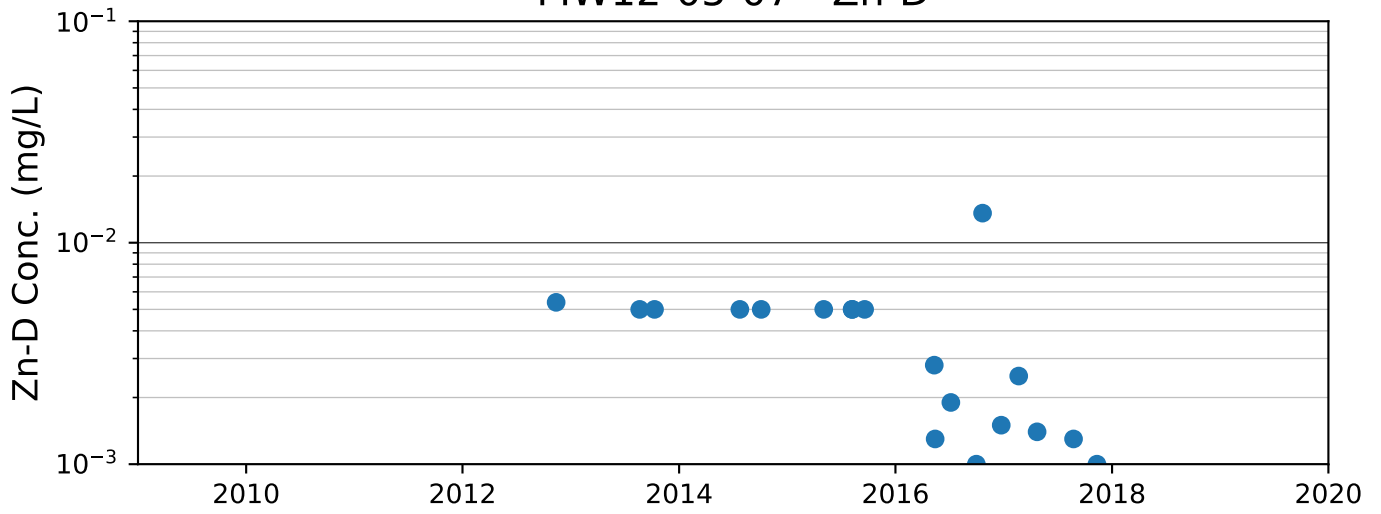
MW12-05-07 - Ni-D



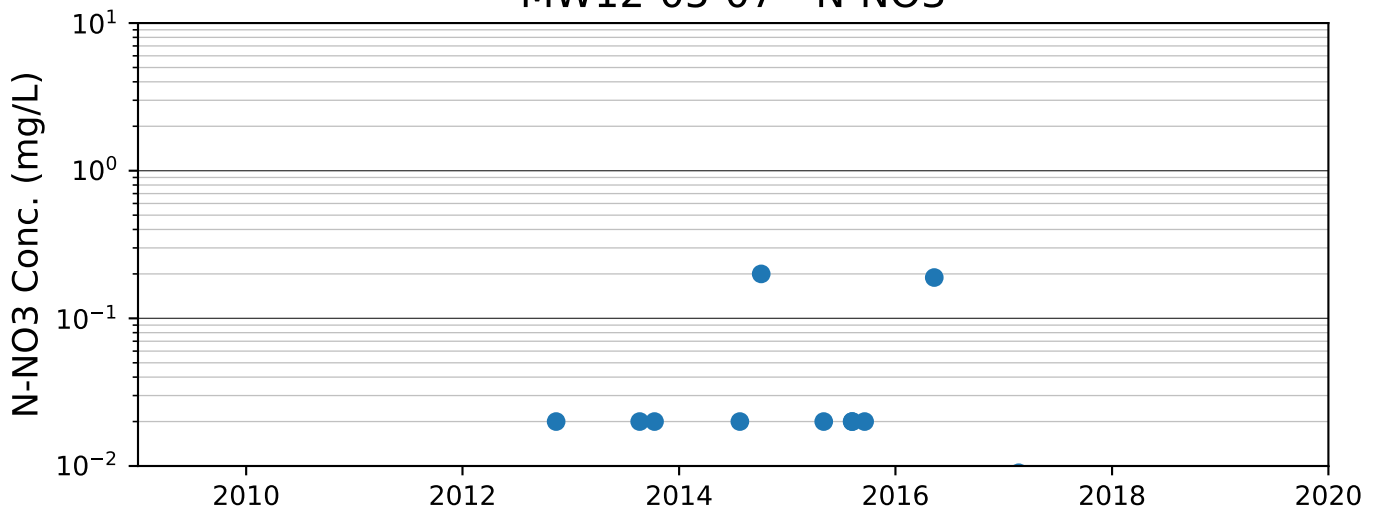
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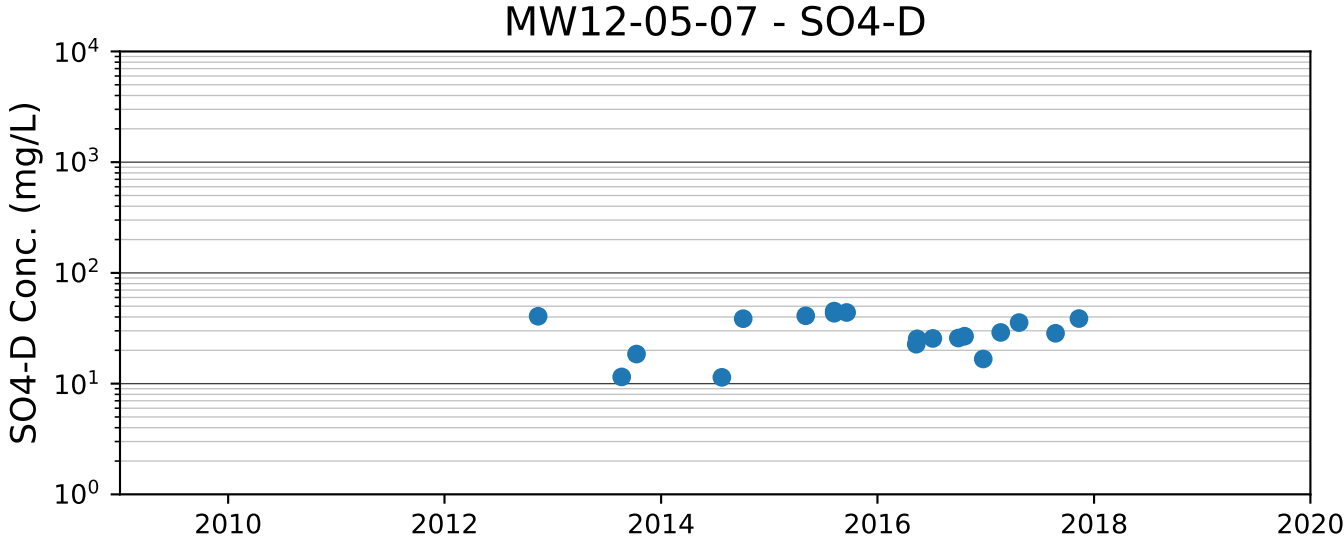


MW12-05-07 - Zn-D

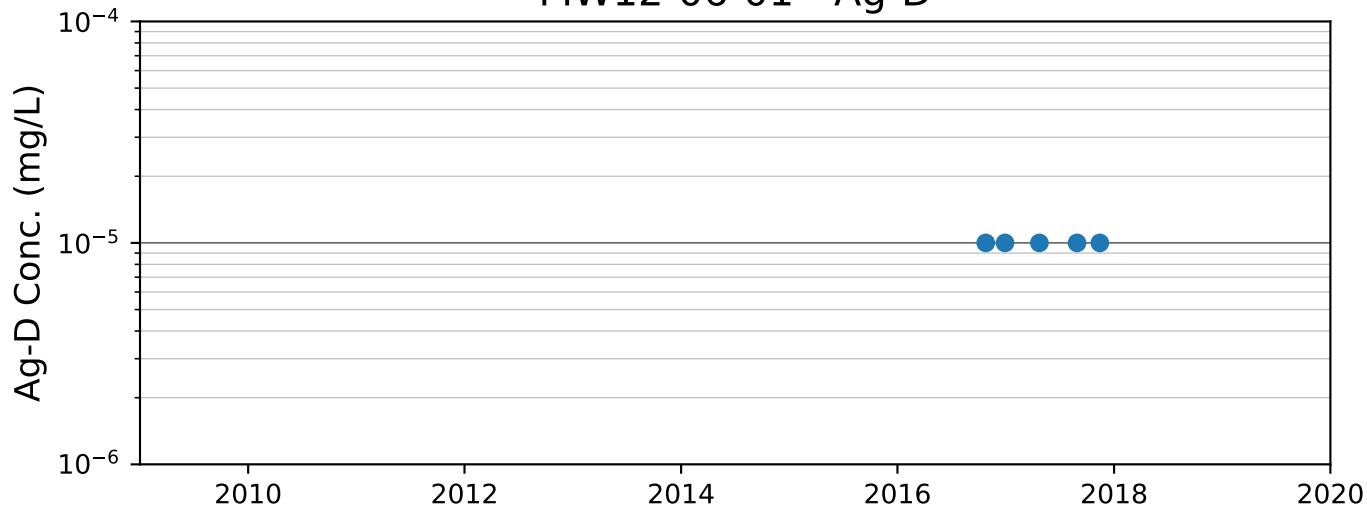


MW12-05-07 - N-NO3

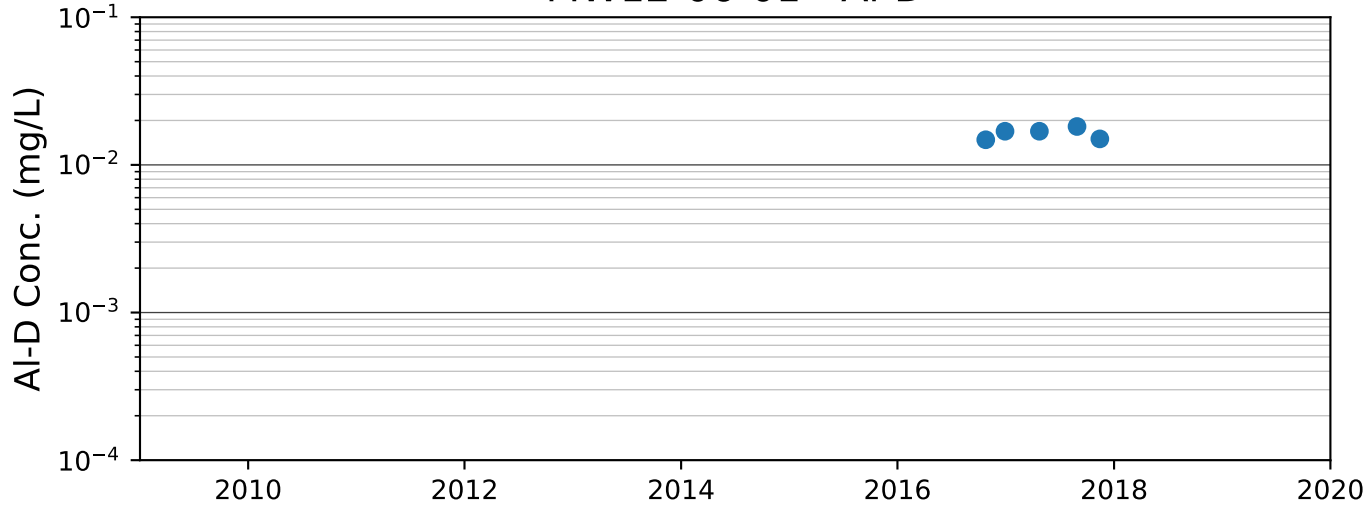




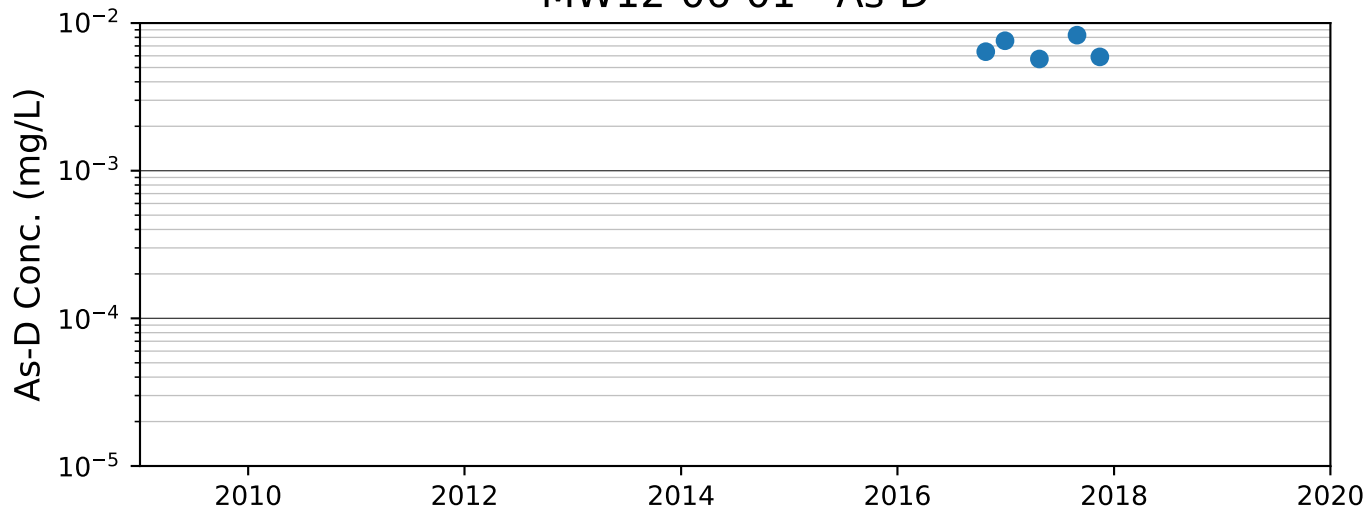
MW12-06-01 - Ag-D



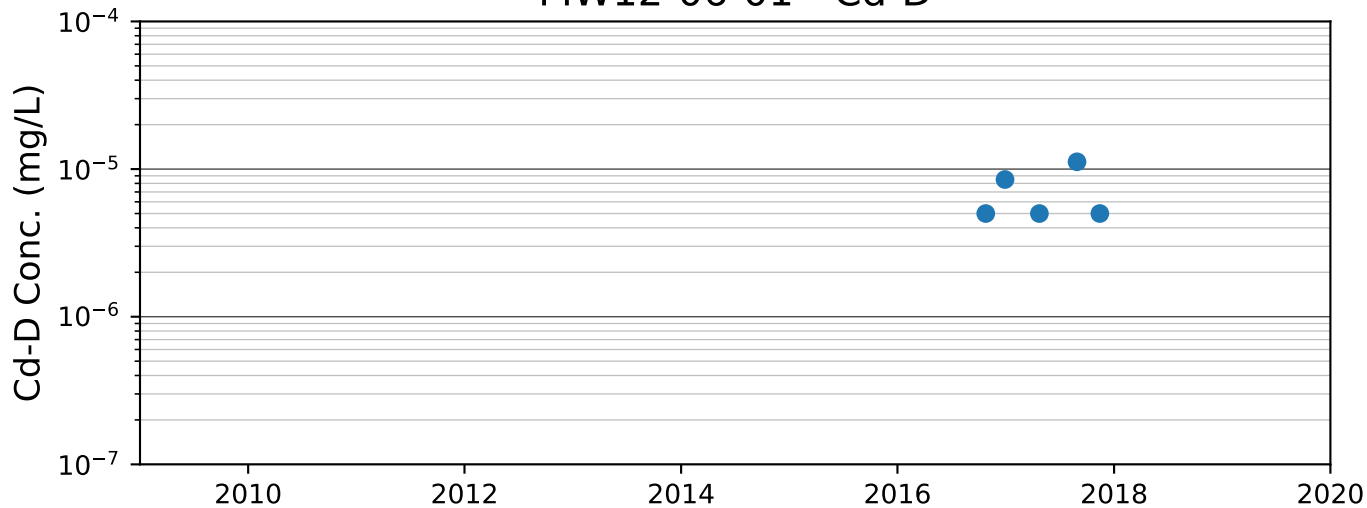
MW12-06-01 - Al-D



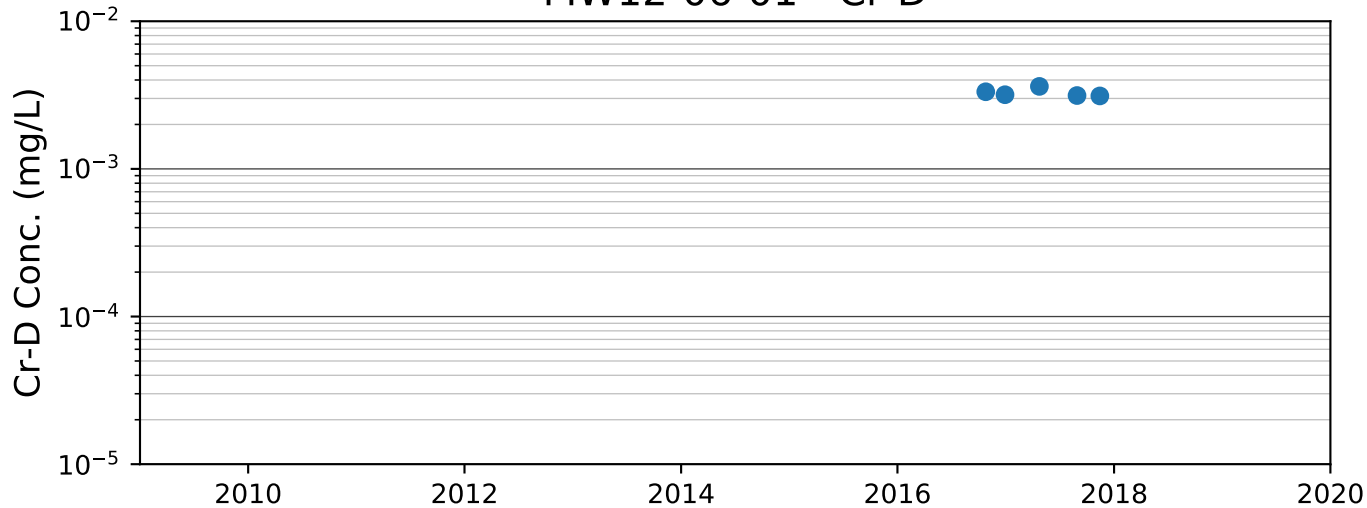
MW12-06-01 - As-D



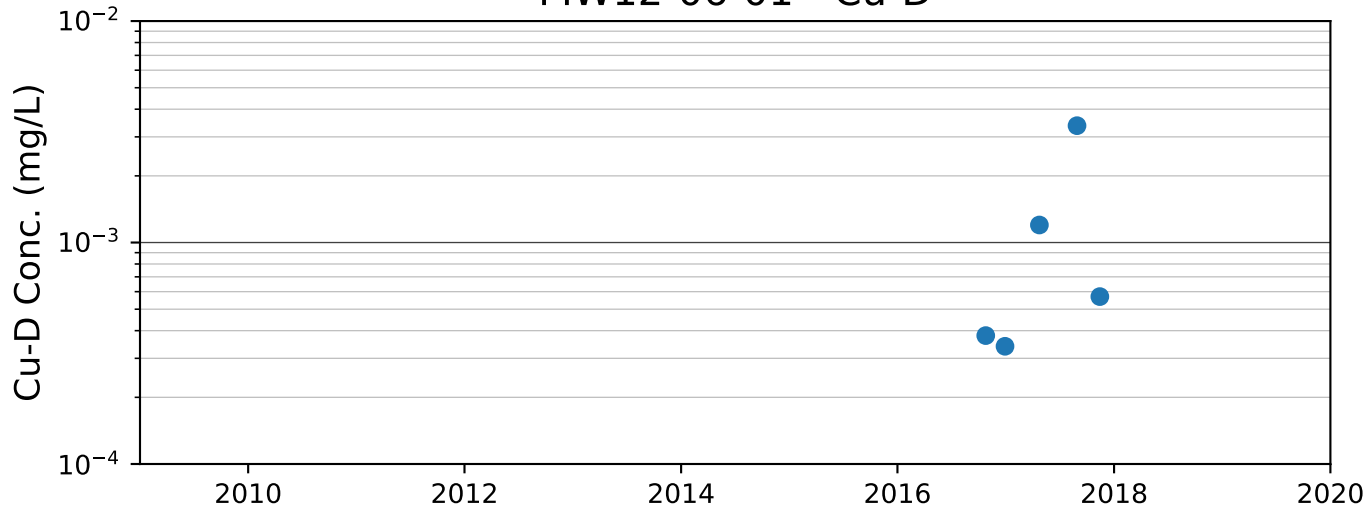
MW12-06-01 - Cd-D



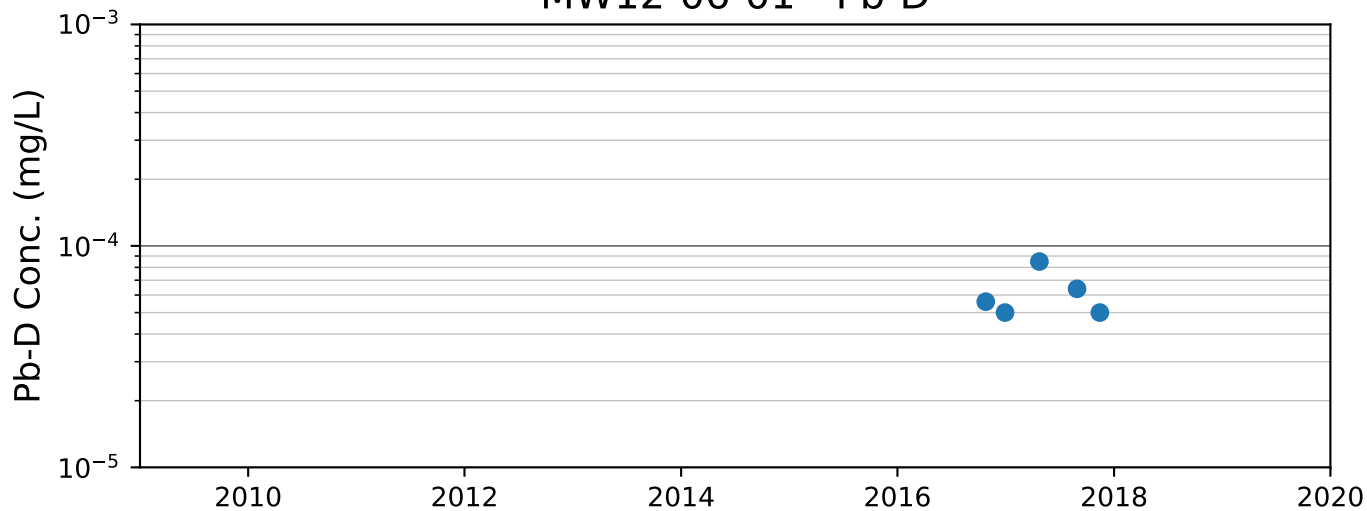
MW12-06-01 - Cr-D



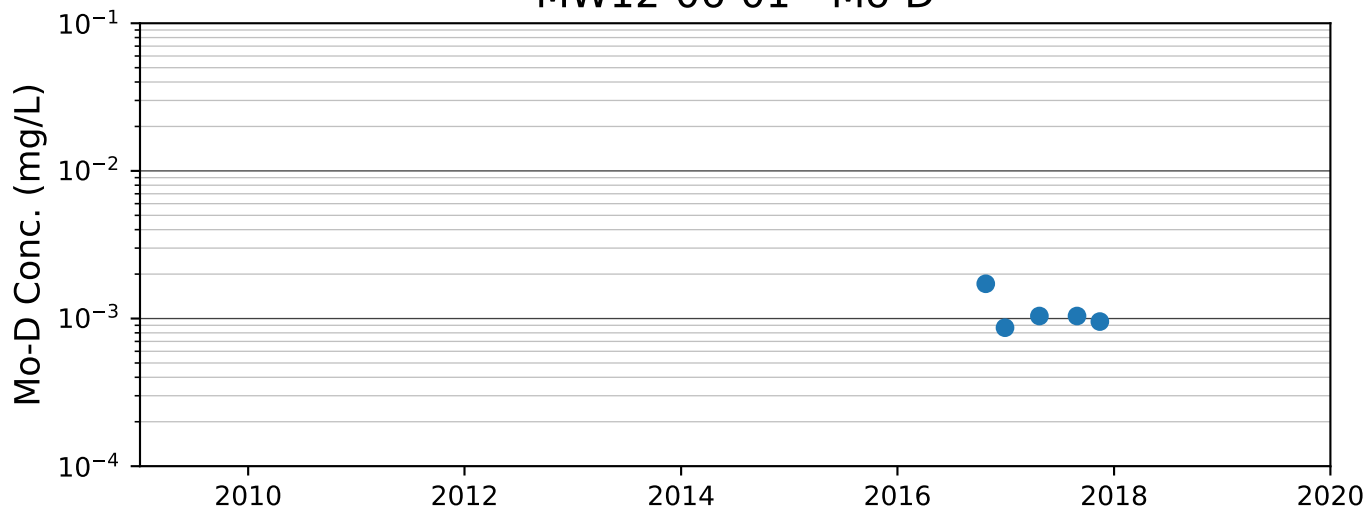
MW12-06-01 - Cu-D



MW12-06-01 - Pb-D



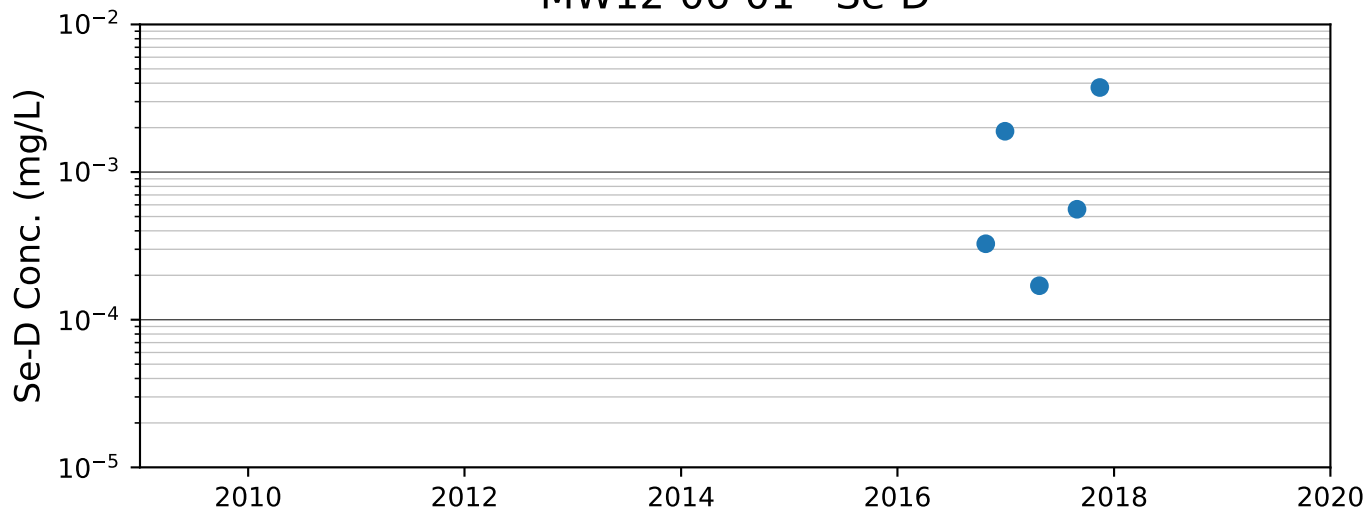
MW12-06-01 - Mo-D



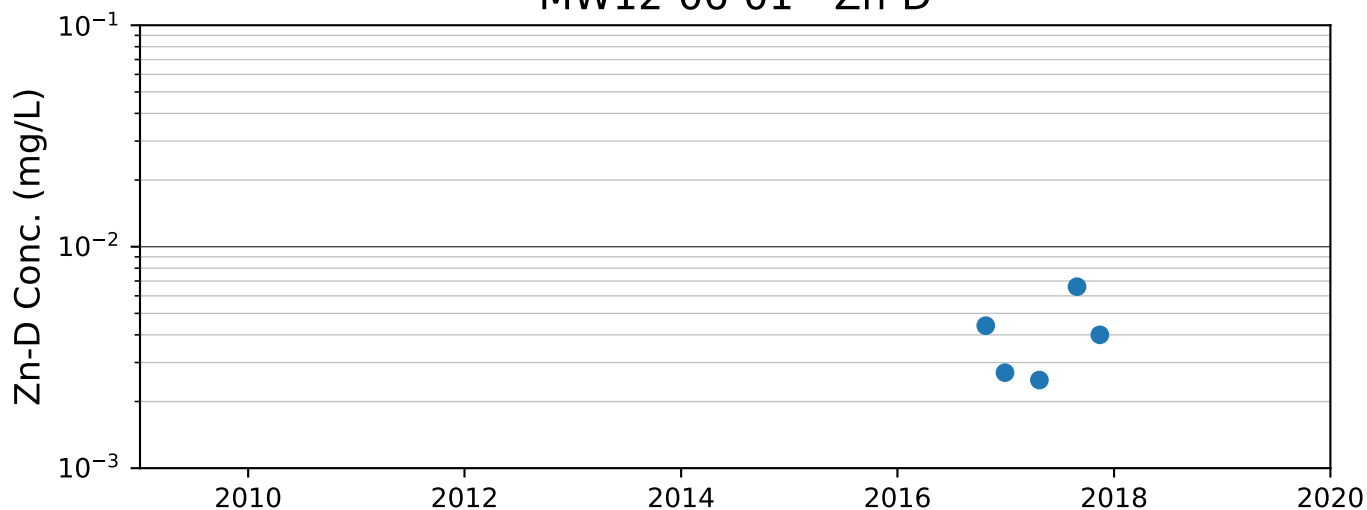
MW12-06-01 - Ni-D



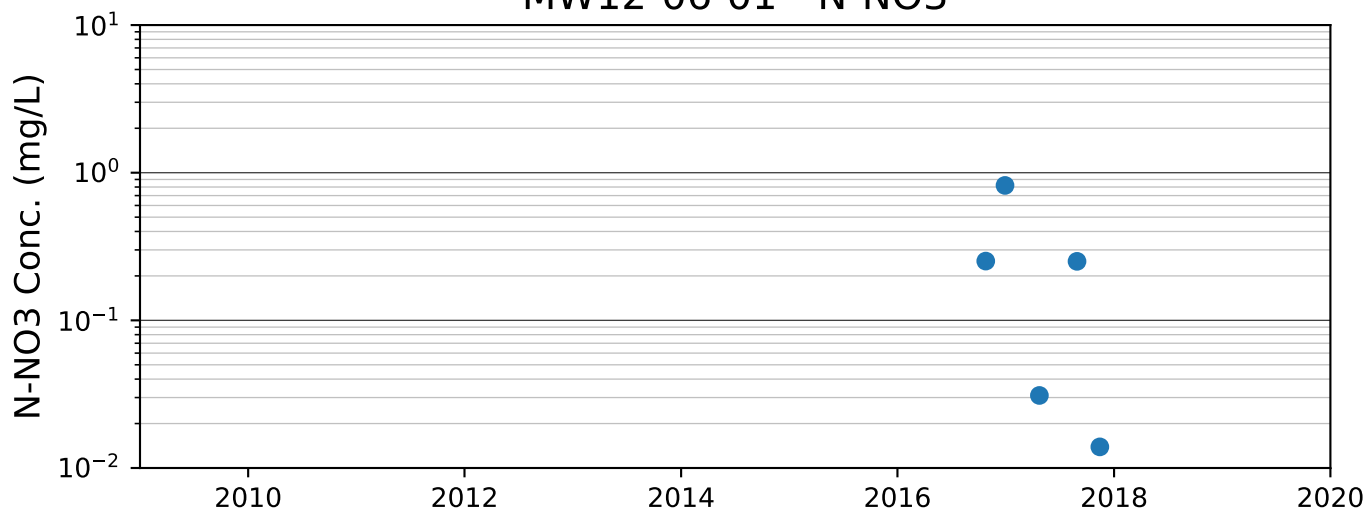
MW12-06-01 - Se-D

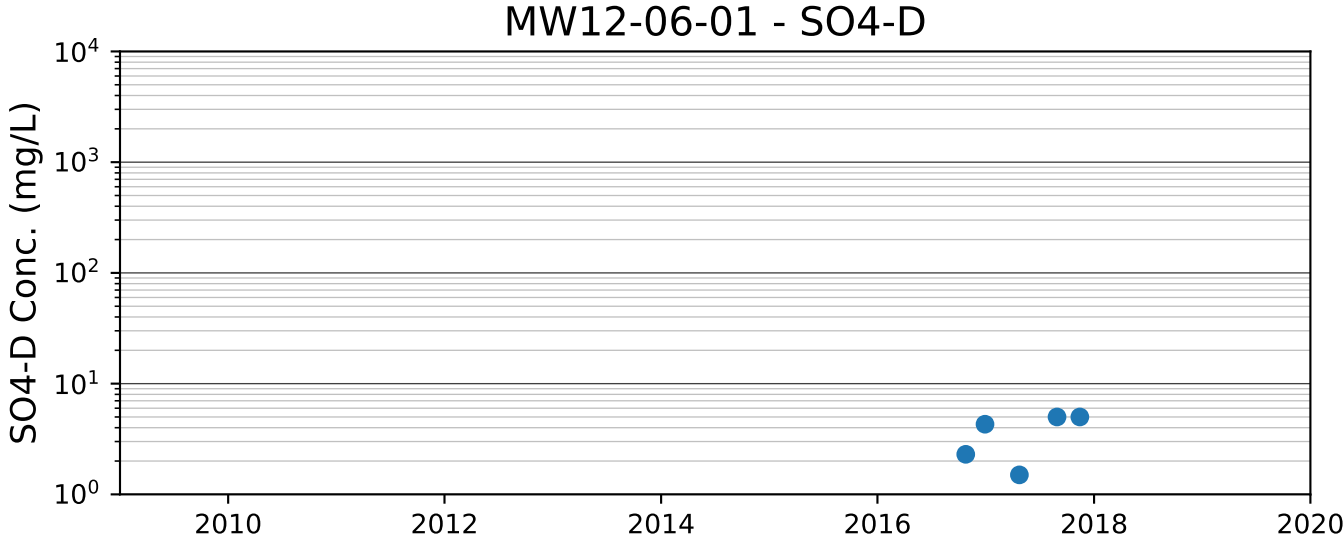


MW12-06-01 - Zn-D

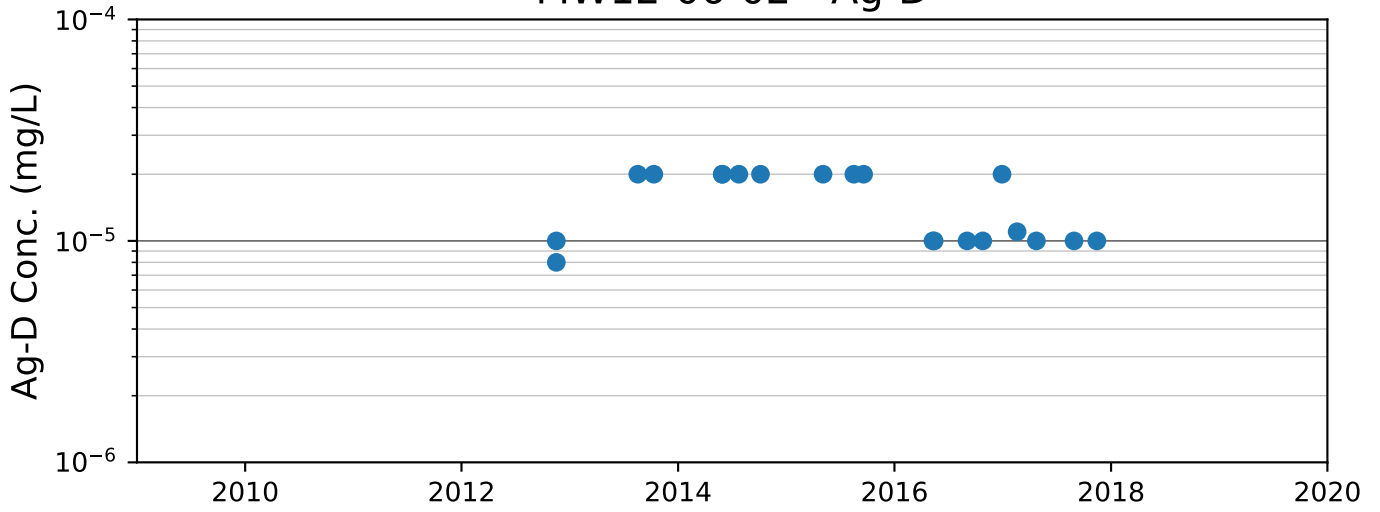


MW12-06-01 - N-NO3

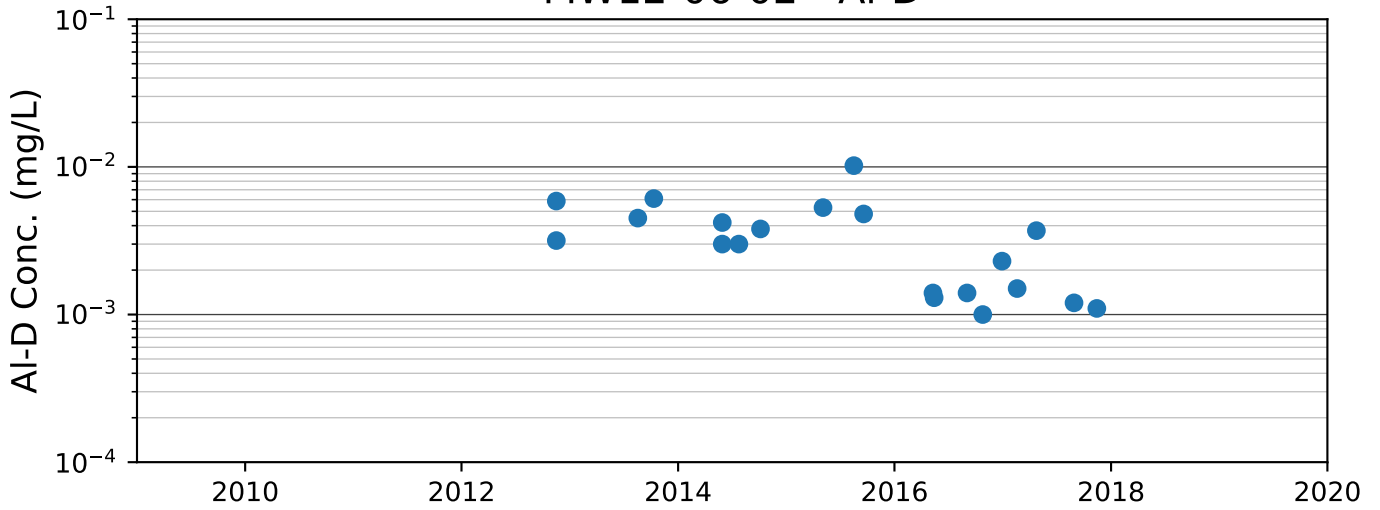




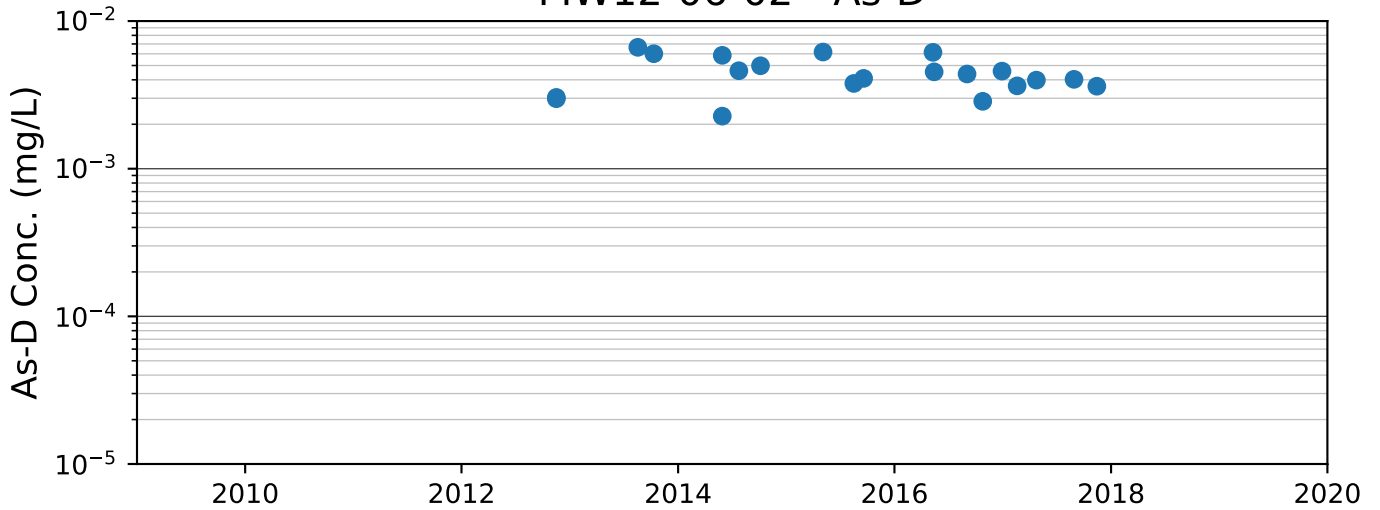
MW12-06-02 - Ag-D



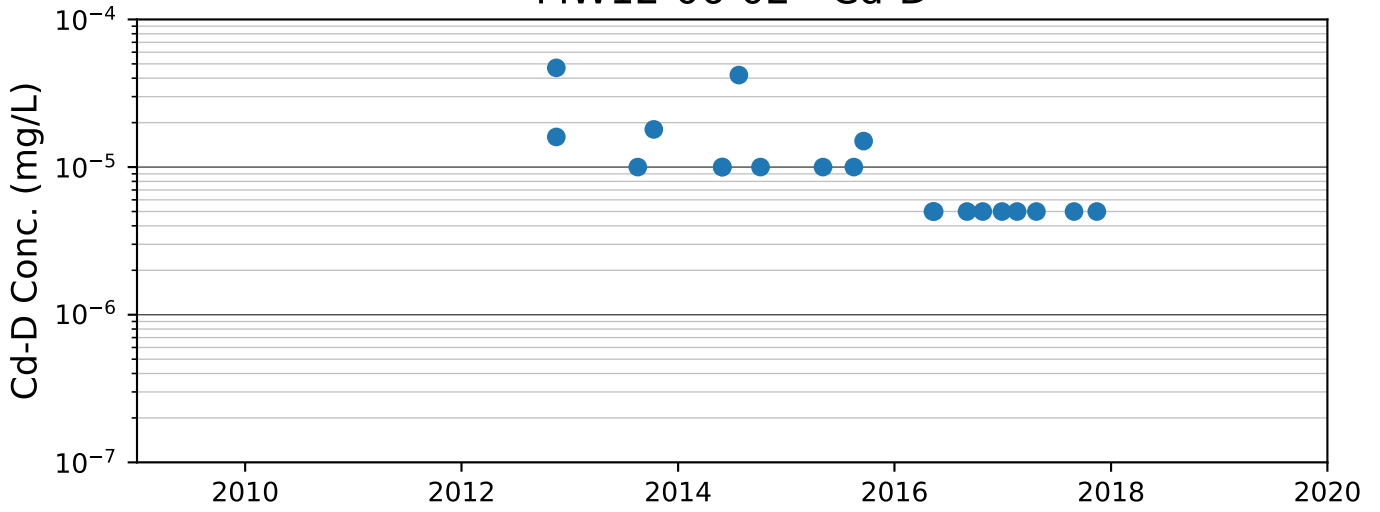
MW12-06-02 - Al-D



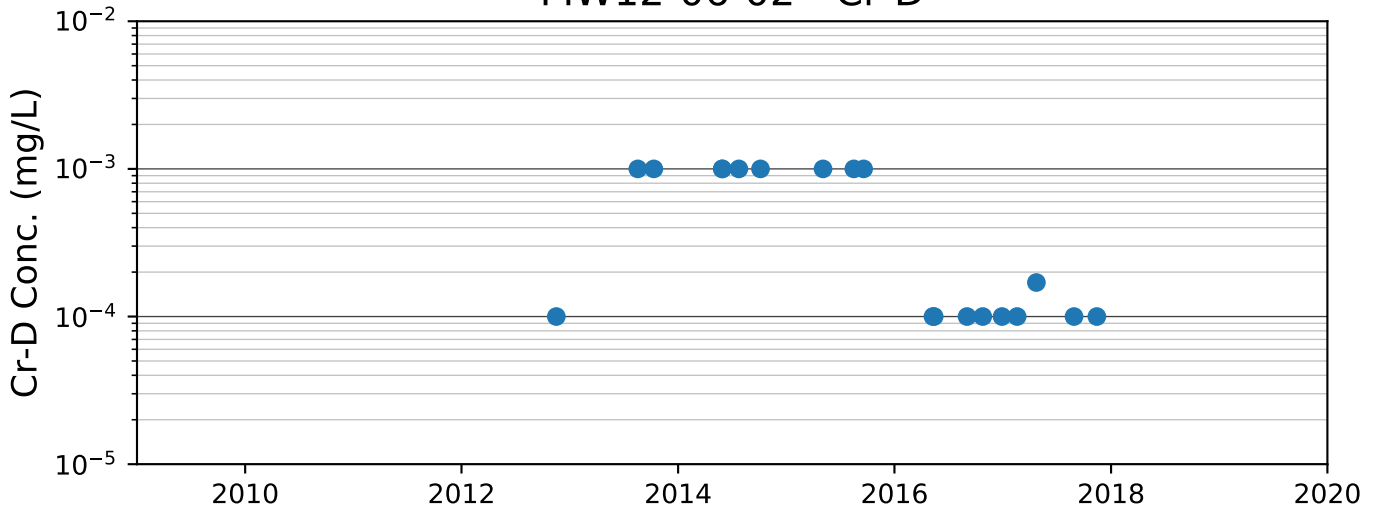
MW12-06-02 - As-D



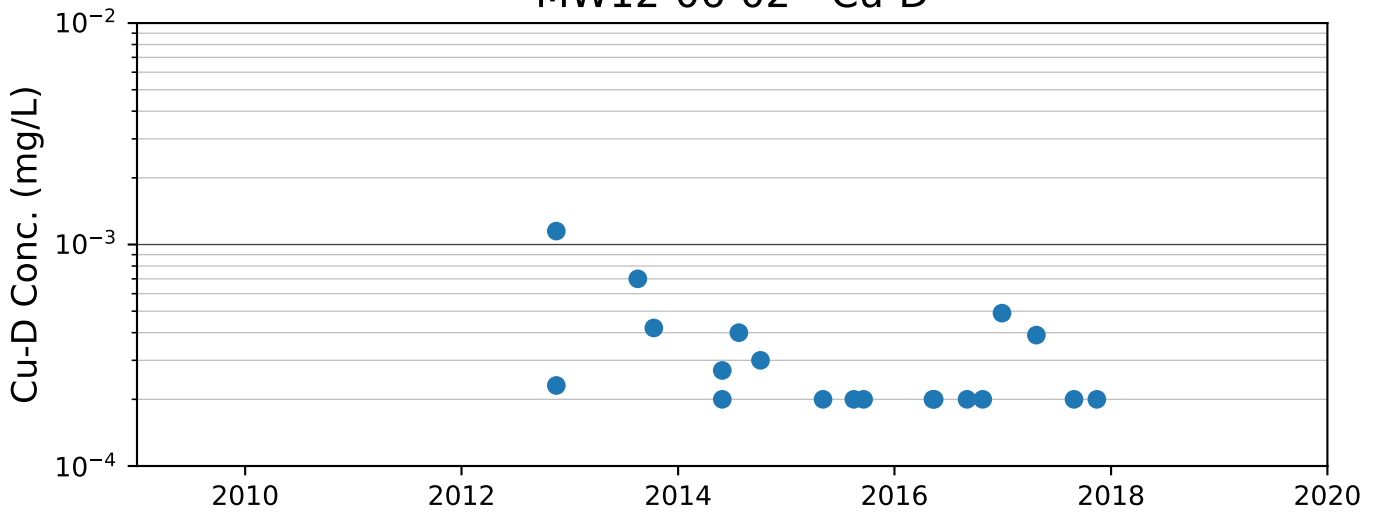
MW12-06-02 - Cd-D

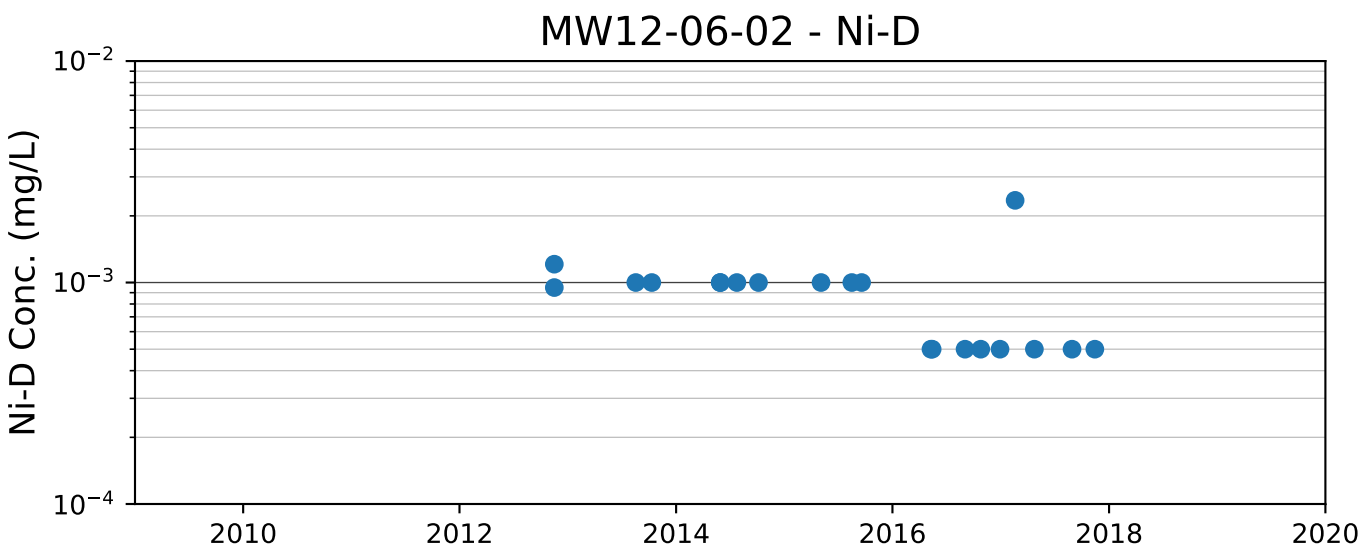
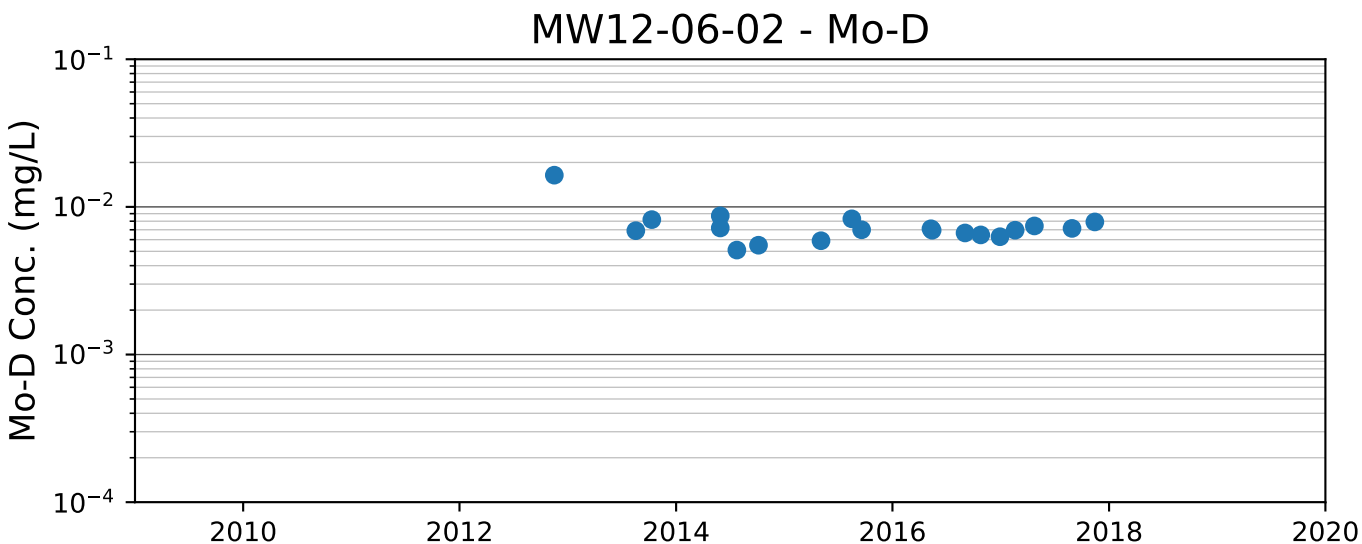
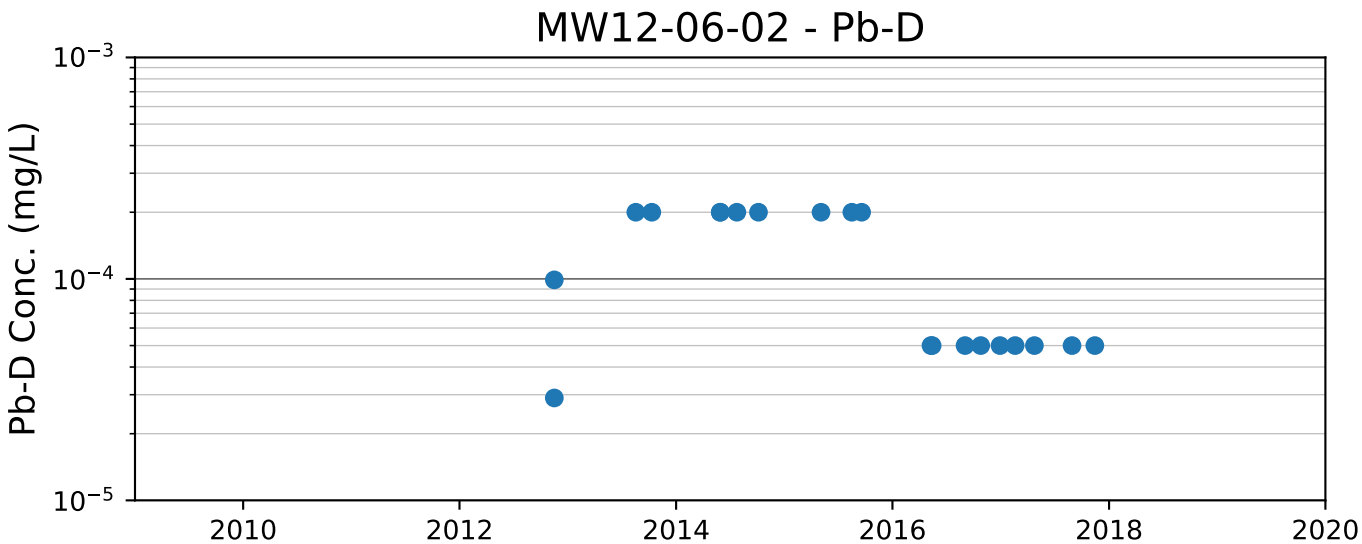


MW12-06-02 - Cr-D

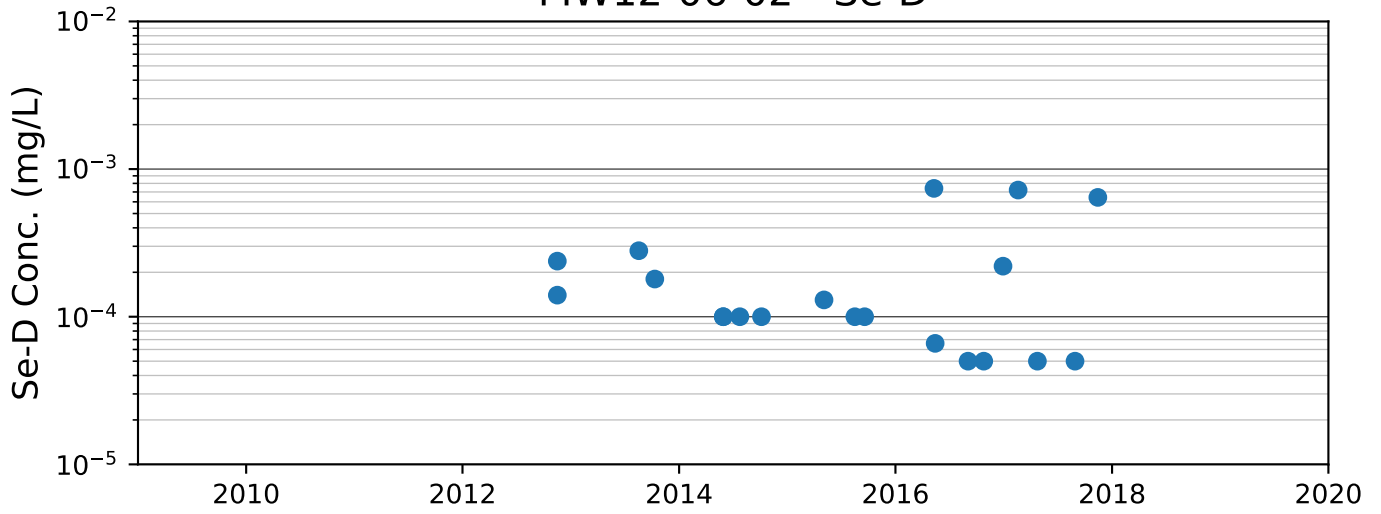


MW12-06-02 - Cu-D

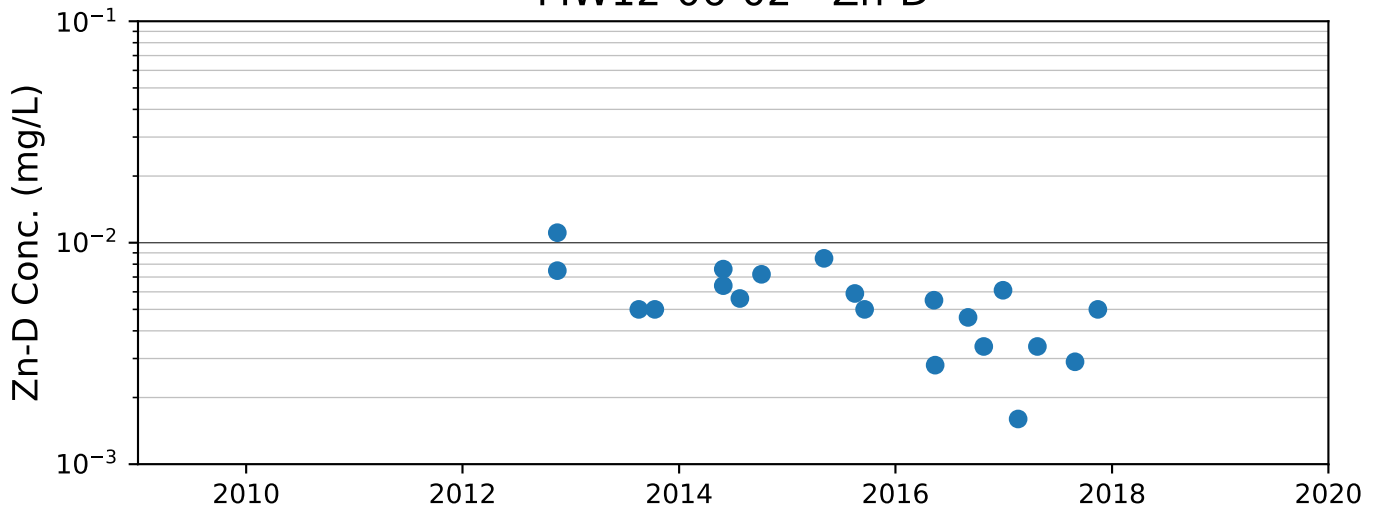




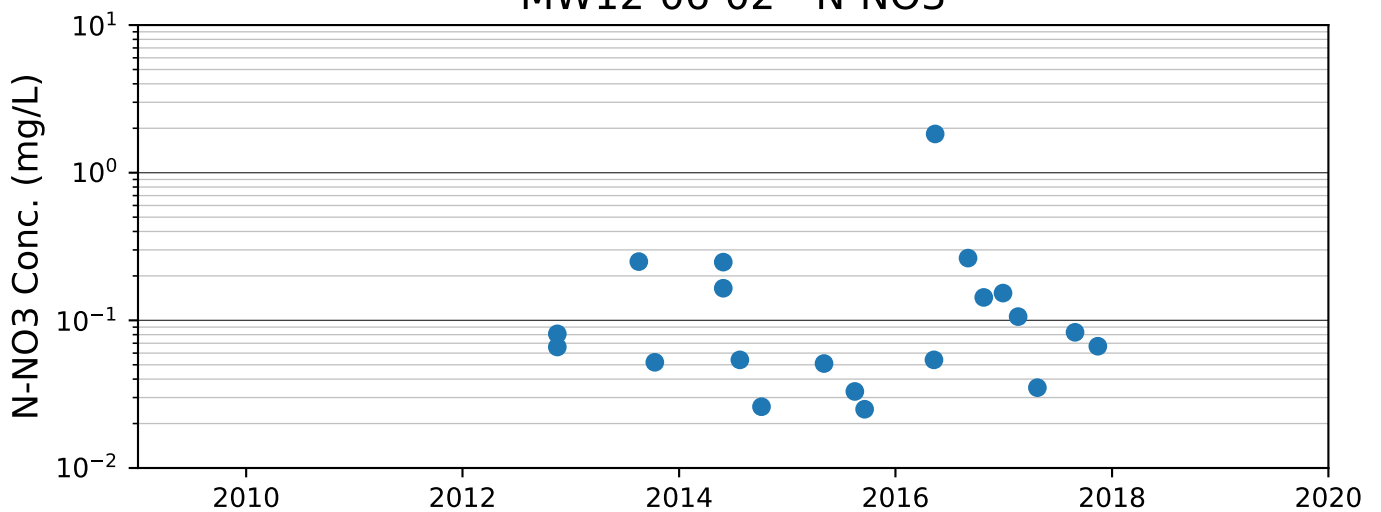
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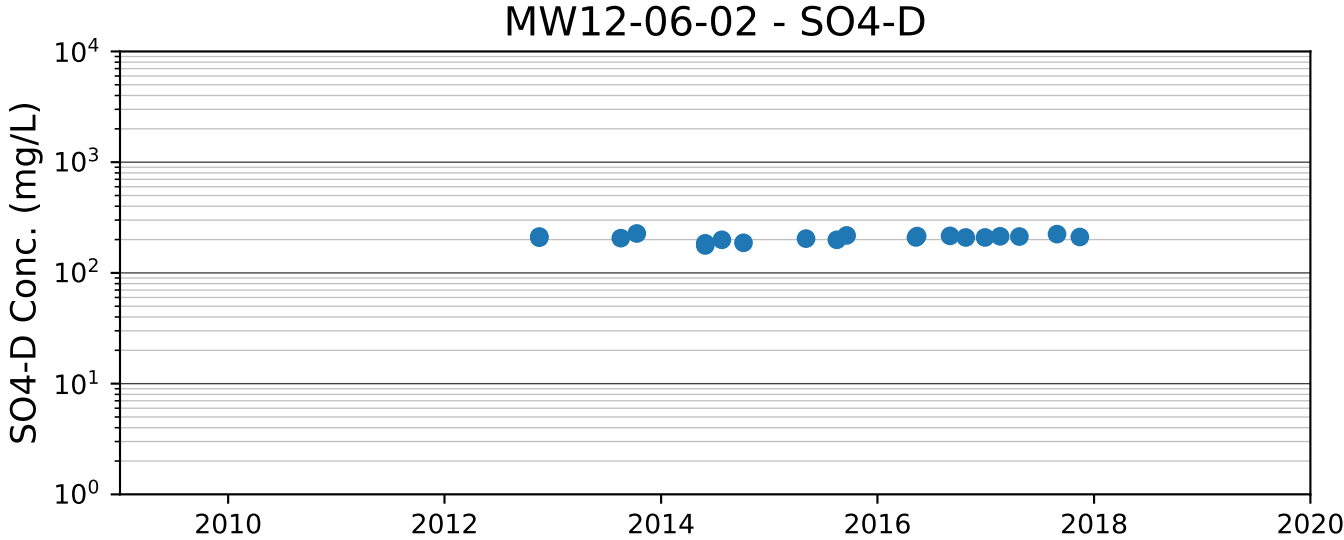


MW12-06-02 - Zn-D

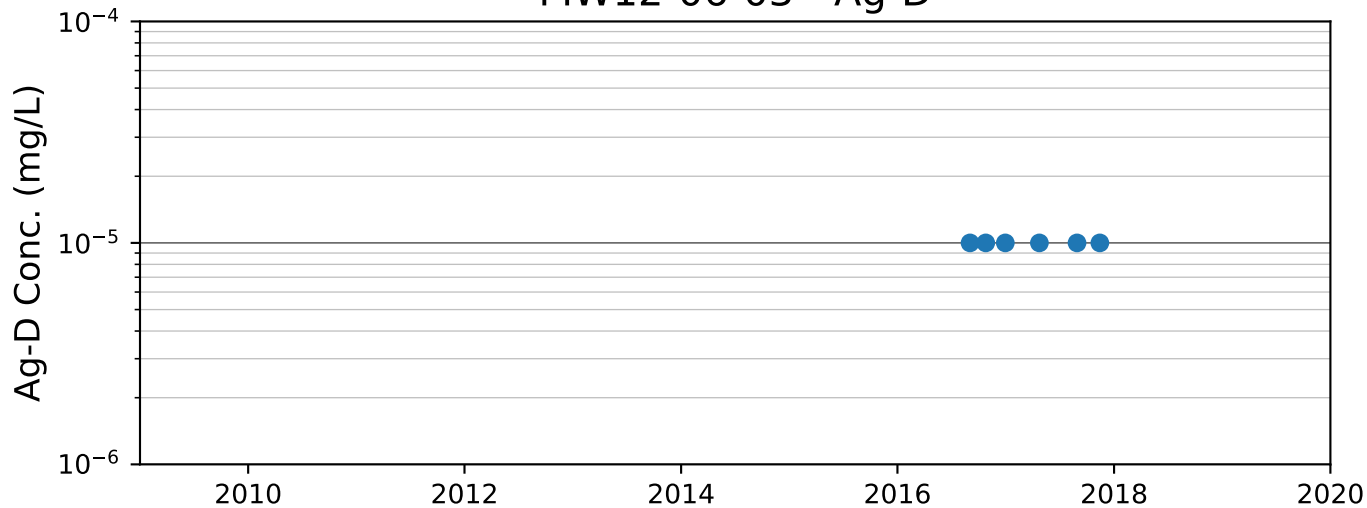


MW12-06-02 - N-NO3

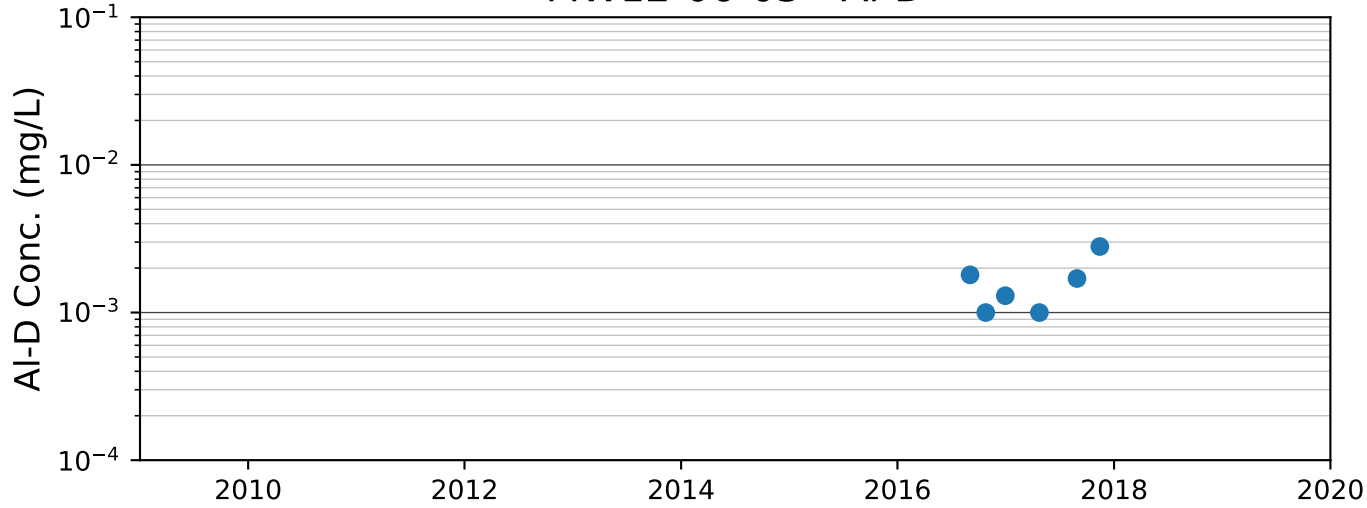




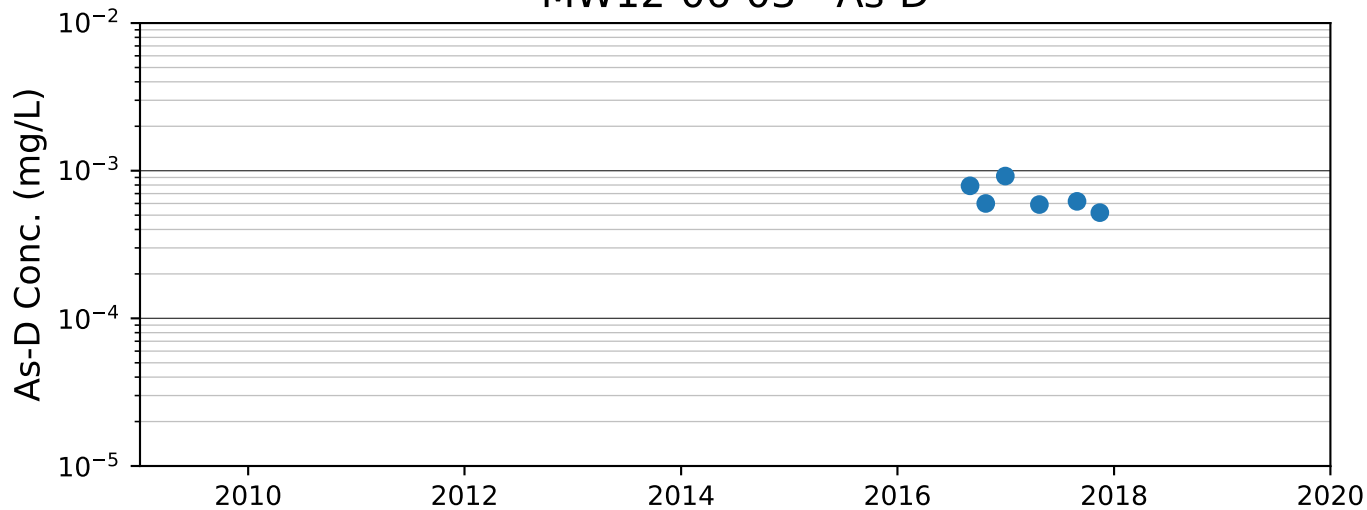
MW12-06-03 - Ag-D



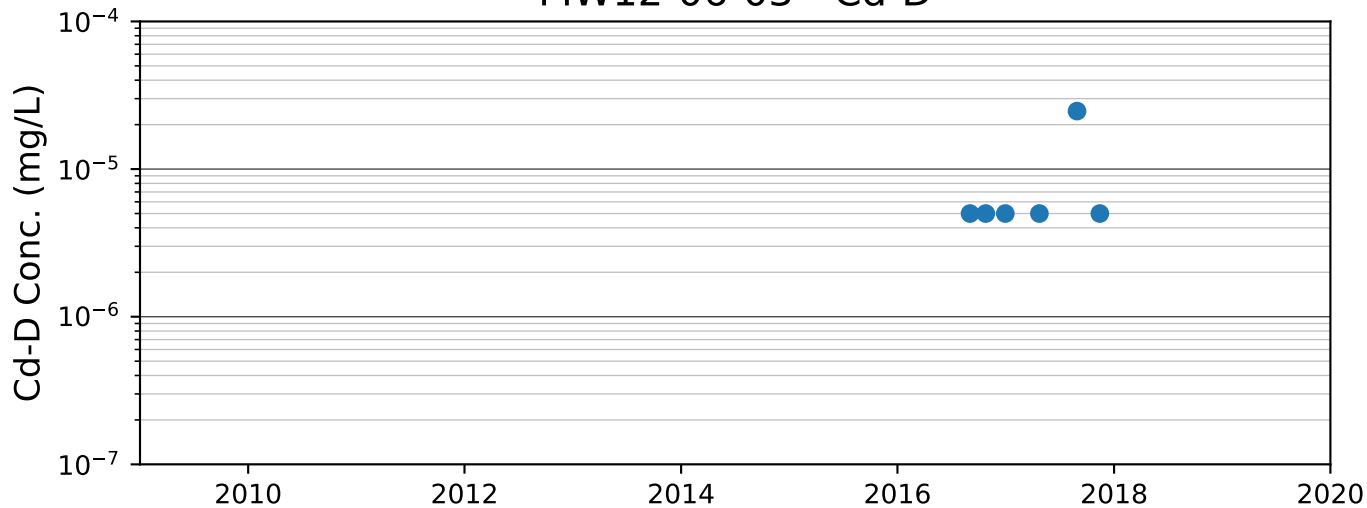
MW12-06-03 - Al-D



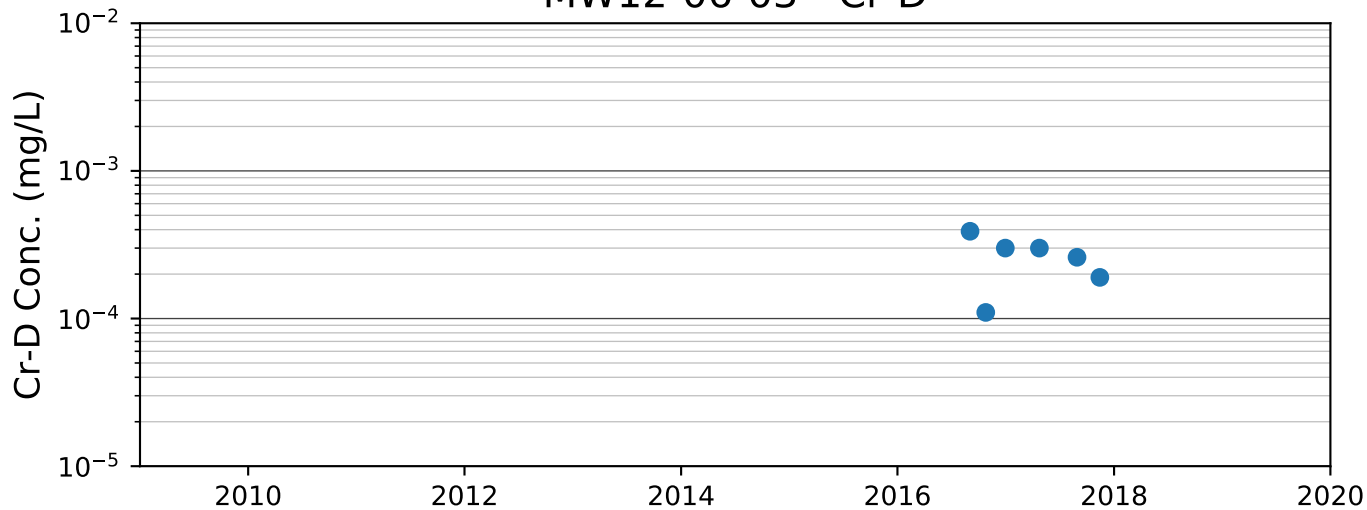
MW12-06-03 - As-D



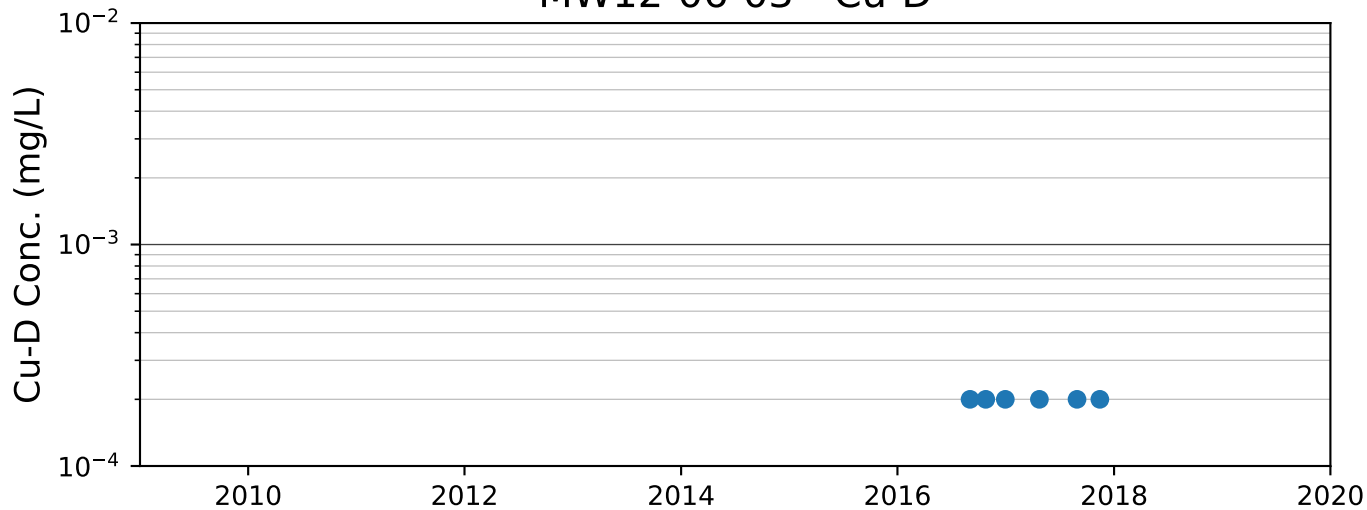
MW12-06-03 - Cd-D



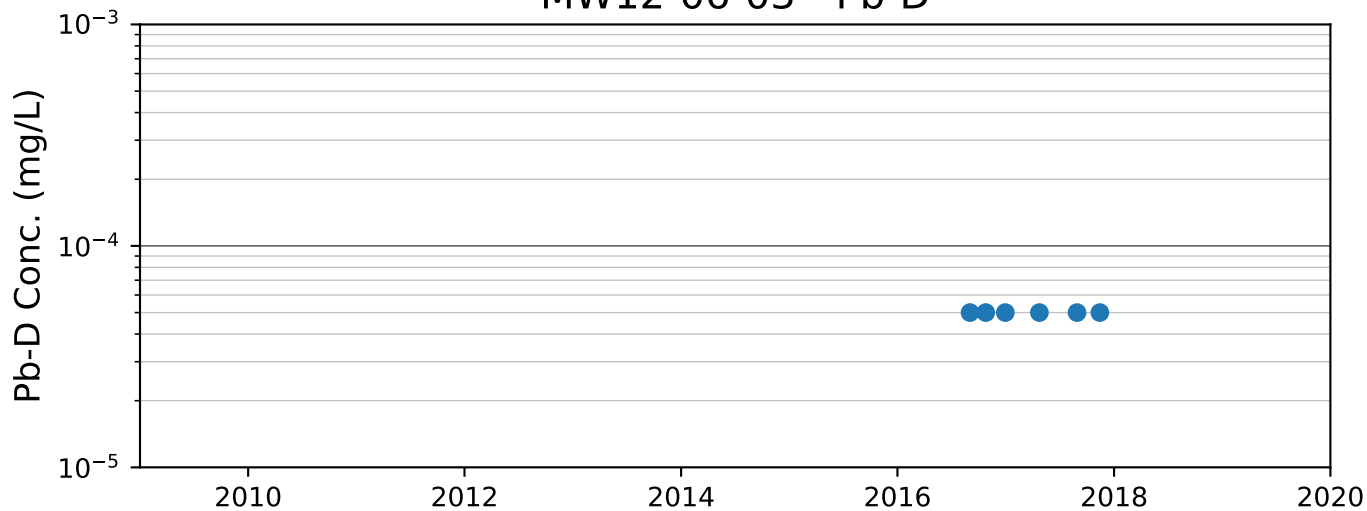
MW12-06-03 - Cr-D



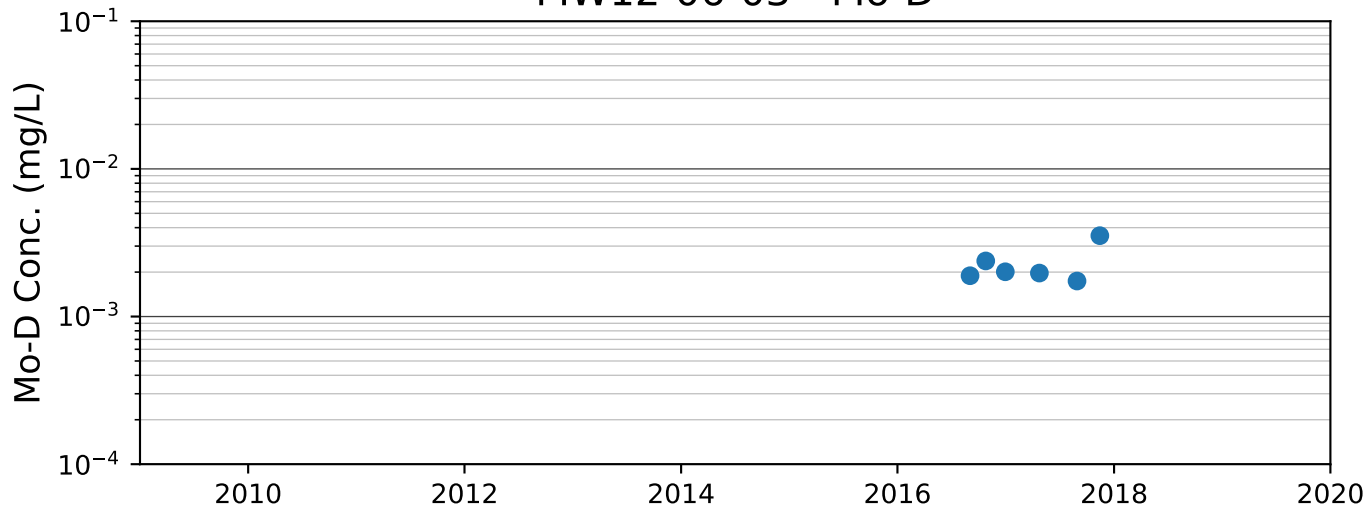
MW12-06-03 - Cu-D



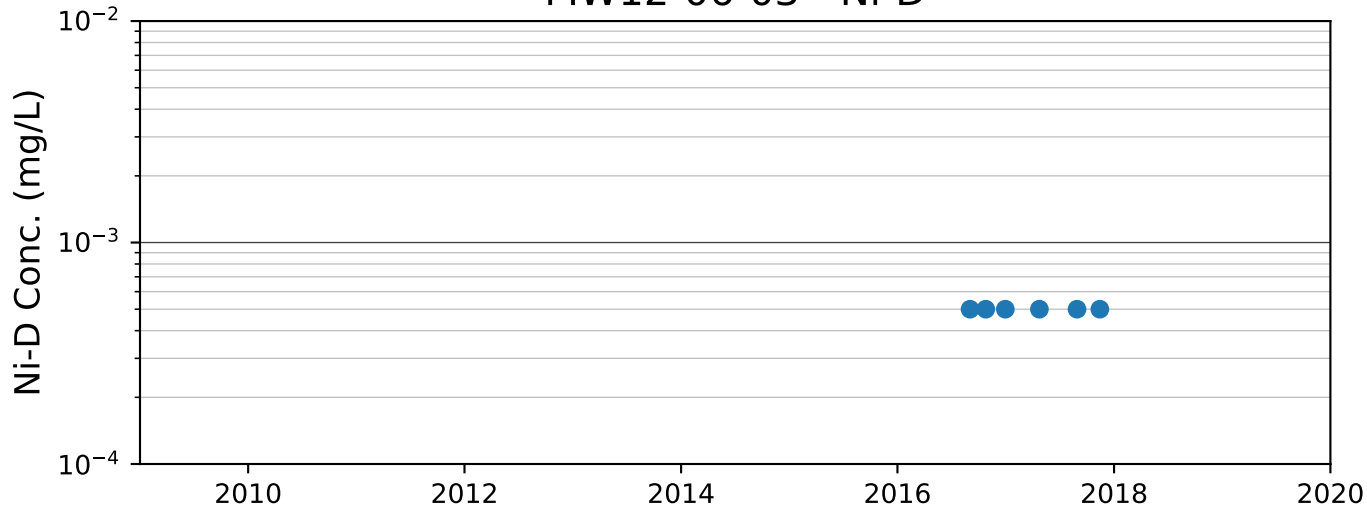
MW12-06-03 - Pb-D



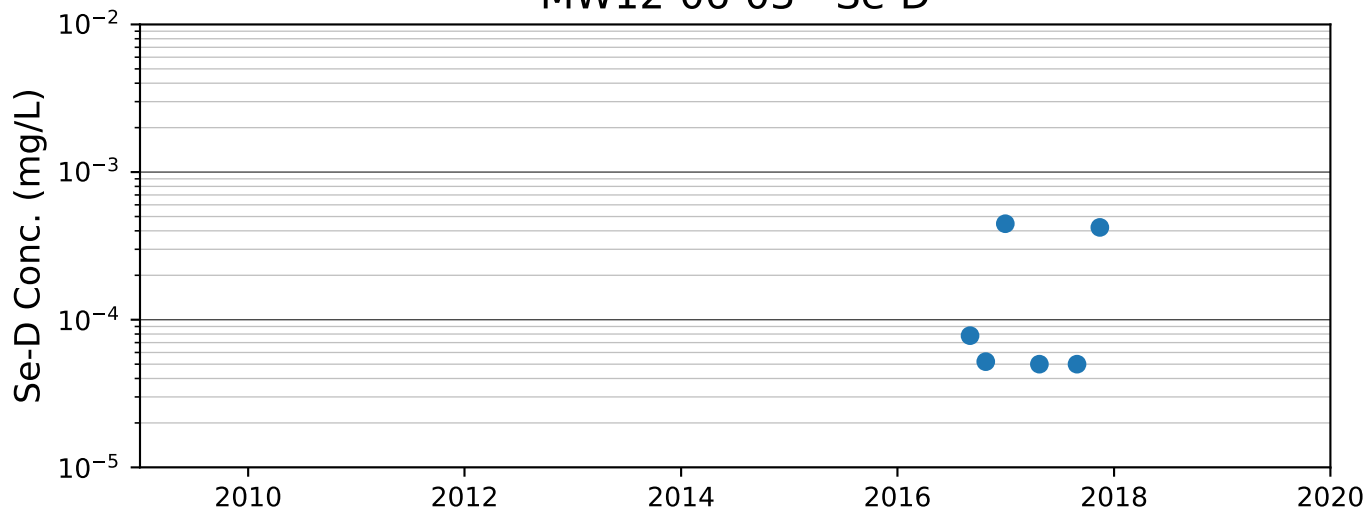
MW12-06-03 - Mo-D



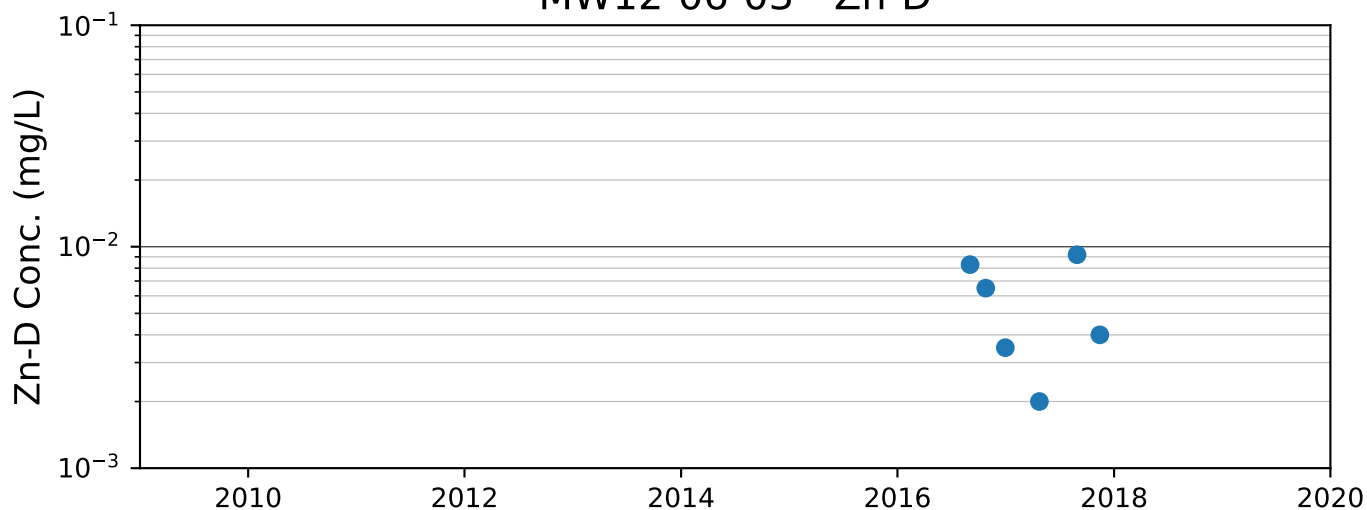
MW12-06-03 - Ni-D



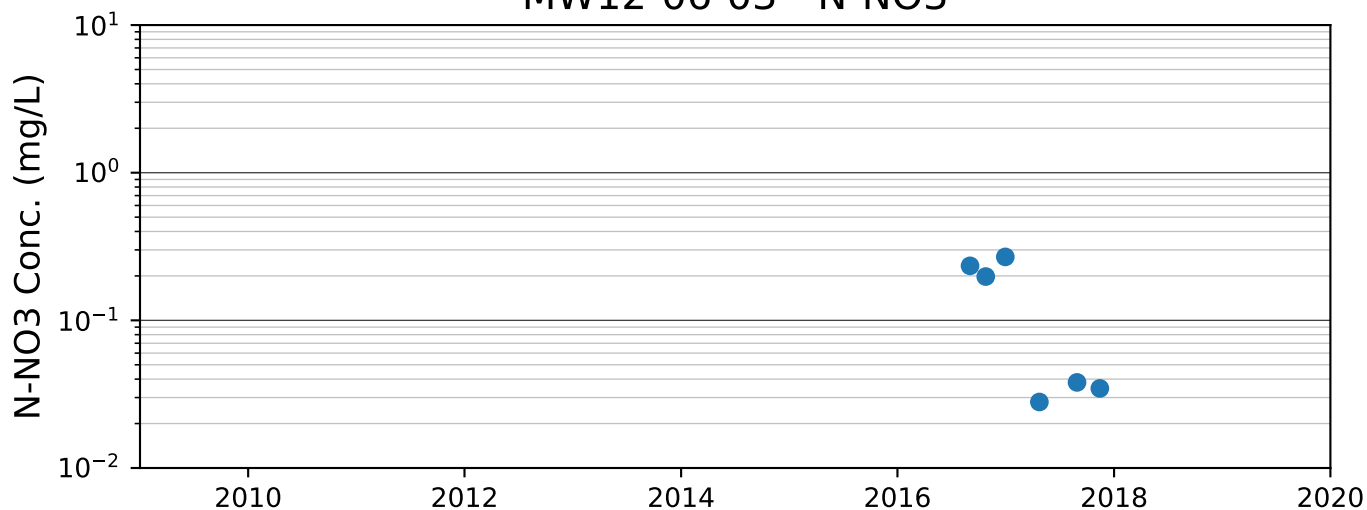
MW12-06-03 - Se-D

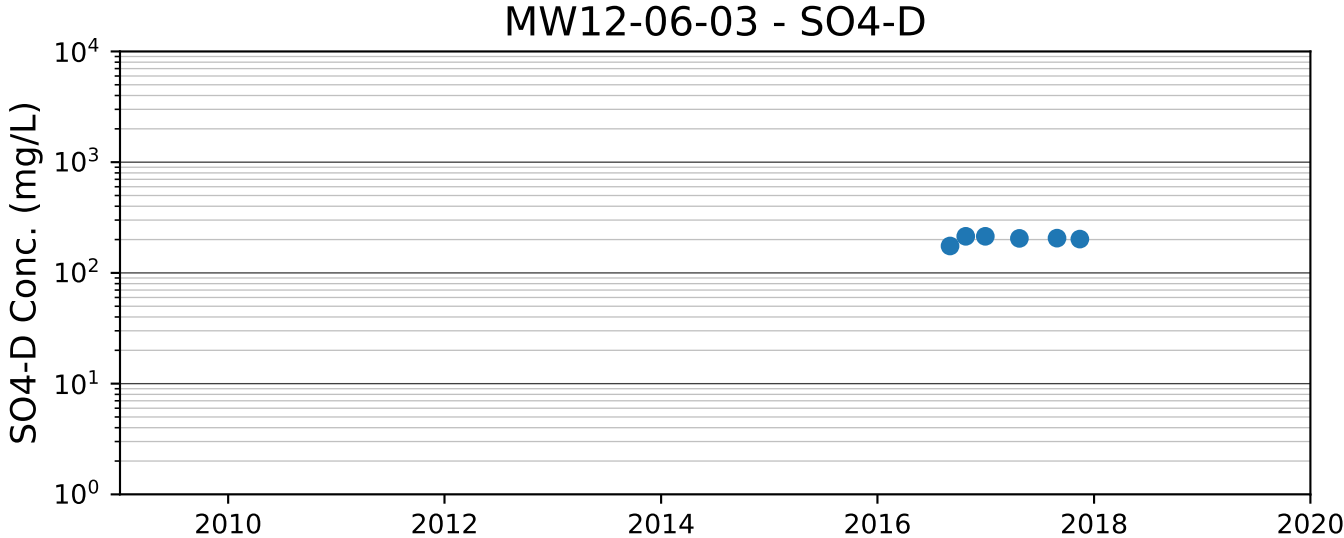


MW12-06-03 - Zn-D

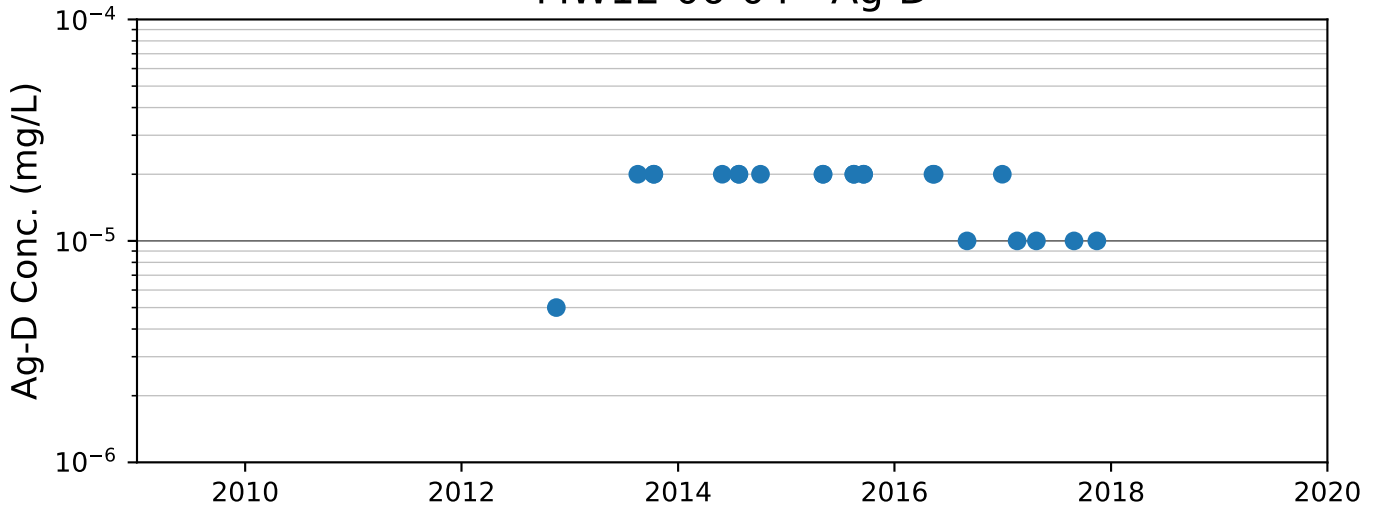


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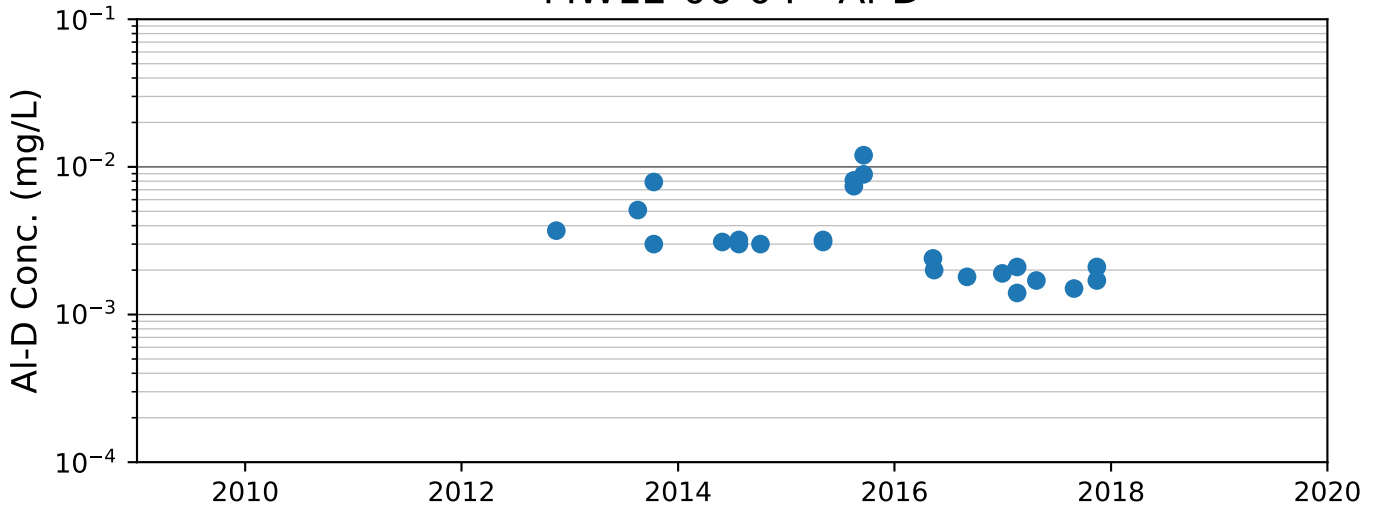




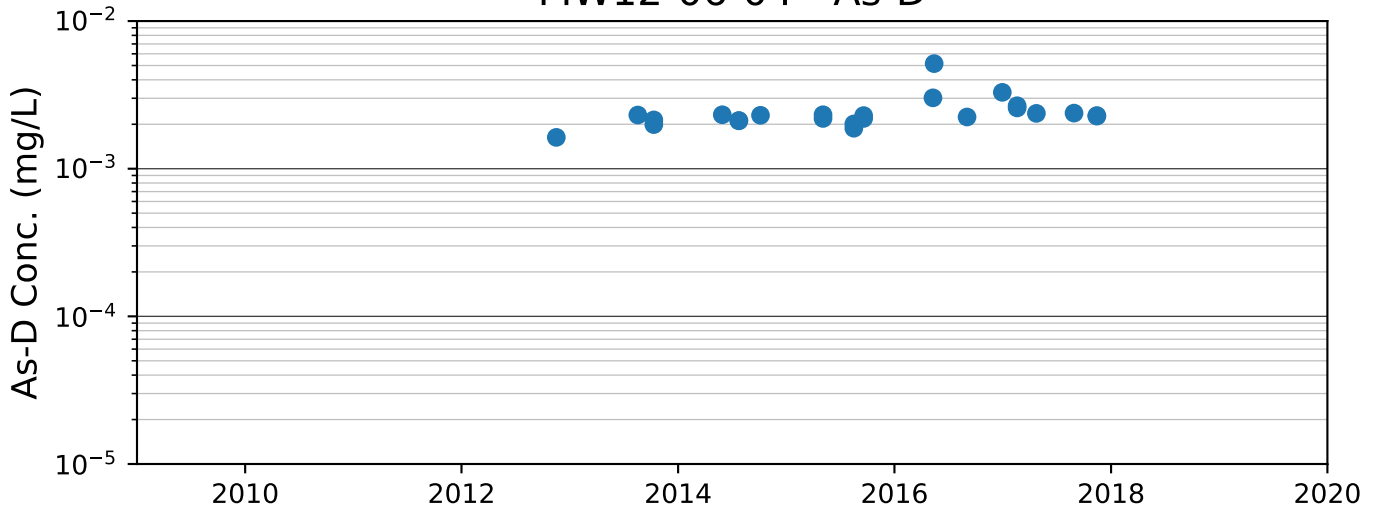
MW12-06-04 - Ag-D



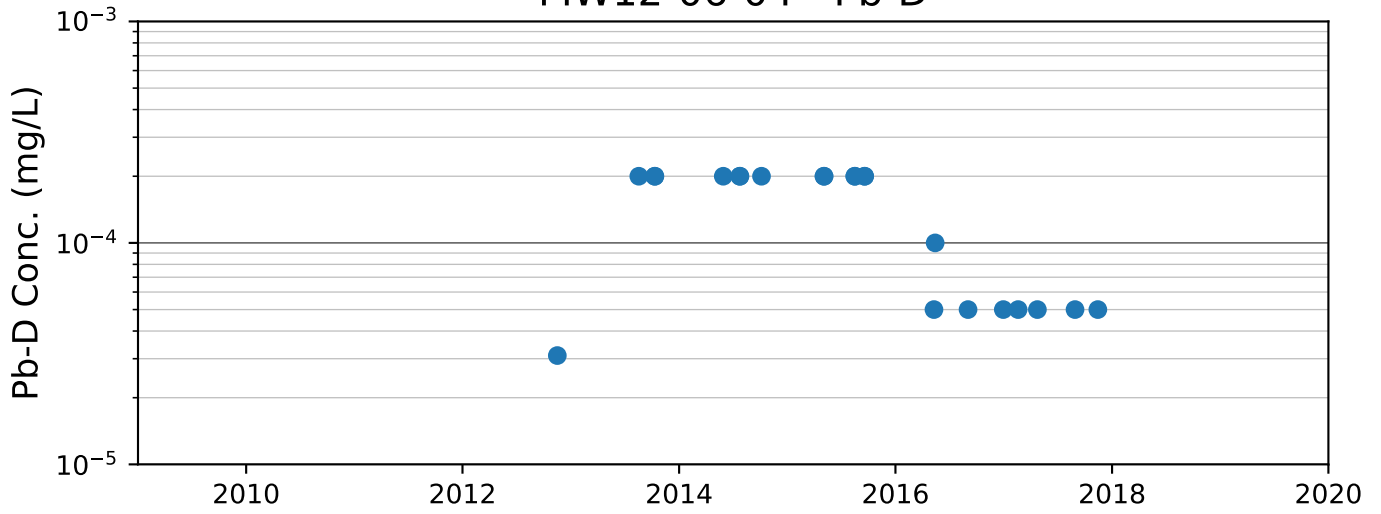
MW12-06-04 - Al-D



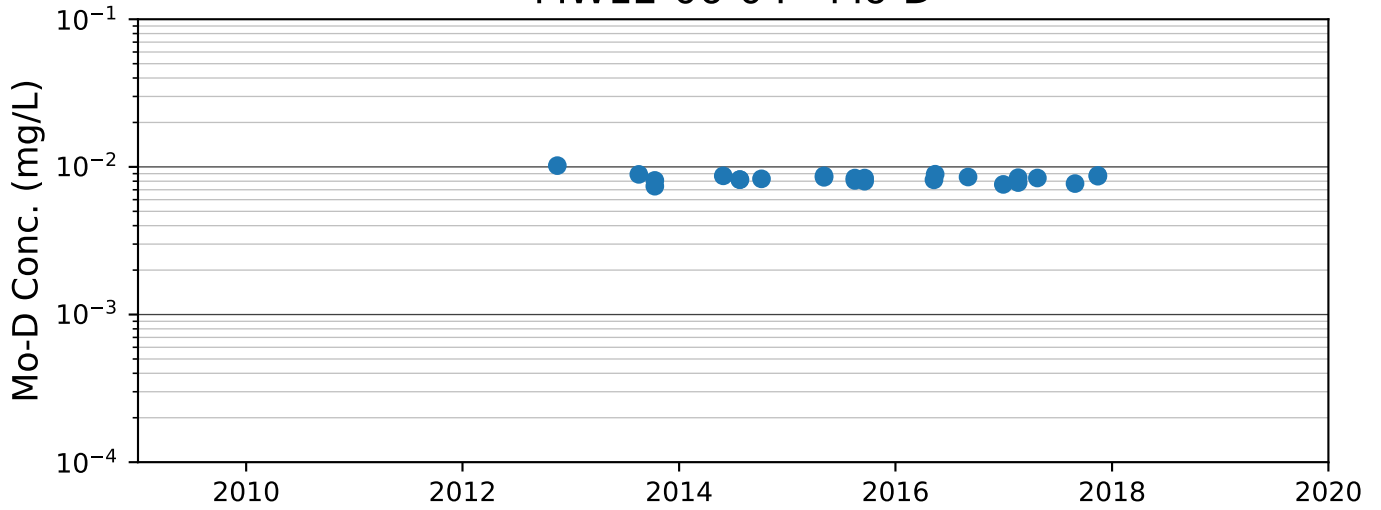
MW12-06-04 - As-D



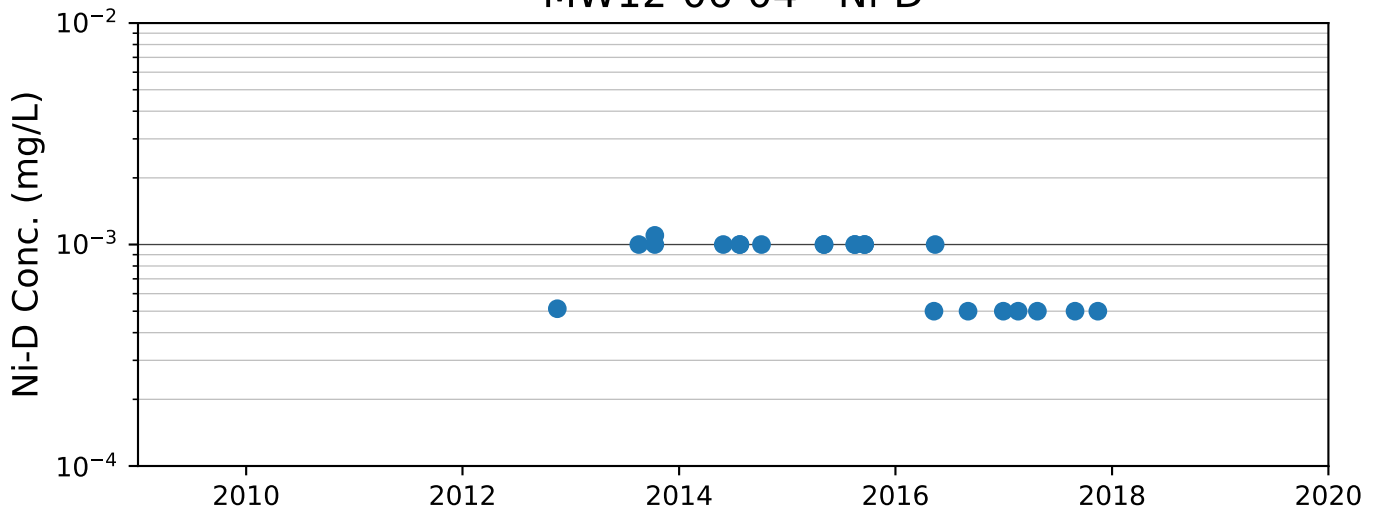
MW12-06-04 - Pb-D



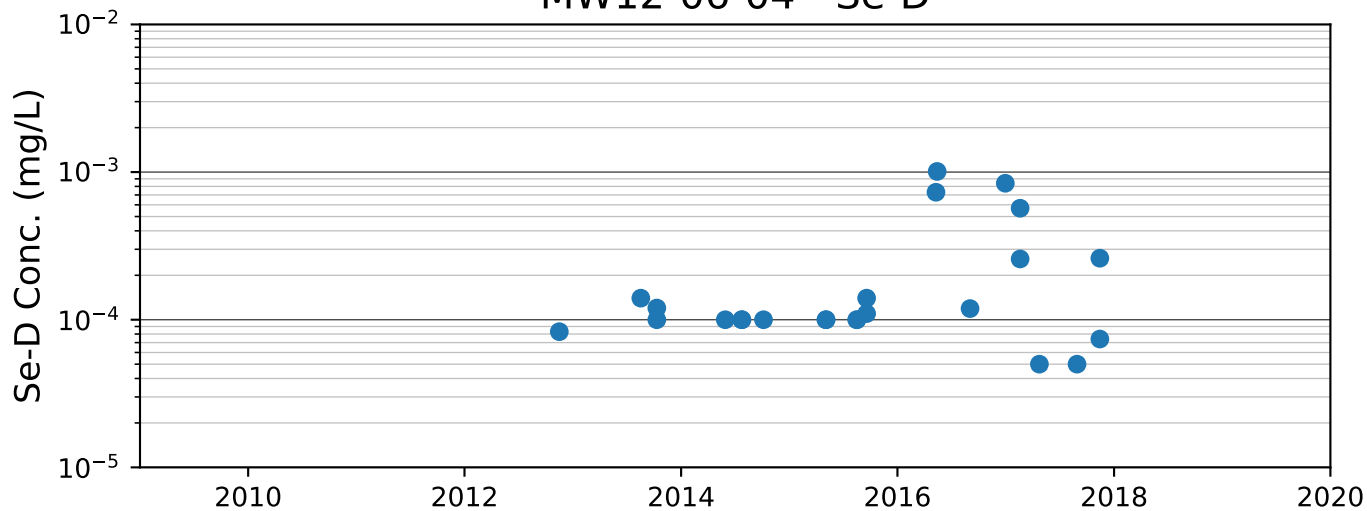
MW12-06-04 - Mo-D



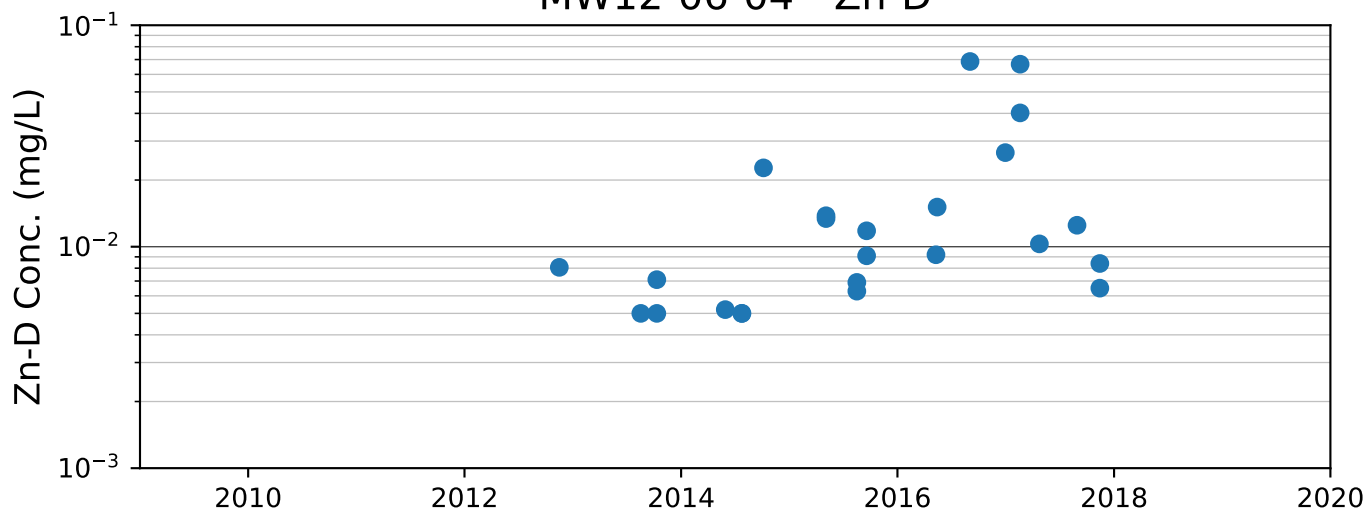
MW12-06-04 - Ni-D



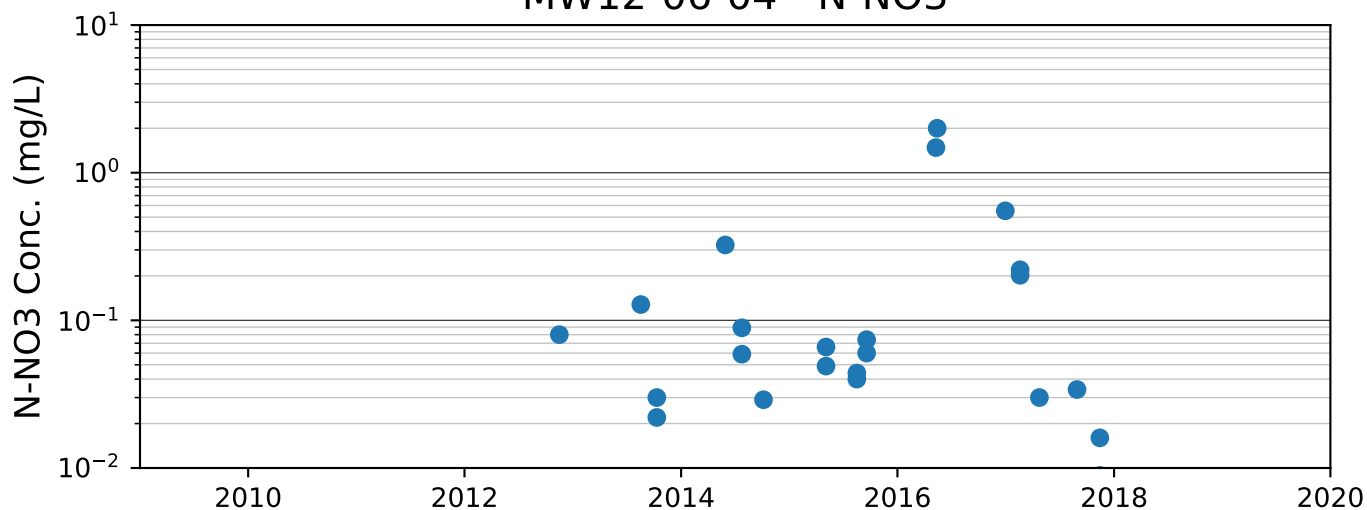
MW12-06-04 - Se-D

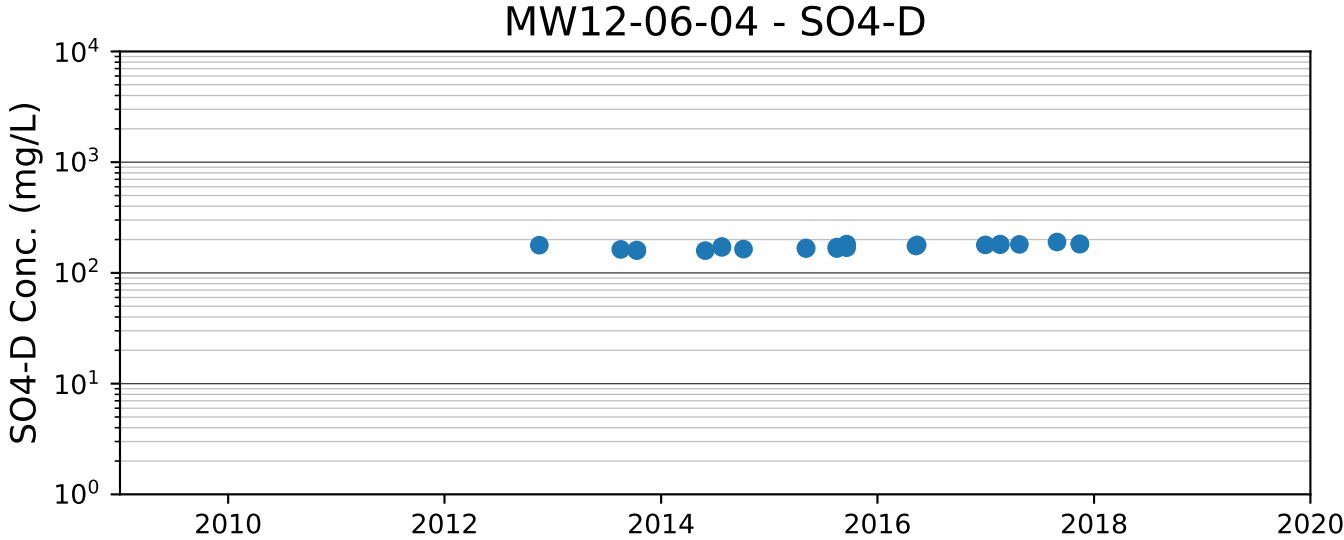


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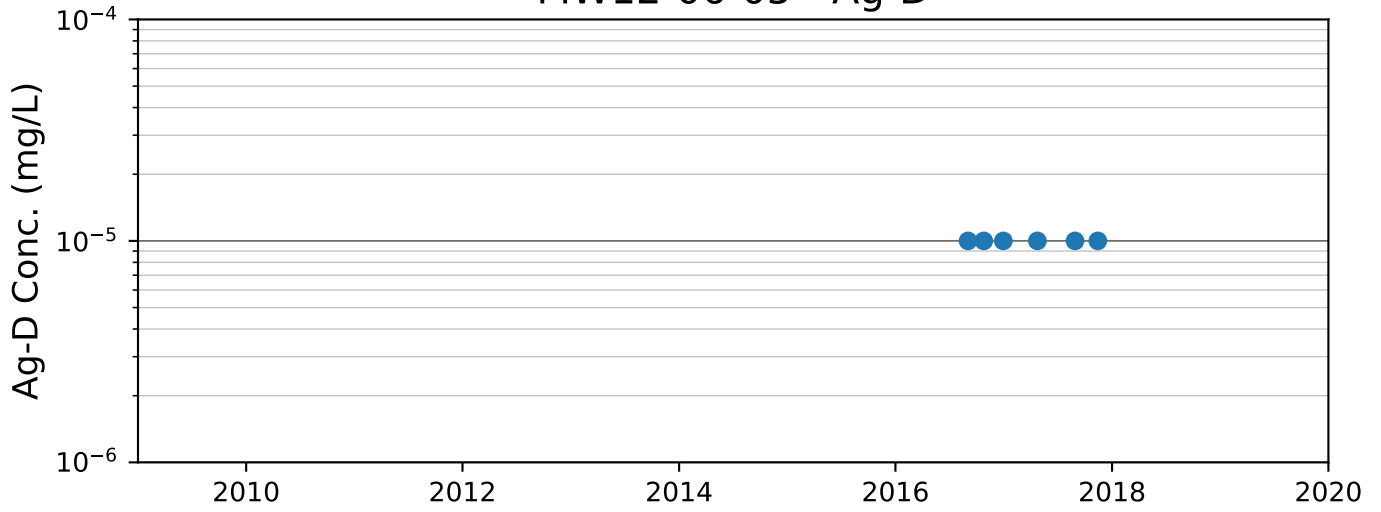


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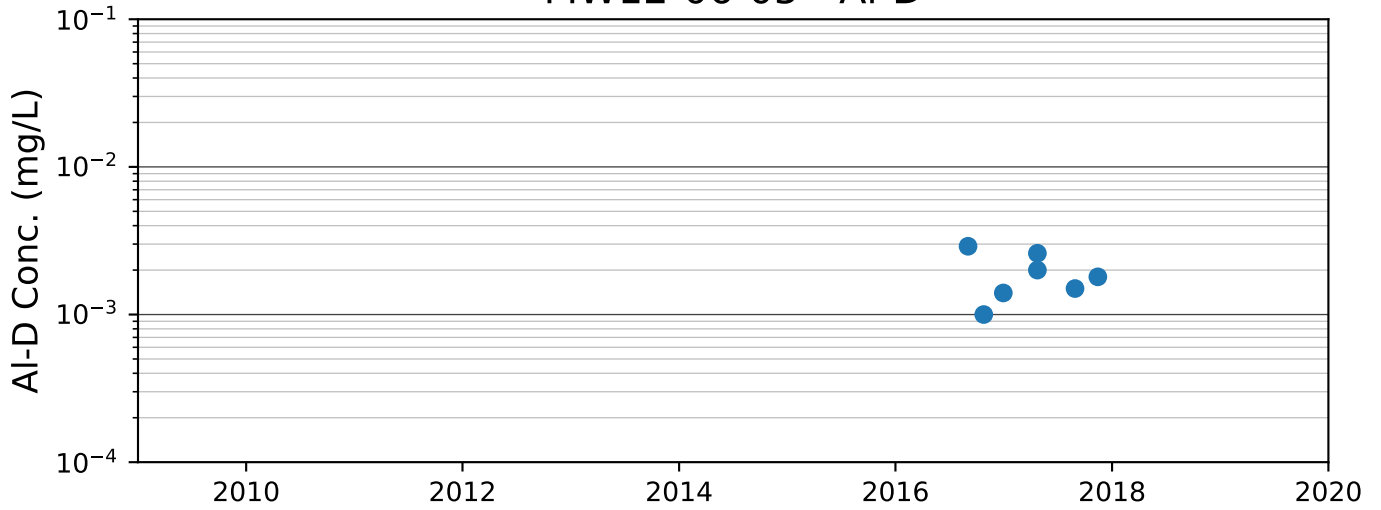




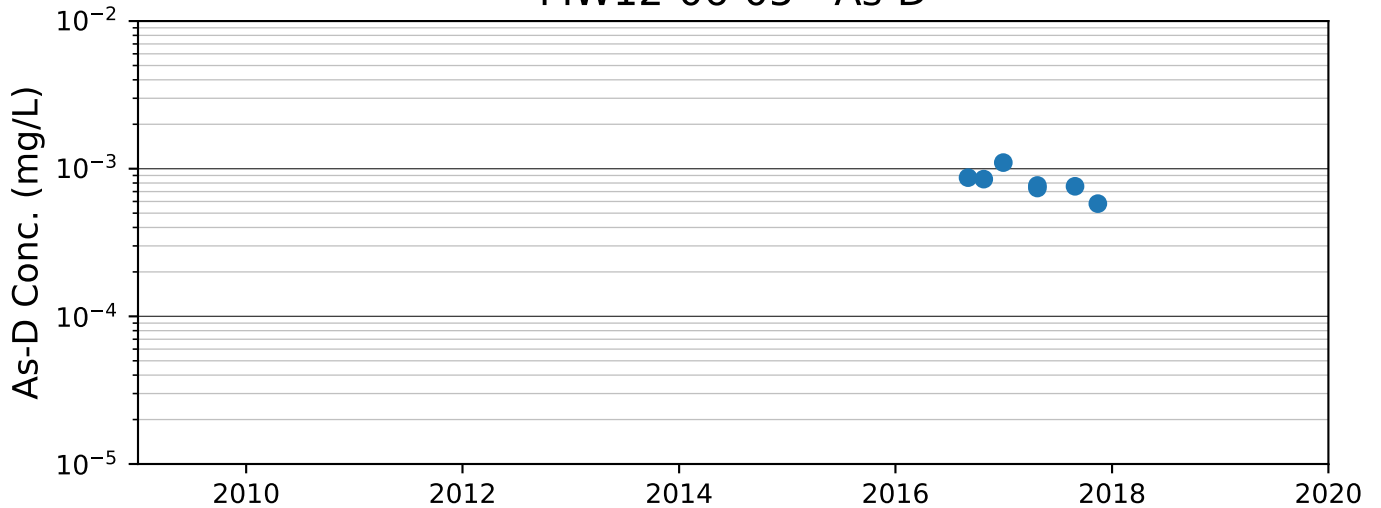
MW12-06-05 - Ag-D



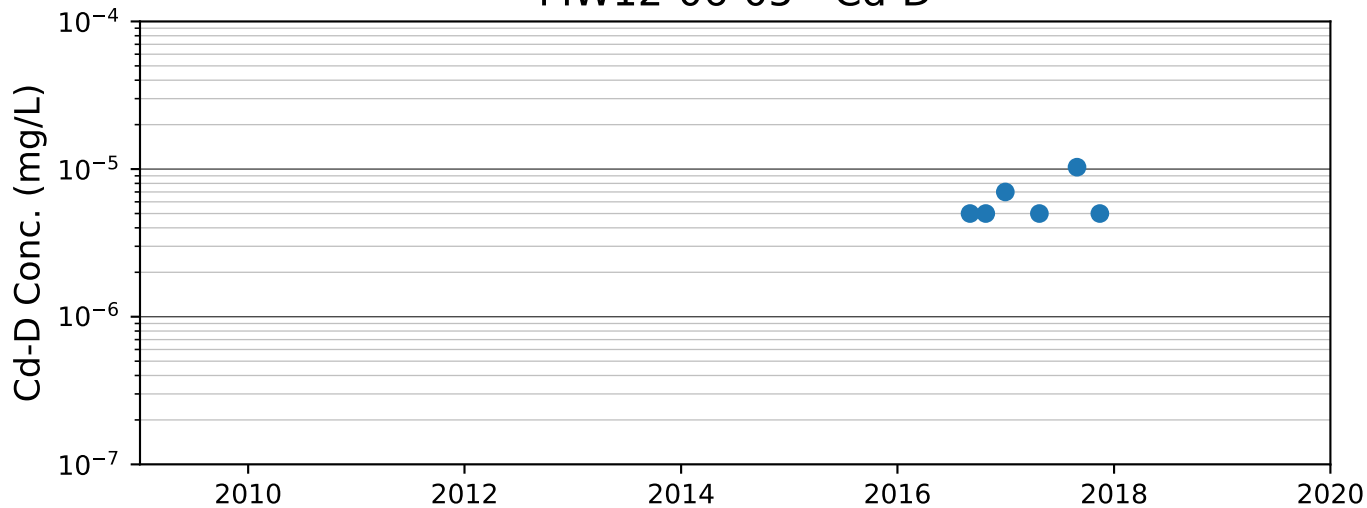
MW12-06-05 - Al-D



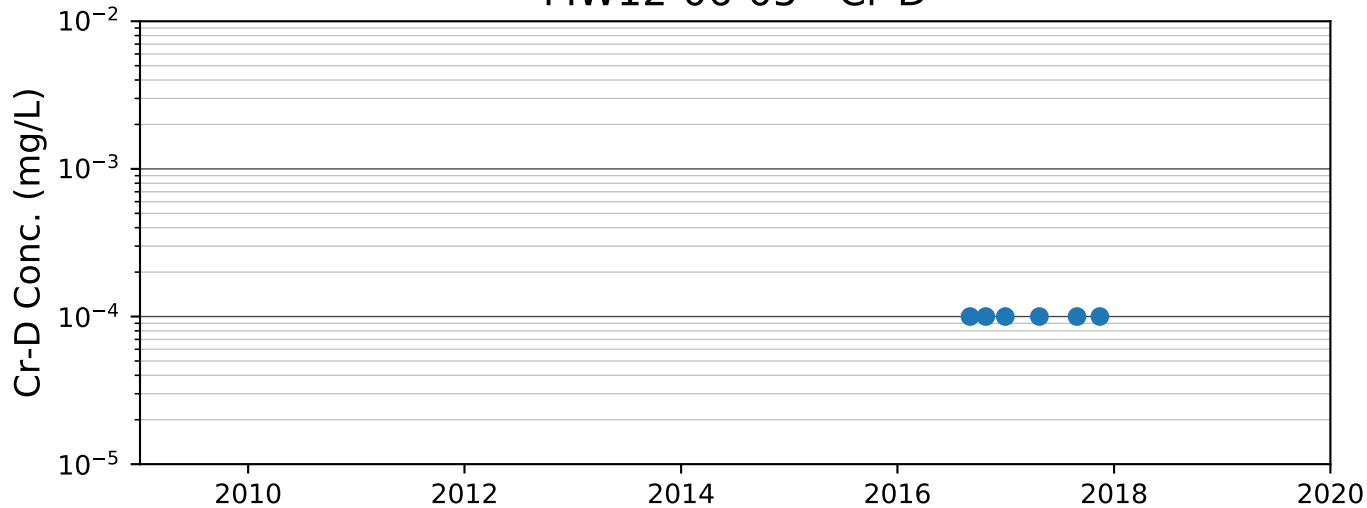
MW12-06-05 - As-D



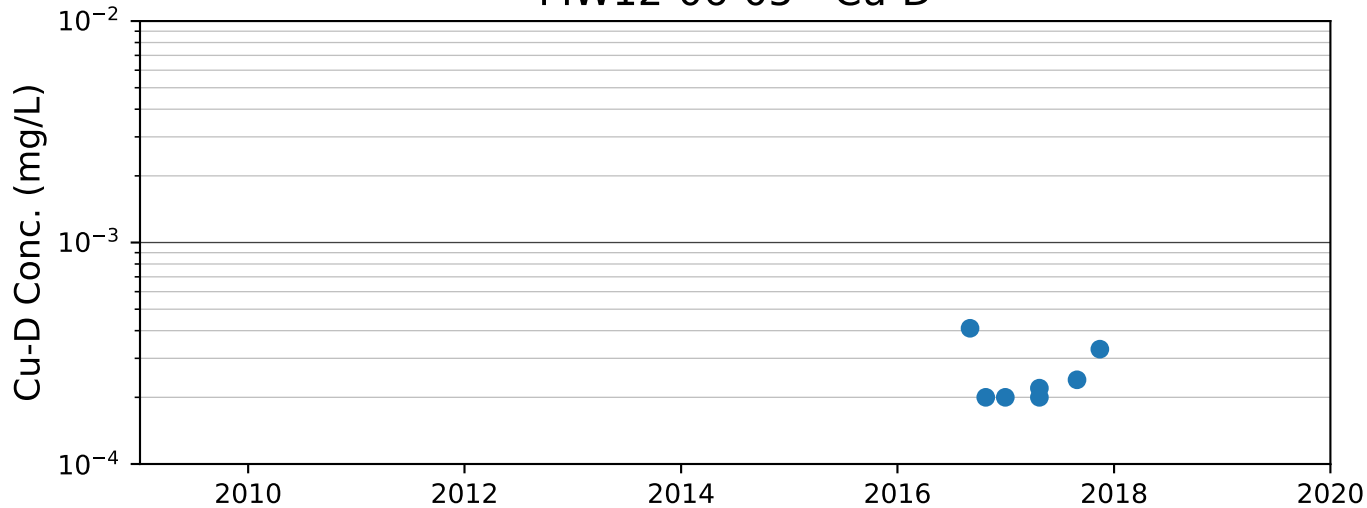
MW12-06-05 - Cd-D



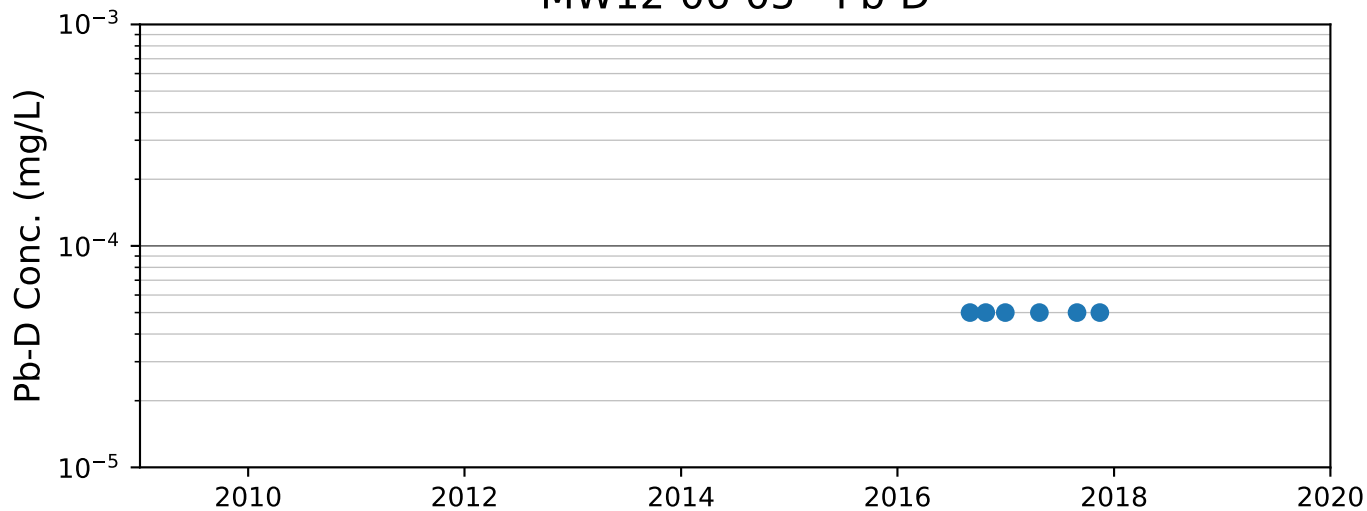
MW12-06-05 - Cr-D



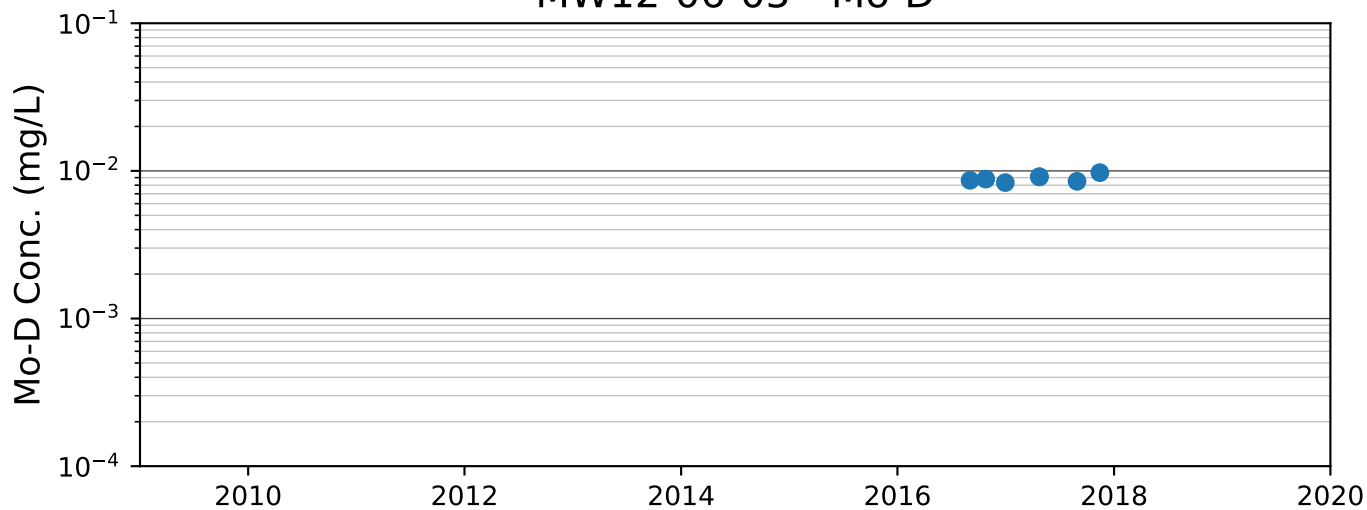
MW12-06-05 - Cu-D



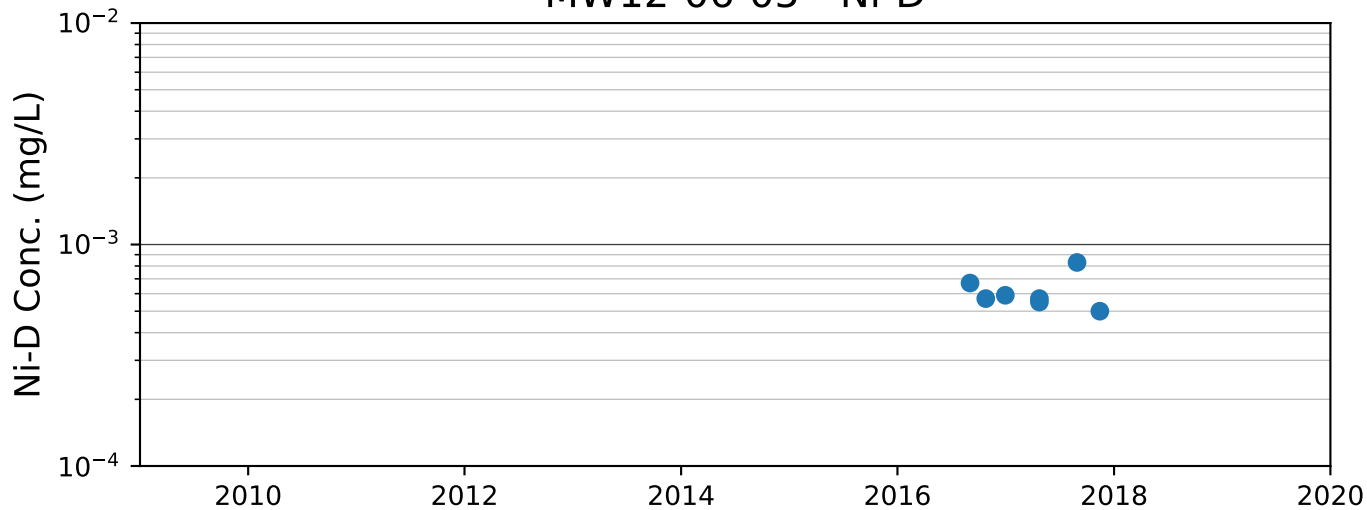
MW12-06-05 - Pb-D



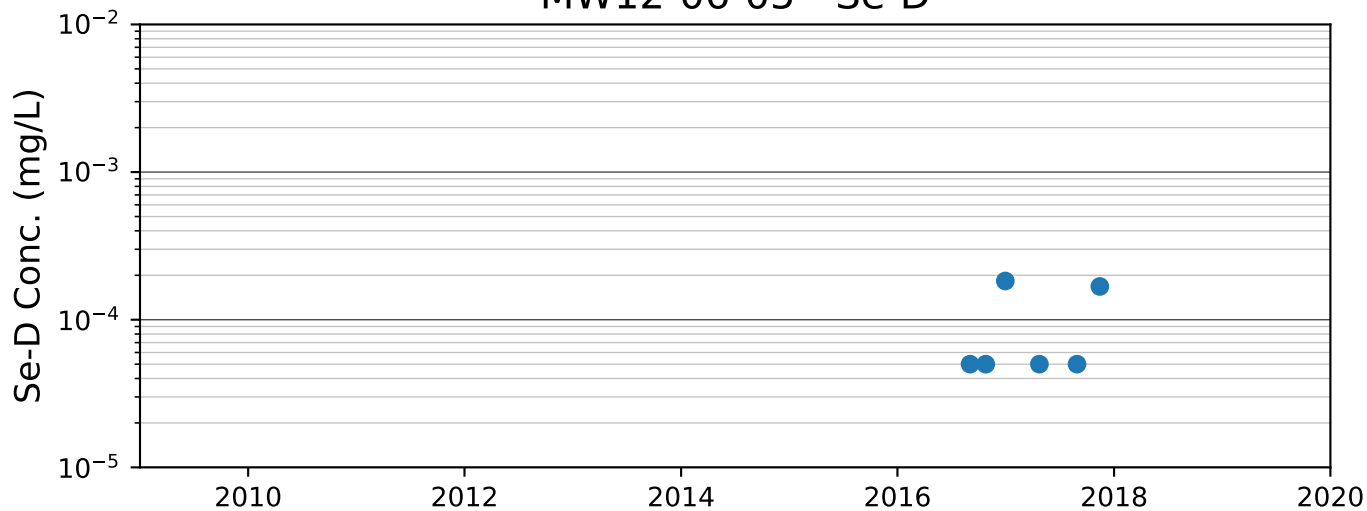
MW12-06-05 - Mo-D



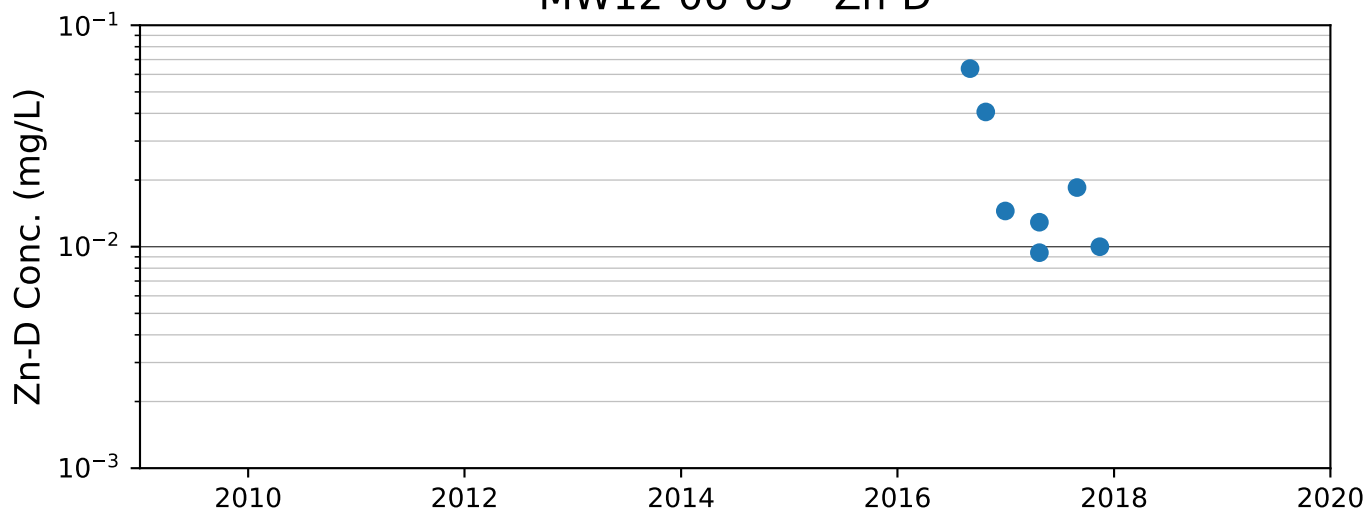
MW12-06-05 - Ni-D



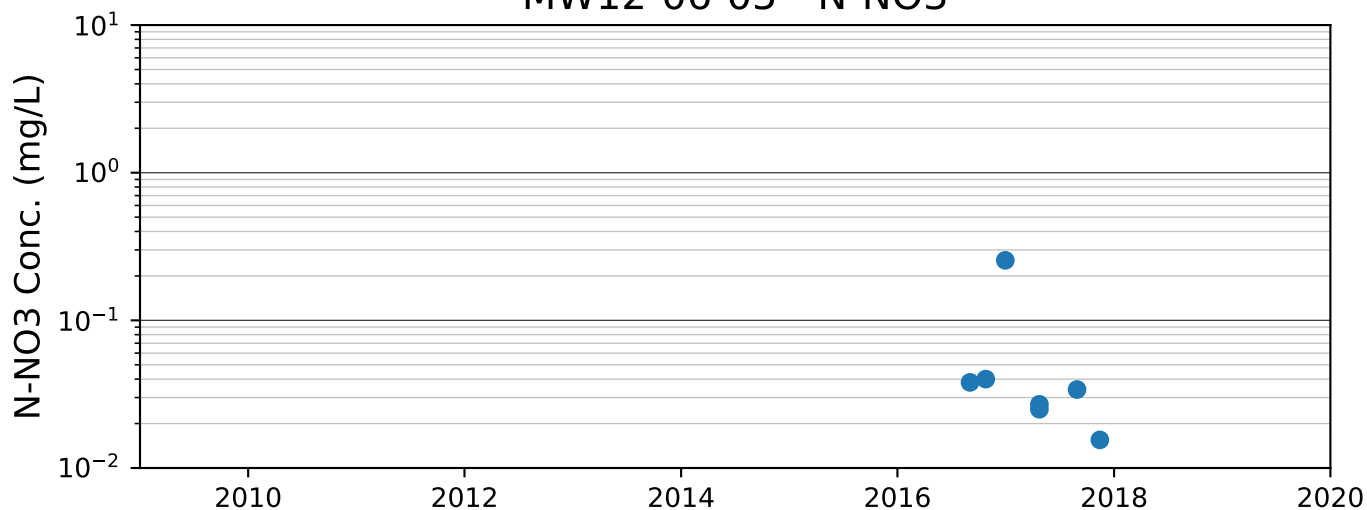
MW12-06-05 - Se-D

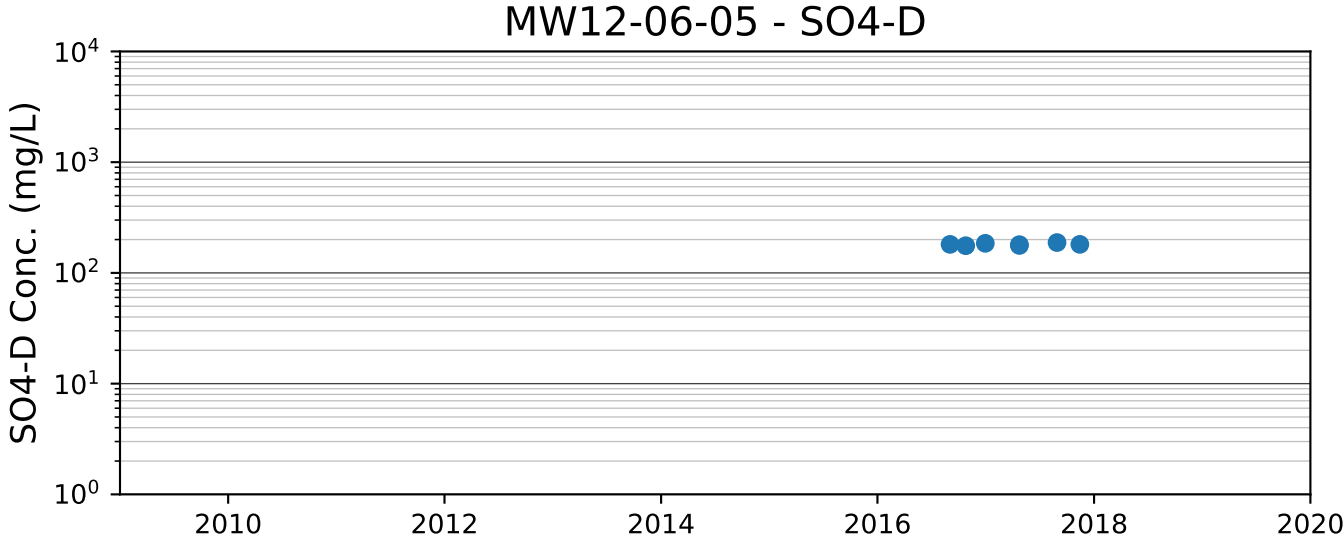


MW12-06-05 - Zn-D

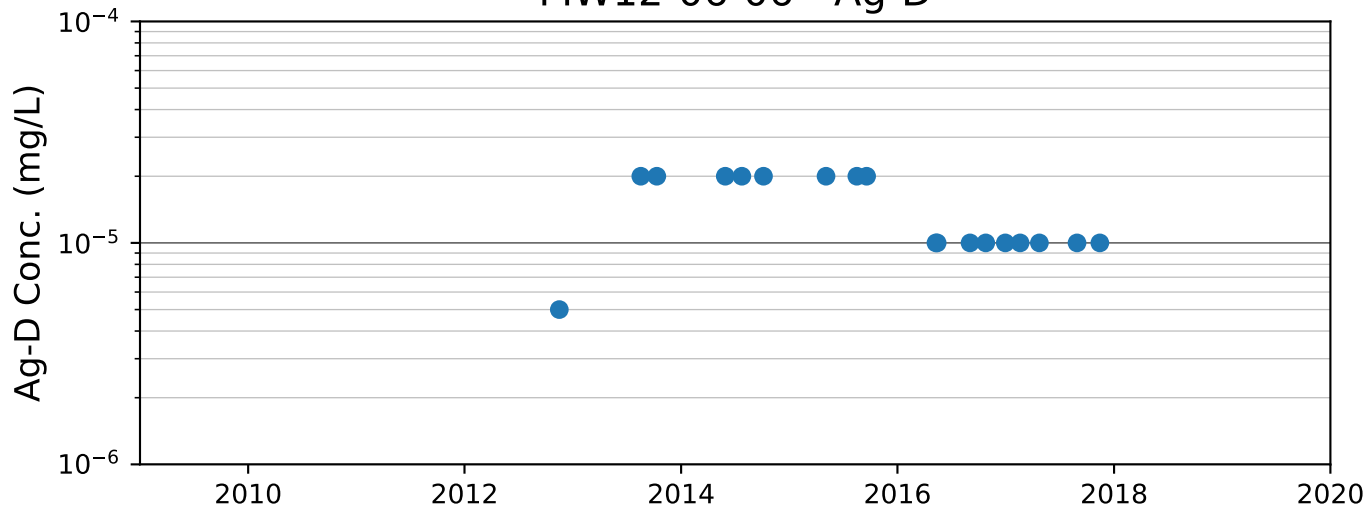


MW12-06-05 - N-NO3

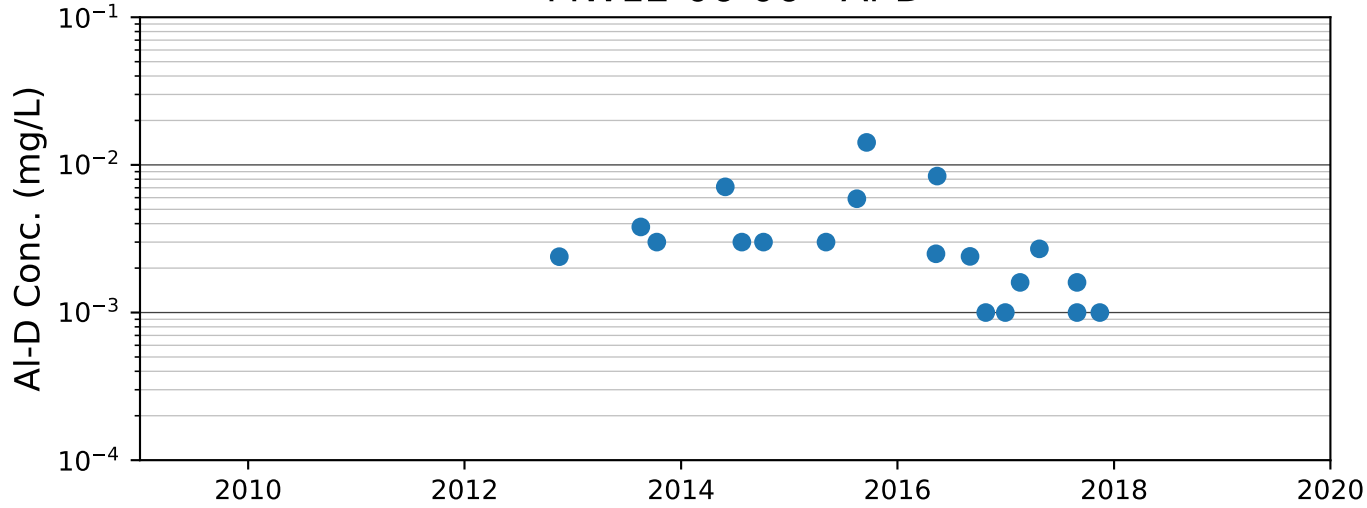




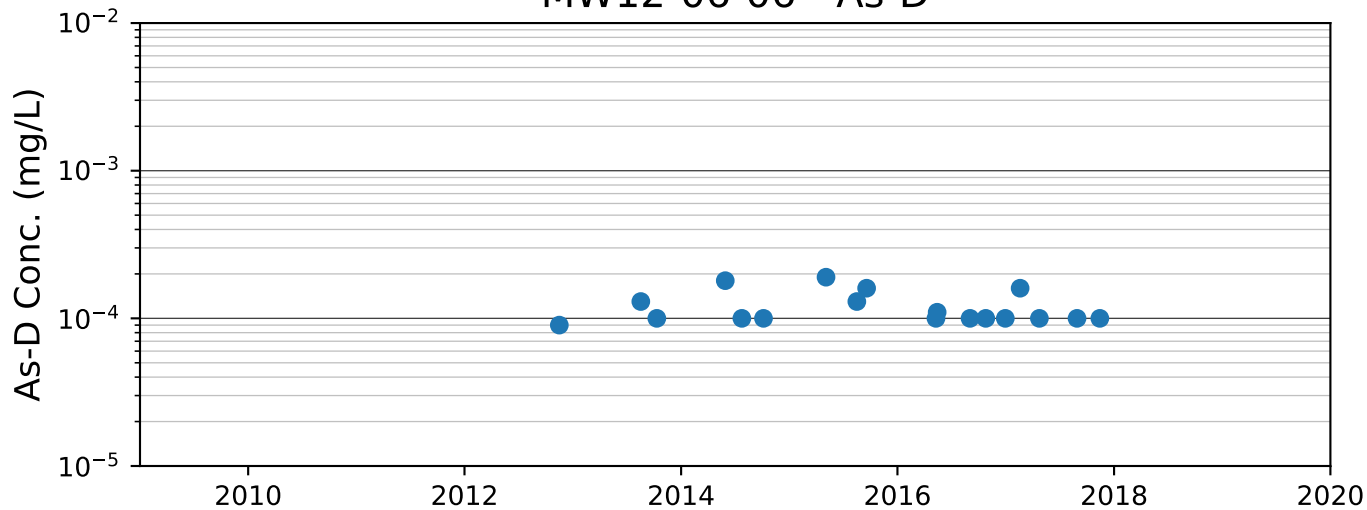
MW12-06-06 - Ag-D



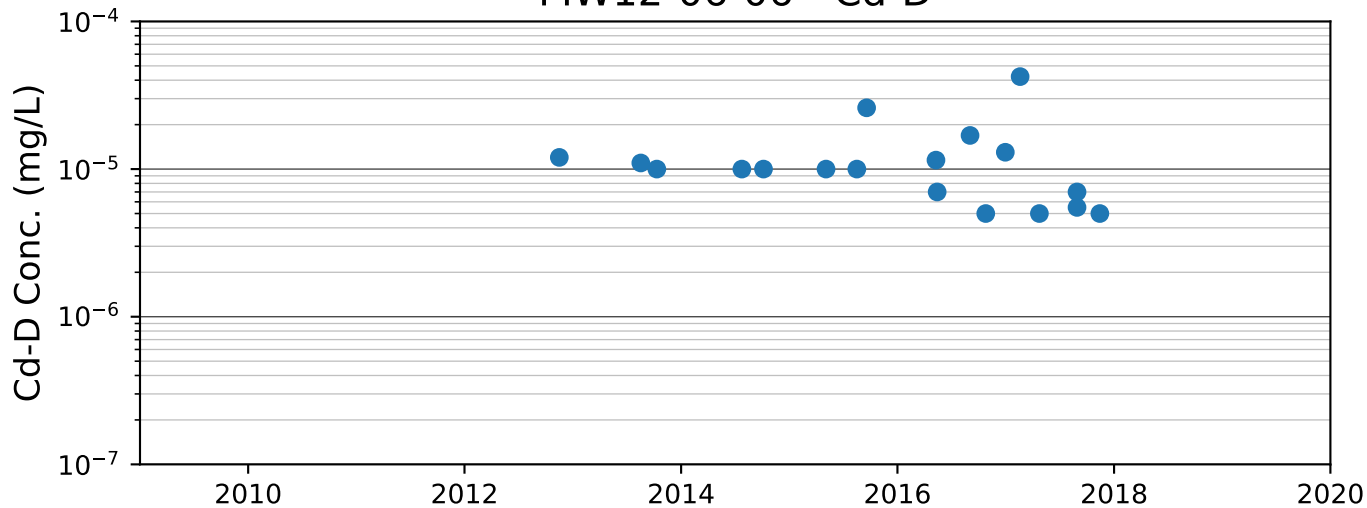
MW12-06-06 - Al-D



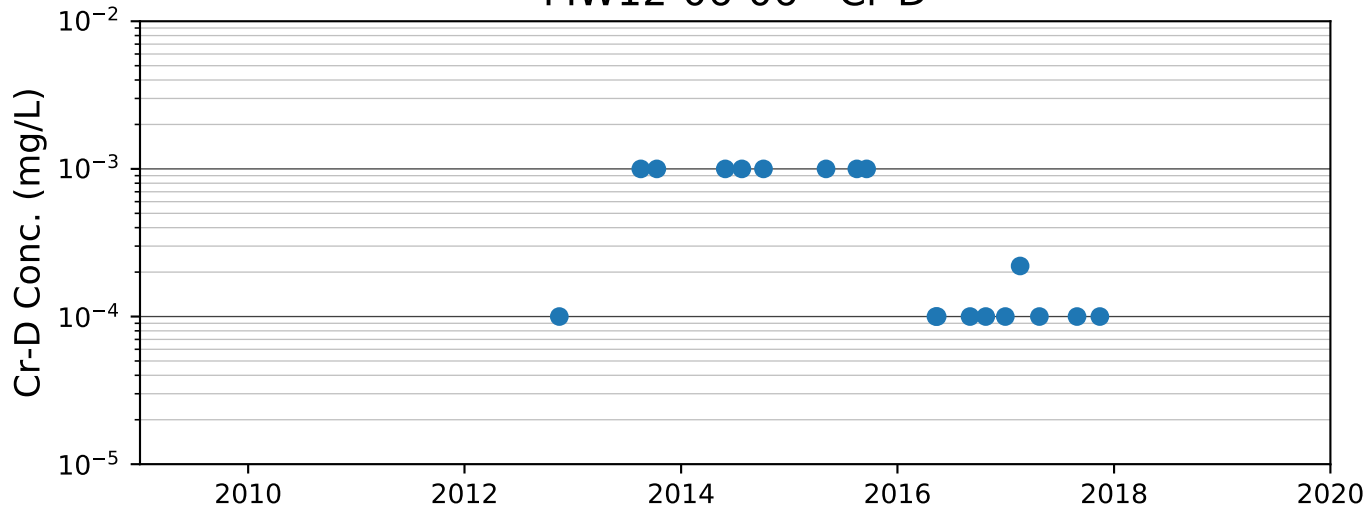
MW12-06-06 - As-D



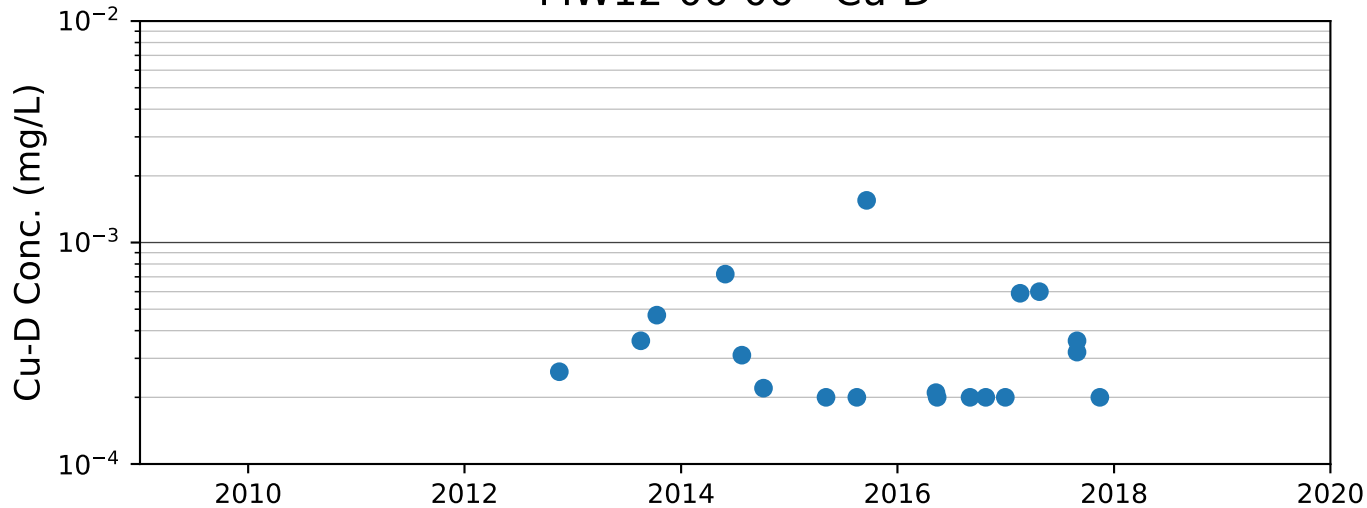
MW12-06-06 - Cd-D



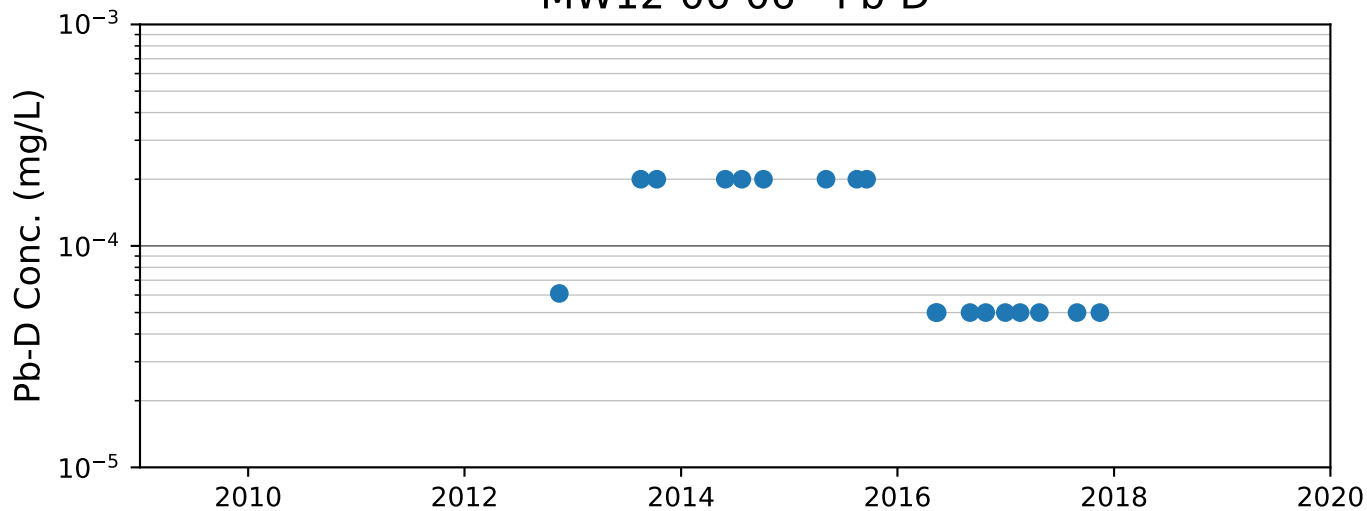
MW12-06-06 - Cr-D



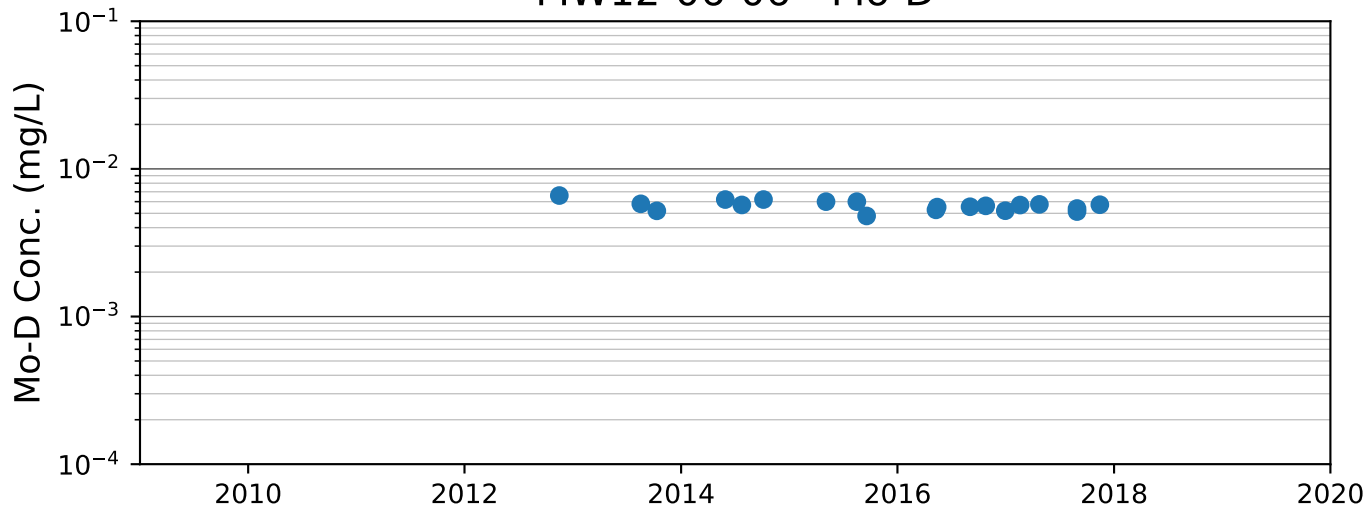
MW12-06-06 - Cu-D



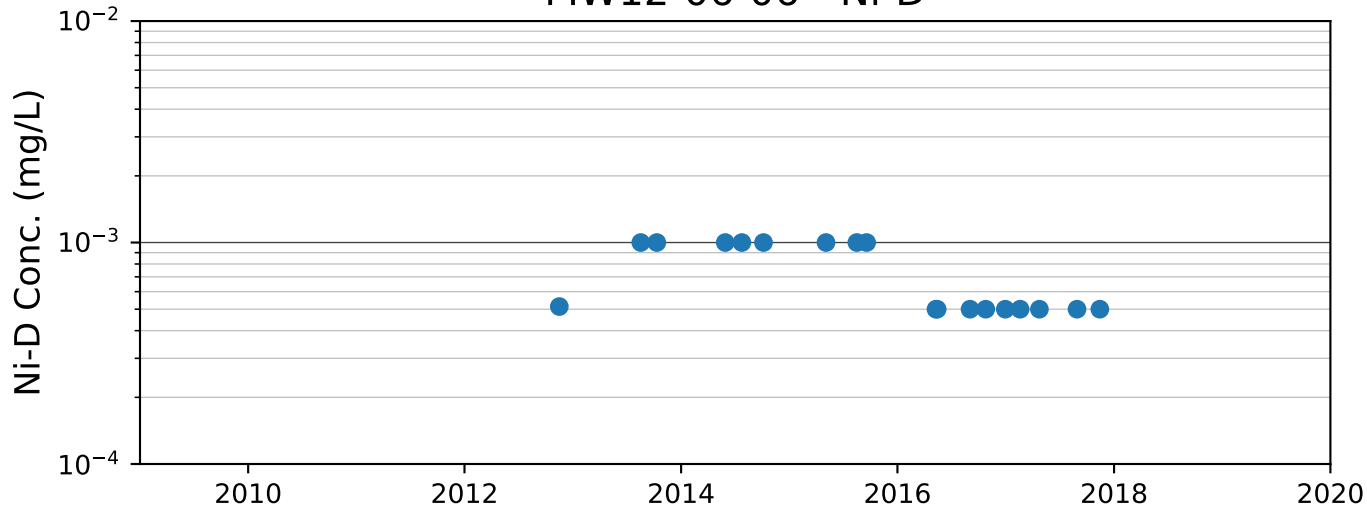
MW12-06-06 - Pb-D



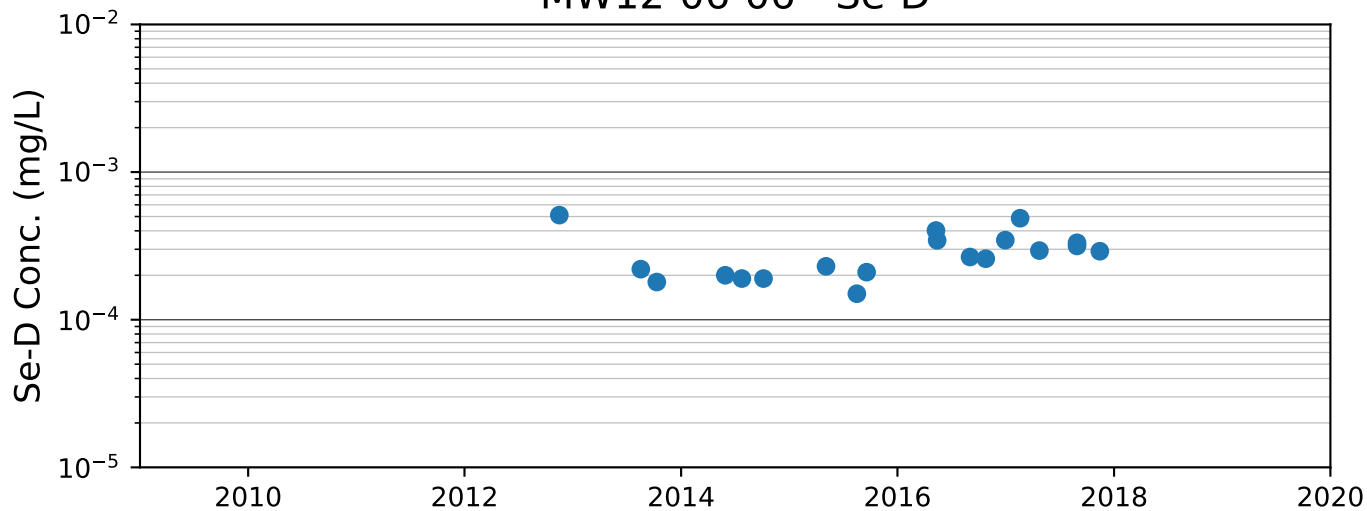
MW12-06-06 - Mo-D



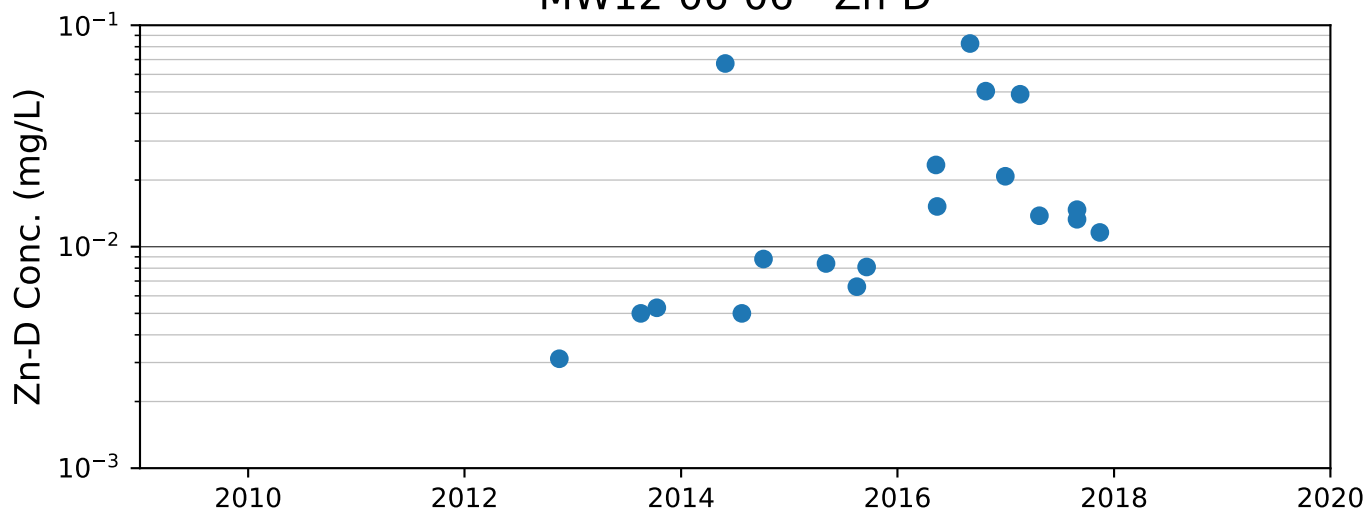
MW12-06-06 - Ni-D



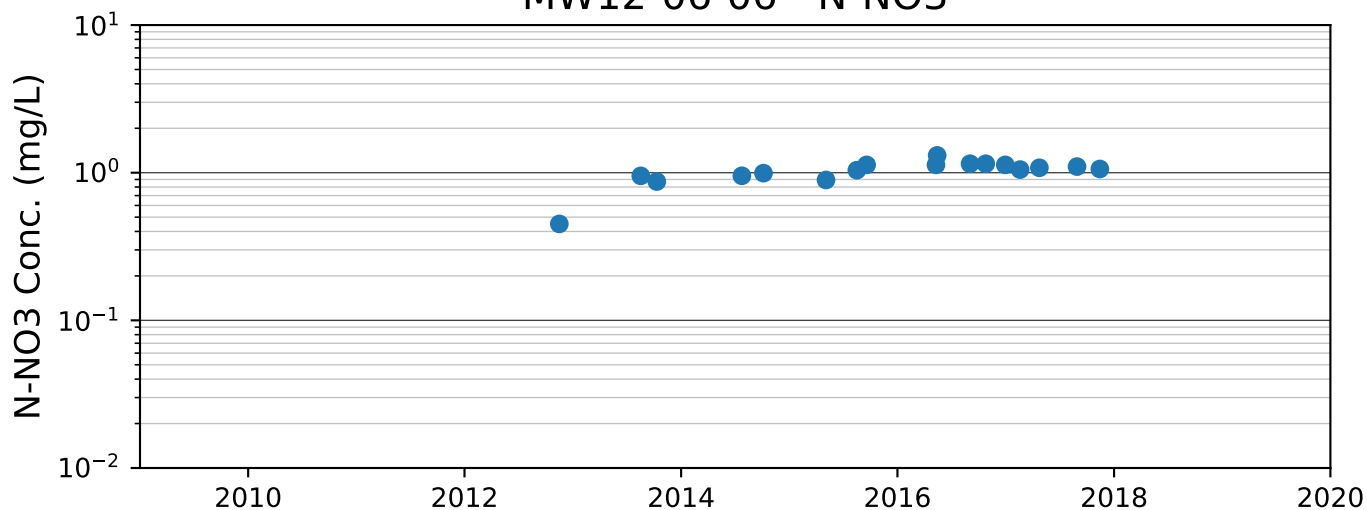
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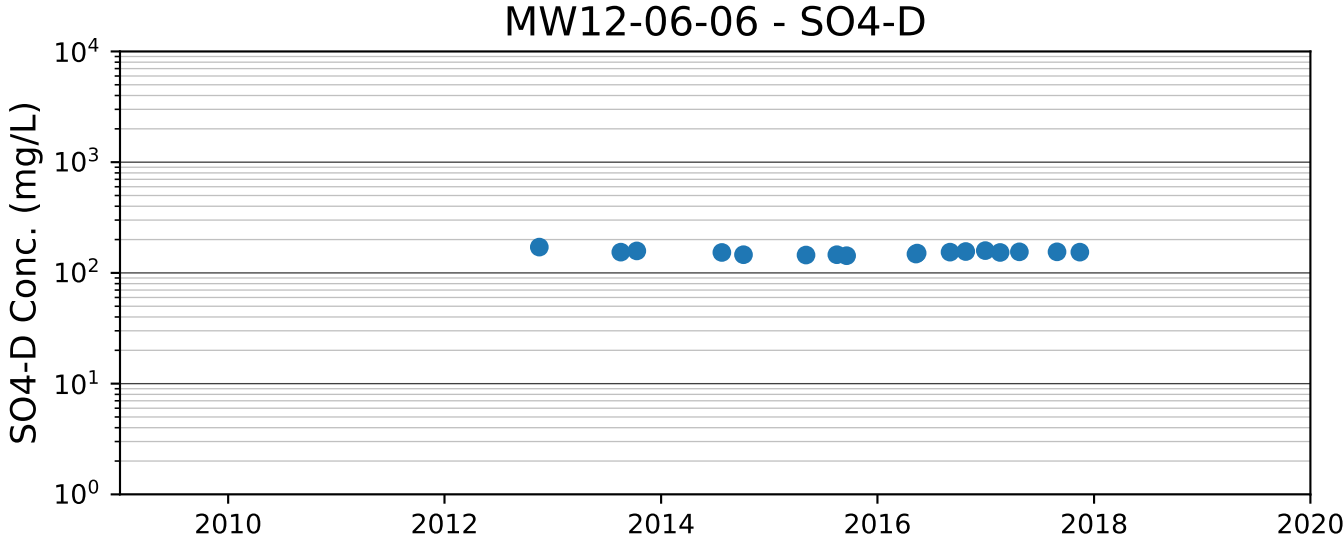


MW12-06-06 - Zn-D



MW12-06-06 - N-NO3





Appendix I – MMER Effluent Monitoring and Environmental Effects Monitoring Water Quality 2017 Submissions

Environment Canada

User Information

Site
User
User:
PYmmSCC469
Region:
Pacific-
Yukon
Regulation:
MMER

- [Home](#)
- [Del. Sub. & pH Data](#)
- [Bioassay Data](#)
- [EEM](#)
- [Annual Report](#)
- [Submission](#)
- [Regulatory Data - Quarterly Report](#)
- [EEM - Annual Report](#)
- [Regulatory Data - Annual Report](#)
- [Queries & Downloads](#)
- [Graphs & Tables](#)
- [Company Information](#)
- [Password Change](#)
- [Comments: Submit](#)
- [Publications](#)
- [RISS Web Service](#)
- [Logout](#)

Data Submitted

Your EEM data has been successfully submitted.

Facility **Minto:**
Explorations
Limited - Minto
Mine (Pelly
Crossing, YT)
Date and Time Submitted
(GMT): 22:30:52
Tracking ID: PYmmSCC469-
2018-03-17-22-
30-52-87597
Reporting
Period: 2017

This is the official receipt of your submission. You may wish to print and retain this receipt for your records.

Signature: _____

Date Modified: 2014-03-27

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[Important Notices](#)

Environment Canada

User Information

- Site
- User
- User:**
PYmmSCC469
- Region:**
Pacific-Yukon
- Regulation:**
MMER
- Home
- Del. Sub. & pH Data
- Bioassay Data
- EEM
- Annual Report
- Submission
- Regulatory Data - Quarterly Report
- EEM - Annual Report
- Regulatory Data - Annual Report
- Queries & Downloads
- Graphs & Tables
- Company Information
- Password Change
- Comments: Submit
- Publications
- RISS Web Service
- Logout

Data Submitted

Your data has been successfully submitted.

Facility: Minto

Name: Explorations Limited - Minto Mine (Pelly Crossing, YT)

Date and Time Submitted (GMT): 2018-03-17 22:06:01

Tracking ID: PYmmSCC469-2018-03-17-22-06-01-09709

Reporting Period: 2017

This is the official receipt of your submission. You may wish to print and retain this receipt for your records.

Signature: _____

Date Modified: 2014-03-27

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[Important Notices](#)

Environment
CanadaEnvironnement
Canada

Canada

View Annual Report

Facility: Minto Explorations Limited - Minto Mine (Pelly Crossing, YT)
Final Discharge Point: Mi.W3 - Runoff Main Water Dam
Reporting Period: 2017
Facility Name on Submission:
Submission Tracking ID:

Facility Information

Mine Name: Minto Explorations Limited - Minto Mine (Pelly Crossing, YT)
Mine Operator: Minto Explorations Ltd.
Address: PO Box 11
 Whitehorse, YT
 Y1A5X9
Telephone: 604-759-0860
E-mail: minto_environment@mintomine.com

Location of Final Discharge Point

Name: Mi.W3 - Runoff Main Water Dam
Latitude: 62° 37' 32" N
Longitude: 137° 12' 11" W

Monthly Mean Concentrations, pH Range and Volume of Effluent (Generated)

| Month | As (mg/L) | Cu (mg/L) | CN (mg/L) | Pb (mg/L) | Ni (mg/L) | Zn (mg/L) | TSS (mg/L) | Ra 226 (Bq/L) | Lowest pH | Highest pH | Effluent Volume (m ³) |
|-----------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|------------------|--------------|---------------|---|
| January | 0.00034 | 0.004592 | NMR | 0.000079 | 0.001192 | 0.00242 | 5.94 | NMR | 7.92 | 8.17 | 6964 |
| February | 0.000308 | 0.005485 | NMR | 0.000056 | 0.00105 | 0.003075 | 4.575 | NMR | 8.1 | 8.24 | 6048 |
| March | 0.000265 | 0.003705 | NMR | 0.000025 | 0.001173 | 0.003725 | 3 | 0.07 | 8 | 8.3 | 5775 |
| April | 0.000228 | 0.00323 | NMR | 0.000025 | 0.00087 | 0.001 | 3 | NMR | 8.03 | 8.3 | 6480 |
| May | 0.00031 | 0.01268 | NMR | 0.00003 | 0.000856 | 0.00092 | 5.78 | NMR | 8.04 | 8.32 | 43800 |
| June | 0.00031 | 0.016053 | NMR | 0.000025 | 0.001078 | 0.000925 | 3.775 | 0.0082 | 8.03 | 8.21 | 46320 |
| July | 0.000308 | 0.00523 | NMR | 0.000042 | 0.001128 | 0.00205 | 3.6 | NMR | 8.11 | 8.33 | 15441 |
| August | 0.000306 | 0.005698 | | 0.000025 | 0.001064 | 0.0015 | 3 | 0.0048 | 8.05 | 8.38 | 15632 |
| September | 0.00026 | 0.002935 | | 0.000025 | 0.000995 | 0.0015 | 3 | | 8.3 | 8.5 | 5270 |
| October | 0.000246 | 0.002868 | NMR | 0.000025 | 0.000996 | 0.0015 | 3 | 0.00425 | 8.2 | 8.42 | 5952 |
| November | 0.00028 | 0.002795 | NMR | 0.000025 | 0.001025 | 0.0015 | 3.425 | NMR | 7.94 | 8.22 | 7770 |
| December | 0.000303 | 0.018483 | NMR | 0.000057 | 0.000985 | 0.002375 | 3.775 | NMR | 8.03 | 8.23 | 6740 |

Results of Acute Lethality Tests and Daphnia magna Monitoring Tests (Generated)

| Date Sample Collected | Results for Rainbow Trout Acute Lethality Tests (mean percentage mortality in 100% effluent test concentration) | Results for Daphnia magna Monitoring Tests (mean percentage mortality in 100% effluent test concentration) |
|-----------------------|--|---|
| 2017-03-14 | | 0 |
| 2017-03-14 | 0 | |
| 2017-06-06 | 0 | 0 |
| 2017-08-08 | 0 | 0 |
| 2017-10-24 | 0 | 0 |
| 2017-10-24 | | |

Non-Compliance Information

If effluent was non-compliant with the authorized limits set out in Schedule 4, indicate the cause(s) of non-compliance and remedial measures planned or implemented in response to the failure of acute lethality tests.

Notes:

Date Modified: 2014-03-27

Close

This section summarizes data collected for MMER requirements during the 2017 reporting year. Table 1 to 4 Present the EEM results from 2017, and Table 5 presents the Radon 226 results from quarterly samples collected in 2017. And finally, ALS Laboratory Results files are presented at the end.

Table 1: EEM Sample Results (1 of 4) - May 16th, 2017

| Station | | W2 | W3 | W7 |
|----------------|----------|------------|------------|------------|
| Lab Report No. | | L1928294 | | |
| Parameters | Unit | | | |
| Hard-D | mg/L | 107 | 170 | 78.4 |
| Alk-T | mg/L | 98.6 | 143 | 76.3 |
| N-NH3 | mg/L | 0.0062 | 0.0069 | 0.0070 |
| N-NO3 | mg/L | 0.0935 | 1.56 | 0.0050 |
| Chloride | mg/L | 1.69 | 4.88 | 0.56 |
| C-DOC | mg/L | 20.7 | 30.0 | 25.6 |
| TSS | mg/L | 6.7 | <3.0 | <3.0 |
| | | | | |
| pH-F | pH units | 7.69 | 7.25 | 7.58 |
| Temp-F | C | 1.5 | 6.6 | -0.1 |
| O-DO | mg/L | 14.56 | 10.22 | 14.96 |
| Cond-F | µS/cm | 117.6 | 252.3 | 79.7 |
| | | | | |
| Al-D | mg/L | 0.0173 | 0.0080 | 0.0279 |
| As-T | mg/L | 0.00068 | 0.00030 | 0.00049 |
| Ca-T | mg/L | 26.7 | 42.0 | 19.1 |
| Cd-T | mg/L | 1.58E-05 | <0.0000050 | 8.2E-06 |
| Cu-T | mg/L | 0.00705 | 0.0138 | 0.00620 |
| Fe-T | mg/L | 0.438 | 0.069 | 0.233 |
| Hg-T | mg/L | <0.0000050 | <0.0000050 | <0.0000050 |
| Mg-T | mg/L | 9.40 | 16.1 | 7.42 |
| Mn-T | mg/L | 0.0350 | 0.0279 | 0.0331 |
| Mo-D | mg/L | 0.00106 | 0.00331 | 0.000846 |
| Na-T | mg/L | 6.48 | 14.7 | 4.77 |
| Ni-T | mg/L | 0.00178 | 0.00090 | 0.00177 |
| P-T | mg/L | <0.050 | <0.050 | <0.050 |
| Pb-T | mg/L | 0.000083 | <0.000050 | <0.000050 |
| Se-T | mg/L | 0.000178 | 0.000537 | 0.000131 |
| Tl-T | mg/L | <0.000010 | <0.000010 | <0.000010 |
| U-T | mg/L | 0.000667 | 0.00130 | 0.000400 |
| Zn-T | mg/L | 0.0056 | <0.0030 | <0.0030 |

Table 2: EEM Sample Results (2 of 4) – June 27th, 2017

| Station | | W2 | W3 | W7 |
|----------------|----------|------------|------------|------------|
| Lab Report No. | | L1950514 | | |
| Parameters | Unit | | | |
| Hard-D | mg/L | 156 | 234 | 111 |
| Alk-T | mg/L | 150 | 214 | 118 |
| N-NH3 | mg/L | 0.0133 | 0.0078 | 0.0114 |
| N-NO3 | mg/L | 0.307 | 0.232 | 0.144 |
| Chloride | mg/L | 2.10 | 4.70 | <0.50 |
| C-DOC | mg/L | 12.4 | 8.26 | 13.1 |
| TSS | mg/L | 7.4 | 3.4 | 22.0 |
| | | | | |
| pH-F | pH units | 7.96 | 7.82 | 8.13 |
| Temp-F | C | 6 | 5.2 | 2.3 |
| O-DO | mg/L | 10.88 | 10.24 | 12.49 |
| Cond-F | µS/cm | 211.9 | 315.1 | 132.8 |
| | | | | |
| Al-D | mg/L | 0.0079 | 0.0045 | 0.0101 |
| As-T | mg/L | 0.00061 | 0.00027 | 0.00059 |
| Ca-T | mg/L | 42.6 | 57.8 | 29.8 |
| Cd-T | mg/L | <0.0000050 | <0.0000050 | 1.04E-05 |
| Cu-T | mg/L | 0.00322 | 0.00533 | 0.00288 |
| Fe-T | mg/L | 0.279 | 0.026 | 0.659 |
| Hg-T | mg/L | <0.0000050 | <0.0000050 | <0.0000050 |
| Mg-T | mg/L | 13.6 | 24.8 | 10.6 |
| Mn-T | mg/L | 0.0225 | 0.0414 | 0.0464 |
| Mo-D | mg/L | 0.00163 | 0.00401 | 0.00140 |
| Na-T | mg/L | 8.92 | 16.2 | 6.49 |
| Ni-T | mg/L | 0.00138 | 0.00107 | 0.00196 |
| P-T | mg/L | <0.050 | <0.050 | <0.050 |
| Pb-T | mg/L | 0.000077 | <0.000050 | 0.000192 |
| Se-T | mg/L | 0.000169 | 0.000283 | 0.000164 |
| Tl-T | mg/L | <0.000010 | <0.000010 | <0.000010 |
| U-T | mg/L | 0.00164 | 0.00261 | 0.00110 |
| Zn-T | mg/L | <0.0030 | <0.0030 | <0.0030 |

Table 3: EEM Sample Results (3 of 4) – August 1st, 2017

| Station | | W2 | W3 | W7 |
|----------------|----------|------------|------------|------------|
| Lab Report No. | | L1969064 | | |
| Parameters | Unit | | | |
| Hard-D | mg/L | 173 | 223 | 125 |
| Alk-T | mg/L | 168 | 185 | 127 |
| N-NH3 | mg/L | 0.0061 | 0.0069 | 0.0140 |
| N-NO3 | mg/L | 0.196 | 1.32 | 0.115 |
| Chloride | mg/L | 1.79 | 5.06 | 0.28 |
| C-DOC | mg/L | 11.5 | 12.2 | 12.4 |
| TSS | mg/L | 34.8 | 3.0 | 21.4 |
| | | | | |
| pH-F | pH units | 7.81 | 7.63 | 7.58 |
| Temp-F | C | 6.7 | 11.3 | 4 |
| O-DO | mg/L | 11.84 | 9.7 | 11.86 |
| Cond-F | µS/cm | 224.2 | 338.8 | 149.4 |
| | | | | |
| Al-D | mg/L | 0.0096 | 0.0026 | 0.0171 |
| As-T | mg/L | 0.00114 | 0.00044 | 0.00071 |
| Ca-T | mg/L | 42.9 | 53.7 | 30.2 |
| Cd-T | mg/L | 0.0000150 | <0.0000050 | 1.07E-05 |
| Cu-T | mg/L | 0.00618 | 0.0142 | 0.00280 |
| Fe-T | mg/L | 1.18 | 0.053 | 0.847 |
| Hg-T | mg/L | <0.0000050 | <0.0000050 | <0.0000050 |
| Mg-T | mg/L | 16.6 | 21.2 | 11.8 |
| Mn-T | mg/L | 0.0556 | 0.0296 | 0.0418 |
| Mo-D | mg/L | 0.00175 | 0.00387 | 0.00131 |
| Na-T | mg/L | 11.0 | 15.5 | 7.58 |
| Ni-T | mg/L | 0.00282 | 0.00123 | 0.00214 |
| P-T | mg/L | 0.057 | <0.050 | <0.050 |
| Pb-T | mg/L | 0.000317 | <0.000050 | 0.000210 |
| Se-T | mg/L | 0.000164 | 0.000435 | 0.000152 |
| Tl-T | mg/L | <0.000010 | <0.000010 | <0.000010 |
| U-T | mg/L | 0.00175 | 0.00160 | 0.00104 |
| Zn-T | mg/L | 0.0042 | <0.0030 | 0.0032 |

Table 4: EEM Sample Results (4 of 4) – October 3rd, 2017

| Station | | W2 | W3 | W7 |
|----------------|----------|------------|------------|------------|
| Lab Report No. | | L2002445 | | |
| Parameters | Unit | | | |
| Hard-D | mg/L | 174 | 261 | 139 |
| Alk-T | mg/L | 174 | 242 | 150 |
| N-NH3 | mg/L | <0.0050 | 0.0053 | 0.0148 |
| N-NO3 | mg/L | 0.0162 | 0.180 | 0.118 |
| Chloride | mg/L | 1.90 | 4.36 | <0.50 |
| C-DOC | mg/L | 8.91 | 5.80 | 8.44 |
| TSS | mg/L | 23.9 | <3.0 | 4.9 |
| | | | | |
| pH-F | pH units | 7.47 | 7.41 | 7.5 |
| Temp-F | C | 0.8 | 0.8 | 0.8 |
| O-DO | mg/L | 14.4 | 13 | 13.72 |
| Cond-F | µS/cm | 192.8 | 291.1 | 164.3 |
| | | | | |
| Al-D | mg/L | 0.0045 | 0.0025 | 0.0053 |
| As-T | mg/L | 0.00038 | 0.00022 | 0.00075 |
| Ca-T | mg/L | 45.2 | 56.1 | 35.5 |
| Cd-T | mg/L | 6.8E-06 | <0.0000050 | 1.39E-05 |
| Cu-T | mg/L | 0.00171 | 0.00257 | 0.00230 |
| Fe-T | mg/L | 0.078 | 0.026 | 1.36 |
| Hg-T | mg/L | <0.0000050 | <0.0000050 | <0.0000050 |
| Mg-T | mg/L | 15.8 | 29.4 | 13.8 |
| Mn-T | mg/L | 0.0197 | 0.0494 | 0.0994 |
| Mo-D | mg/L | 0.00130 | 0.00456 | 0.00137 |
| Na-T | mg/L | 10.3 | 18.7 | 8.19 |
| Ni-T | mg/L | 0.00104 | 0.00097 | 0.00278 |
| P-T | mg/L | <0.050 | <0.050 | 0.108 |
| Pb-T | mg/L | <0.000050 | <0.000050 | 0.000385 |
| Se-T | mg/L | 0.000085 | 0.000369 | 0.000108 |
| Tl-T | mg/L | <0.000010 | <0.000010 | <0.000010 |
| U-T | mg/L | 0.00225 | 0.00299 | 0.00153 |
| Zn-T | mg/L | <0.0030 | <0.0030 | 0.0055 |

Table 5: Ra²²⁶ Results for W3 in 2017

| Sample Date | | 14-Mar-2017 | 6-Jun-2017 | 1-Aug-2017 | 24-Oct-2017 |
|---------------|-------|-------------|------------|------------|-------------|
| Lab Report No | | L1901651 | L1938367 | L1969064 | L2013230 |
| Parameter | Units | | | | |
| Ra-226 | Bq/L | 0.070 | 0.0082 | <0.0096 | <0.0085 |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 05-JAN-17
Report Date: 13-JAN-17 16:50 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1876399
Project P.O. #: 223322 (WUL)
Job Reference:
C of C Numbers: 2017-01-04 A
Legal Site Desc:

Ariel McDonnell, B.Sc.
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

13-JAN-17 16:50 (MT)

Version: FINAL

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1876399-1 | L1876399-2 | L1876399-3 | L1876399-4 | L1876399-5 |
|-----------------------------------|---|--------------|--------------------------|-----------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 02-JAN-17 | 10:50 | W10 | 02-JAN-17 | 02-JAN-17 | 02-JAN-17 | 02-JAN-17 | 02-JAN-17 |
| | | | | | 10:50 | 11:15 | 14:15 | 14:25 | 15:25 |
| | | | | | W10 | W45 | W14 | W12 | W8A |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 635 | 2840 | 2160 | 2000 | 1570 | | | |
| | Hardness (as CaCO3) (mg/L) | 321 | 1380 | 787 | 792 | 812 | | | |
| | pH (pH) | 7.02 | 7.98 | 8.15 | 7.83 | 7.46 | | | |
| | Total Suspended Solids (mg/L) | 128 | 17.8 | 63.9 | 4.3 | 36.5 | | | |
| | TDS (Calculated) (mg/L) | 377 | 2600 | 1730 | 1570 | 1070 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 351 | 130 | 135 | 171 | 638 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 351 | 130 | 135 | 171 | 638 | | | |
| | Ammonia, Total (as N) (mg/L) | 1.36 | 7.76 | 3.83 | 5.40 | 0.420 | | | |
| | Chloride (Cl) (mg/L) | 0.99 | 41 | 40 | 35.6 | 16.1 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.738 | 38.5 | 35.7 | 29.9 | 6.24 | | | |
| | Nitrate (as N) (mg/L) | 0.665 | 35.5 | 33.0 | 27.3 | 5.86 | | | |
| | Nitrite (as N) (mg/L) | 0.0723 | 2.95 | 2.74 | 2.65 | 0.374 | | | |
| | Sulfate (SO4) (mg/L) | 20.5 | 1540 | 910 | 834 | 297 | | | |
| | Anion Sum (meq/L) | 7.52 | 38.6 | 25.3 | 23.9 | 19.8 | | | |
| | Cation Sum (meq/L) | 7.60 | 36.8 | 24.8 | 22.7 | 18.8 | | | |
| | Cation - Anion Balance (%) | 0.5 | -2.4 | -1.0 | -2.7 | -2.7 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | | | | | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0836 | 0.235 | | 0.0790 | 0.0198 | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00049 | 0.00034 | | 0.00035 | 0.00015 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00098 | 0.00055 | | 0.00052 | 0.00052 | | | |
| | Barium (Ba)-Total (mg/L) | 0.471 | 0.165 | | 0.112 | 0.198 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000040 ^{DLA} | | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.00010 ^{DLA} | | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | 0.013 | 0.260 | | 0.241 | 0.039 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.000087 | 0.000088 | | 0.0000865 | 0.000311 | | | |
| | Calcium (Ca)-Total (mg/L) | 100 | 523 | | 284 | 238 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00035 | <0.00020 ^{DLA} | | <0.00010 | 0.00103 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00189 | 0.00198 | | 0.00065 | 0.00155 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00359 | 0.0385 | | 0.0602 | 0.103 | | | |
| | Iron (Fe)-Total (mg/L) | 11.5 | 0.397 | | 0.155 | 1.98 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.00016 | | 0.000720 | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0013 | 0.0159 | | 0.0125 | 0.0048 | | | |
| | Magnesium (Mg)-Total (mg/L) | 20.5 | 39.2 | | 34.0 | 69.4 | | | |
| | Manganese (Mn)-Total (mg/L) | 1.71 | 0.736 | | 0.392 | 5.75 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | L1876399-6 | L1876399-7 | L1876399-8 | | |
|-----------------------------------|---|------------|------------|----------------------|--|
| Description | WATER | WATER | WATER | | |
| Sampled Date | 03-JAN-17 | 03-JAN-17 | 03-JAN-17 | | |
| Sampled Time | 10:00 | 10:15 | 10:00 | | |
| Client ID | W3 | W17 | T-BL | | |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 539 | 516 | <2.0 | |
| | Hardness (as CaCO3) (mg/L) | 247 | 239 | <0.50 ^{HTC} | |
| | pH (pH) | 7.92 | 8.06 | 5.41 | |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | <3.0 | |
| | TDS (Calculated) (mg/L) | 310 | 299 | <1.0 | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 242 | 221 | <1.0 | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 242 | 221 | <1.0 | |
| | Ammonia, Total (as N) (mg/L) | 0.0095 | <0.0050 | <0.0050 | |
| | Chloride (Cl) (mg/L) | 4.70 | 6.44 | <0.50 | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.364 | 0.803 | <0.0051 | |
| | Nitrate (as N) (mg/L) | 0.364 | 0.803 | <0.0050 | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | <0.0010 | |
| | Sulfate (SO4) (mg/L) | 57.5 | 55.3 | <0.30 | |
| | Anion Sum (meq/L) | 6.20 | 5.81 | <0.10 | |
| | Cation Sum (meq/L) | 5.75 | 5.50 | <0.10 | |
| | Cation - Anion Balance (%) | -3.8 | -2.7 | 0.0 | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 4.53 | 8.05 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0191 | 0.0064 | <0.0030 | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00021 | <0.00010 | |
| | Arsenic (As)-Total (mg/L) | 0.00027 | 0.00036 | <0.00010 | |
| | Barium (Ba)-Total (mg/L) | 0.0772 | 0.0783 | <0.000050 | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Total (mg/L) | 0.026 | 0.036 | <0.010 | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000051 | 0.0000072 | <0.0000050 | |
| | Calcium (Ca)-Total (mg/L) | 59.0 | 70.7 | <0.050 | |
| | Chromium (Cr)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Copper (Cu)-Total (mg/L) | 0.00271 | 0.00618 | <0.00050 | |
| | Iron (Fe)-Total (mg/L) | 0.045 | <0.010 | <0.010 | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Total (mg/L) | 0.0031 | 0.0016 | <0.0010 | |
| | Magnesium (Mg)-Total (mg/L) | 30.0 | 21.5 | <0.10 | |
| | Manganese (Mn)-Total (mg/L) | 0.0829 | 0.0610 | <0.00010 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

13-JAN-17 16:50 (MT)

Version: FINAL

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1876399-1 | L1876399-2 | L1876399-3 | L1876399-4 | L1876399-5 |
|-------------------------|---------------------------------------|--------------|--------------------------|-----------|--|--|--|--|--|
| | | | | | L1876399-1 WATER 02-JAN-17 10:50 W10 | L1876399-2 WATER 02-JAN-17 11:15 W45 | L1876399-3 WATER 02-JAN-17 14:15 W14 | L1876399-4 WATER 02-JAN-17 14:25 W12 | L1876399-5 WATER 02-JAN-17 15:25 W8A |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | | <0.0000050 | | | | 0.0000064 |
| | Molybdenum (Mo)-Total (mg/L) | 0.000476 | 0.0923 | | | | | 0.0869 | 0.0121 |
| | Nickel (Ni)-Total (mg/L) | 0.00113 | 0.0049 | | | | | 0.00291 | 0.00218 |
| | Phosphorus (P)-Total (mg/L) | 0.068 | <0.10 ^{DLA} | | | | | <0.050 | 0.056 |
| | Potassium (K)-Total (mg/L) | 2.87 | 75.6 | | | | | 47.8 | 9.13 |
| | Selenium (Se)-Total (mg/L) | 0.000094 | 0.0166 | | | | | 0.0145 | 0.00526 |
| | Silicon (Si)-Total (mg/L) | 7.57 | 2.67 | | | | | 3.40 | 8.53 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000020 ^{DLA} | | | | | 0.000013 | 0.000025 |
| | Sodium (Na)-Total (mg/L) | 15.0 | 157 | | | | | 128 | 52.0 |
| | Strontium (Sr)-Total (mg/L) | 0.569 | 7.01 | | | | | 5.54 | 3.58 |
| | Sulfur (S)-Total (mg/L) | 7.83 | 580 | | | | | 326 | 106 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000020 ^{DLA} | | | | | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000020 ^{DLA} | | | | | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.00429 | 0.0119 | | | | | 0.00306 | 0.00110 |
| | Uranium (U)-Total (mg/L) | 0.000135 | 0.00349 | | | | | 0.00364 | 0.00401 |
| | Vanadium (V)-Total (mg/L) | 0.00073 | <0.0010 ^{DLA} | | | | | 0.00053 | 0.00229 |
| | Zinc (Zn)-Total (mg/L) | 0.0057 | <0.0060 ^{DLA} | | | | | 0.0041 | 0.409 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00060 ^{DLA} | | | | | <0.00030 | 0.00083 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0101 | 0.0108 | | 0.0242 | 0.0056 | 0.0074 | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00035 | 0.00028 | | 0.00021 | 0.00030 | 0.00011 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00061 | 0.00043 | | 0.00037 | 0.00048 | 0.00057 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.355 | 0.161 ^{DLA} | | 0.198 | 0.0962 | 0.184 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000040 ^{DLA} | | <0.000020 | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | | <0.000050 | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.226 | | 0.156 | 0.207 | 0.036 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000067 | 0.000031 | | 0.0000203 | 0.0000142 | 0.000267 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 94.8 | 492 ^{DLA} | | 260 | 262 | 215 | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00012 | <0.00020 ^{DLA} | | <0.00010 | <0.00010 | 0.00068 | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00189 | 0.00193 | | 0.00114 | 0.00057 | 0.00151 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00067 | 0.00100 | | 0.00120 | 0.0117 | 0.0484 | | |
| | Iron (Fe)-Dissolved (mg/L) | 6.49 | 0.026 | | <0.010 | 0.024 | 0.410 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | | <0.000050 | 0.000061 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0012 | 0.0135 | | 0.0212 | 0.0107 | 0.0041 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 20.5 | 36.7 | | 33.6 | 33.6 | 66.9 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 1.64 | 0.714 | | 0.345 | 0.366 | 5.29 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1876399-6 | L1876399-7 | L1876399-8 | | |
|-------------------------|---------------------------------------|--------------|--------------|------------|------------|------------|------------|--|--|
| | | | | | WATER | WATER | WATER | | |
| | | 03-JAN-17 | 10:00 | | 03-JAN-17 | 03-JAN-17 | 03-JAN-17 | | |
| | | | 10:00 | | 10:15 | 10:15 | 10:00 | | |
| | | | | W3 | W17 | W17 | T-BL | | |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | | | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00505 | 0.00559 | <0.000050 | | | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00088 | 0.00076 | <0.00050 | | | | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | | | | | |
| | Potassium (K)-Total (mg/L) | 2.29 | 3.89 | <0.10 | | | | | |
| | Selenium (Se)-Total (mg/L) | 0.000388 | 0.000391 | <0.000050 | | | | | |
| | Silicon (Si)-Total (mg/L) | 6.53 | 5.35 | <0.050 | | | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | | | | | |
| | Sodium (Na)-Total (mg/L) | 19.1 | 16.7 | <0.050 | | | | | |
| | Strontium (Sr)-Total (mg/L) | 0.806 | 0.847 | <0.00020 | | | | | |
| | Sulfur (S)-Total (mg/L) | 20.7 | 19.5 | <0.50 | | | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | | | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | | | | | |
| | Titanium (Ti)-Total (mg/L) | 0.00081 | <0.00030 | <0.00030 | | | | | |
| | Uranium (U)-Total (mg/L) | 0.00276 | 0.00245 | <0.000010 | | | | | |
| | Vanadium (V)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | | | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | | | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | | | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | | | | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | | | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0016 | 0.0017 | | | | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00025 | 0.00035 | | | | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0758 | 0.0747 | | | | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | | | | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | | | | | |
| | Boron (B)-Dissolved (mg/L) | 0.025 | 0.032 | | | | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000059 | <0.0000050 | | | | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 52.6 | 64.1 | | | | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00194 | 0.00738 | | | | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.019 | <0.010 | | | | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | | | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0027 | 0.0013 | | | | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 28.1 | 19.2 | | | | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0635 | 0.0265 | | | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1876399-1 WATER 02-JAN-17 10:50 W10 | L1876399-2 WATER 02-JAN-17 11:15 W45 | L1876399-3 WATER 02-JAN-17 14:15 W14 | L1876399-4 WATER 02-JAN-17 14:25 W12 | L1876399-5 WATER 02-JAN-17 15:25 W8A |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000383 | 0.0851 | 0.0827 | 0.0775 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00106 | 0.0048 | 0.00216 | 0.00268 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.10 ^{DLA} | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 2.49 | 72.3 | 93.7 | 46.2 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000123 | 0.0179 | 0.0218 | 0.0153 |
| | Silicon (Si)-Dissolved (mg/L) | 7.35 | 2.16 | 2.23 | 3.09 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 14.2 | 156 | 148 | 121 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.539 | 6.39 | 6.35 | 5.13 |
| | Sulfur (S)-Dissolved (mg/L) | 7.10 | 562 | 346 | 278 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00020 ^{DLA} | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00048 | <0.00060 ^{DLA} | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | 0.000124 | 0.00323 | 0.00313 | 0.00341 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.0010 ^{DLA} | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0018 | <0.0020 ^{DLA} | 0.0012 | 0.0031 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00060 ^{DLA} | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1876399-6 | L1876399-7 | L1876399-8 | | |
|-------------------------|----------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | WATER | WATER | WATER | | |
| | | Sampled Date | 03-JAN-17 | 03-JAN-17 | 03-JAN-17 | | |
| | | Sampled Time | 10:00 | 10:15 | 10:00 | | |
| | | Client ID | W3 | W17 | T-BL | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00451 | 0.00509 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00080 | 0.00068 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | | 2.32 | 3.50 | | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000418 | 0.000460 | | | |
| | Silicon (Si)-Dissolved (mg/L) | | 6.05 | 5.06 | | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | | 17.2 | 14.4 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.667 | 0.710 | | | |
| | Sulfur (S)-Dissolved (mg/L) | | 18.9 | 18.2 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | 0.00016 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.00254 | 0.00232 | | | |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|---|-----------|--|
| Method Blank | Alkalinity, Total (as CaCO ₃) | B | L1876399-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1876399-6, -7 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1876399-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1876399-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1876399-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1876399-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1876399-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1876399-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1876399-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1876399-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L1876399-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1876399-1, -2, -4 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1876399-1, -2, -4 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1876399-1, -2, -4 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1876399-1, -2, -4 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1876399-1, -2, -4 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1876399-1, -2, -4 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1876399-1, -2, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| B | Method Blank exceeds ALS DQO. All associated sample results are at least 5 times greater than blank levels and are considered reliable. |
| DLA | Detection Limit adjusted for required dilution |
| HTC | Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |

Reference Information

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = $\frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

Reference Information

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-01-04 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Canada Toll Free: 1 800 668 9878

L1876399-COFC

| Report To | | Report Format / Distribution | | | Priority (Business Days) | | | | | | | | | | EMERGENCY | |
|--|---|--|--------------|-------------|--|------------------------------|------------------------------|-----------------------------|--|--|--|---------------------------|--------------------------------|----------------------|--|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | 4 day [P4] <input type="checkbox"/> | | | | | 1 Business day [E1] <input type="checkbox"/> | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | 3 day [P3] <input type="checkbox"/> | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: PO# | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: Routing Code: | | | | | | | | | | | | | | |
| PO / AFE: 223322 (WUL) | | Requisitioner: | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Ariel Tang Sampler: CH | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | |
| W10 | | 2-Jan-17 | 10:50 | Water | R | R | R | R | R | R | R | R | | | 6 | |
| W45 | | 2-Jan-17 | 11:15 | Water | R | R | R | R | R | R | R | R | | | 6 | |
| W14 | | 2-Jan-17 | 14:15 | Water | R | R | R | R | R | R | R | R | | | 4 | |
| W12 | | 2-Jan-17 | 14:25 | Water | R | R | R | R | R | R | R | R | | | 6 | |
| W8A | | 2-Jan-17 | 15:25 | Water | R | R | R | R | R | R | R | R | | | 6 | |
| W3 | | 3-Jan-17 | 10:00 | Water | R | R | R | R | R | R | R | R | R | R | 7 | |
| W17 | | 3-Jan-17 | 10:15 | Water | R | R | R | R | R | R | R | R | R | R | 7 | |
| T-BL | | 3-Jan-17 | 10:00 | Water | R | R | R | R | R | R | R | R | | | 6 | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> | | | | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> | | | | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | |
| | | | | | -3.0 | | | | | 2 5 | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | |
| Released by: Chris Harry Date: 2017-01-04 9:00 Time: | | Received by: LFH Date: 4 Jan 2017 Time: 14:41 | | | Received by: JC Date: JAN - 5 2017 Time: 15:00 | | | | | | | | | | | |

Short Holding Time
 Ⓞ Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 12-JAN-17
Report Date: 24-JAN-17 15:41 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1878946
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-01-11 A
Legal Site Desc:

Ariel McDonnell, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1878946-1 | L1878946-2 | L1878946-3 | L1878946-4 |
|-----------------------------|---|---------------------------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 09-JAN-17 | 10-JAN-17 | 10-JAN-17 | 10-JAN-17 |
| | | Sampled Time | 16:15 | 10:15 | 11:10 | |
| | | Client ID | W8A | W3 | W17 | F-BL |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 1580 | 540 | 527 | <2.0 | |
| | Hardness (as CaCO3) (mg/L) | 865 | 254 | 251 | <0.50 | |
| | pH (pH) | 7.60 | 7.97 | 8.04 | 5.48 | |
| | Total Suspended Solids (mg/L) | 39.6 | <3.0 | <3.0 | <3.0 | |
| | TDS (Calculated) (mg/L) | 1070 | 308 | 306 | <1.0 | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 725 | 236 | 225 | <1.0 | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 725 | 236 | 225 | <1.0 | |
| | Ammonia, Total (as N) (mg/L) | 0.434 | 0.0113 | <0.0050 | <0.0050 | |
| | Chloride (Cl) (mg/L) | 16.7 | 4.68 | 6.46 | <0.50 | |
| | Nitrate and Nitrite (as N) (mg/L) | 2.54 | 0.358 | 0.703 | <0.0051 | |
| | Nitrate (as N) (mg/L) | 2.09 | 0.358 | 0.703 | <0.0050 | |
| | Nitrite (as N) (mg/L) | 0.442 | <0.0010 | <0.0010 | <0.0010 | |
| | Sulfate (SO4) (mg/L) | 236 | 57.0 | 55.2 | <0.30 | |
| | Anion Sum (meq/L) | 20.0 | 6.07 | 5.87 | <0.10 | |
| | Cation Sum (meq/L) | 20.2 | 5.91 | 5.80 | <0.10 | |
| | Cation - Anion Balance (%) | 0.3 | -1.3 | -0.6 | 0.0 | |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 4.41 | 8.53 | <0.50 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.316 | 0.0173 | 0.0120 | <0.0030 | |
| | Antimony (Sb)-Total (mg/L) | 0.00024 | <0.00010 | 0.00010 | <0.00010 | |
| | Arsenic (As)-Total (mg/L) | 0.00079 | 0.00024 | 0.00034 | <0.00010 | |
| | Barium (Ba)-Total (mg/L) | 0.237 | 0.0764 | 0.0809 | <0.000050 | |
| | Beryllium (Be)-Total (mg/L) | 0.000032 | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Total (mg/L) | 0.039 | 0.025 | 0.034 | <0.010 | |
| | Cadmium (Cd)-Total (mg/L) | 0.000368 | 0.0000051 | 0.0000083 | <0.0000050 | |
| | Calcium (Ca)-Total (mg/L) | 229 | 55.8 | 68.9 | <0.050 | |
| | Chromium (Cr)-Total (mg/L) | 0.00142 | <0.00010 | <0.00010 | <0.00010 | |
| | Cobalt (Co)-Total (mg/L) | 0.00199 | <0.00010 | <0.00010 | <0.00010 | |
| | Copper (Cu)-Total (mg/L) | 0.241 | 0.00393 | 0.00899 | <0.00050 | |
| | Iron (Fe)-Total (mg/L) | 7.28 | 0.049 | 0.015 | <0.010 | |
| | Lead (Pb)-Total (mg/L) | 0.000212 | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Total (mg/L) | 0.0056 | 0.0042 | 0.0022 | <0.0010 | |
| | Magnesium (Mg)-Total (mg/L) | 74.0 | 29.6 | 22.0 | <0.10 | |
| | Manganese (Mn)-Total (mg/L) | 6.50 | 0.0787 | 0.166 | <0.00010 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1878946-1 | L1878946-2 | L1878946-3 | L1878946-4 |
|-------------------------|---------------------------------------|--------------|------------|------------|------------|-------------------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 09-JAN-17 | 10-JAN-17 | 10-JAN-17 | 10-JAN-17 |
| | | Sampled Time | 16:15 | 10:15 | 11:10 | |
| | | Client ID | W8A | W3 | W17 | F-BL |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | | 0.0000058 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | | 0.0106 | 0.00510 | 0.00540 | <0.000050 |
| | Nickel (Ni)-Total (mg/L) | | 0.00203 | 0.00091 | 0.00081 | <0.00050 |
| | Phosphorus (P)-Total (mg/L) | | 0.127 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | | 8.75 | 2.20 | 3.81 | <0.10 |
| | Selenium (Se)-Total (mg/L) | | 0.00419 | 0.000353 | 0.000363 | <0.000050 |
| | Silicon (Si)-Total (mg/L) | | 10.3 | 6.42 | 5.45 | <0.050 |
| | Silver (Ag)-Total (mg/L) | | 0.000088 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | | 54.8 | 18.5 | 16.8 | <0.050 |
| | Strontium (Sr)-Total (mg/L) | | 3.45 | 0.760 | 0.792 | <0.00020 |
| | Sulfur (S)-Total (mg/L) | | 91.1 | 19.9 | 19.6 | <0.50 |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | | 0.0186 | 0.00054 | 0.00037 | <0.00030 |
| | Uranium (U)-Total (mg/L) | | 0.00447 | 0.00297 | 0.00268 | <0.000010 |
| | Vanadium (V)-Total (mg/L) | | 0.00527 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | | 0.438 | <0.0030 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | | 0.00096 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0157 | 0.0022 | 0.0021 | <0.0010 |
| | Antimony (Sb)-Dissolved (mg/L) | | 0.00012 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00098 | 0.00022 | 0.00029 | <0.00010 |
| | Barium (Ba)-Dissolved (mg/L) | | 0.208 | 0.0760 | 0.0792 | 0.000239 ^{RRV} |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | 0.036 | 0.023 | 0.032 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | | 0.000252 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | | 225 | 54.1 | 65.8 | <0.050 |
| | Chromium (Cr)-Dissolved (mg/L) | | 0.00073 | <0.00010 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | | 0.00175 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | | 0.0456 | 0.00262 | 0.00559 | 0.00071 ^{RRV} |
| | Iron (Fe)-Dissolved (mg/L) | | 0.564 | 0.024 | <0.010 | <0.010 |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | | 0.0053 | 0.0035 | 0.0018 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | | 73.9 | 28.8 | 21.0 | <0.10 |
| | Manganese (Mn)-Dissolved (mg/L) | | 6.37 | 0.0653 | 0.0382 | <0.00010 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1878946-1 Water 09-JAN-17 16:15 W8A | L1878946-2 Water 10-JAN-17 10:15 W3 | L1878946-3 Water 10-JAN-17 11:10 W17 | L1878946-4 Water 10-JAN-17 F-BL |
|-------------------------|---|--|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00992 | 0.00484 | 0.00543 | <0.000050 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00183 | 0.00082 | 0.00067 | <0.00050 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 8.77 | 2.14 | 3.68 | <0.10 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00409 | 0.000338 | 0.000368 | <0.000050 |
| | Silicon (Si)-Dissolved (mg/L) | 9.27 | 6.29 | 5.22 | <0.050 |
| | Silver (Ag)-Dissolved (mg/L) | 0.000017 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 53.9 | 18.0 | 16.0 | <0.050 |
| | Strontium (Sr)-Dissolved (mg/L) | 3.36 | 0.734 | 0.767 | <0.00020 |
| | Sulfur (S)-Dissolved (mg/L) | 89.9 | 19.7 | 19.0 | <0.50 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00085 ^{RRV} |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00084 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | 0.00428 | 0.00284 | 0.00248 | <0.000010 |
| | Vanadium (V)-Dissolved (mg/L) | 0.00169 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.238 | <0.0010 | <0.0010 | 0.0062 ^{RRV} |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00096 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1878946-2, -3, -4 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1878946-1, -2, -3, -4 |
| Matrix Spike | Boron (B)-Total | MS-B | L1878946-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1878946-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1878946-1, -2, -3, -4 |
| Matrix Spike | Silicon (Si)-Total | MS-B | L1878946-1, -2, -3, -4 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1878946-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1878946-1, -2, -3, -4 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1878946-1, -2, -3, -4 |
| Matrix Spike | Uranium (U)-Total | MS-B | L1878946-1, -2, -3, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |
| RRV | Reported Result Verified By Repeat Analysis |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |

Reference Information

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

| | |
|----|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |
|----|---|

Reference Information

Chain of Custody Numbers:

2017-01-11 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1878946-COFC

COC Number: 2017-01-11 A

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| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|--|--|---|-------------------------------------|-----|---|-----|-------------|-----------|--|------------------------------|--------------|---|----------------------|----------------------|---|---|--|--|--|---|---|--|--|----------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|---|-----|---|-----|---|-----|--|--|--|--|--|--|--|---|------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-----------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|---------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | Priority (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: _____ determined by _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | <table border="1"> <thead> <tr> <th colspan="11">Analysis Request</th> <th rowspan="2">Number of Containers</th> </tr> <tr> <th colspan="11">Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below</th> </tr> <tr> <th></th><th></th><th></th><th></th><th>P</th><th>F/P</th><th>P</th><th>F/P</th><th>P</th><th>F/P</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th> </tr> </thead> <tbody> <tr> <td rowspan="4">pH / Conductivity / Alkalinity / Anions</td> <td>Total Suspended Solids (TSS)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>Total Dissolved Solids (TDS)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>Total Metals (TM), Hardness</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>Dissolved Metals (DM) (Filtered and preserved)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td rowspan="2">Total Mercury, Hardness</td> <td>Dissolved Mercury [1] (Filtered + preserved)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>Total Nutrients (Ammonia)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td colspan="2">Dissolved Organic Carbon (DOC)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </tbody> </table> | | | | | | | | | | | Analysis Request | | | | | | | | | | | Number of Containers | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | P | F/P | P | F/P | P | F/P | | | | | | | | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | | | | | | | | | | | | | | | | Total Dissolved Solids (TDS) | | | | | | | | | | | | | | | | Total Metals (TM), Hardness | | | | | | | | | | | | | | | | Dissolved Metals (DM) (Filtered and preserved) | | | | | | | | | | | | | | | | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | | | | | | | | | | | | | | | | Total Nutrients (Ammonia) | | | | | | | | | | | | | | | | Dissolved Organic Carbon (DOC) | | | | | | | | | | | | | | | | |
| Analysis Request | | | | | | | | | | | | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | P | F/P | P | F/P | P | F/P | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Total Dissolved Solids (TDS) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Total Metals (TM), Hardness | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Dissolved Metals (DM) (Filtered and preserved) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Total Nutrients (Ammonia) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dissolved Organic Carbon (DOC) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 224162 (WUL) | | | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | ALS Contact: Ariel Tang | | Sampler: CH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W8A | | | | 9-Jan-17 | 16:15 | Water | R | R | R | R | R | R | R | R | R | R | | R | | | | | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W3 | | | | 10-Jan-17 | 10:15 | Water | R | R | R | R | R | R | R | R | R | R | | R | R | | | | | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W17 | | | | 10-Jan-17 | 11:10 | Water | R | R | R | R | R | R | R | R | R | R | | R | R | | | | | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F-BL | | | | 10-Jan-17 | | Water | R | R | R | R | R | R | R | R | R | R | | R | R | | | | | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RUSH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Drinking Water (DW) Samples ¹ (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-01-11 9:00 | | Time: | | Received by: EHF | | Date: 11 Jan 2017 | | Time: 15:40 | | Received by: Shayan | | Date: Jan 12 | | Time: 1510 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION. WHITE - LABORATORY COPY. YELLOW - CLIENT COPY. OCTOBER 2015 FRONT.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 18-JAN-17
Report Date: 30-JAN-17 17:22 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1880962
Project P.O. #: 224162(WUL)
Job Reference:
C of C Numbers: 2017-01-18A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1880962-1 | L1880962-2 | L1880962-3 |
|-----------------------------|---|---------------------------------|------------|------------|------------|
| | | Description | WATER | WATER | WATER |
| | | Sampled Date | 17-JAN-17 | 17-JAN-17 | 17-JAN-17 |
| | | Sampled Time | 10:55 | 11:10 | 11:25 |
| | | Client ID | W3 | W17 | W8A |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 542 | 523 | 1590 |
| | Hardness (as CaCO3) (mg/L) | | 264 | 258 | 882 |
| | pH (pH) | | 8.17 | 8.24 | 7.83 |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | 54.3 |
| | TDS (Calculated) (mg/L) | | 313 | 308 | 1080 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 237 | 223 | 741 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 237 | 223 | 741 |
| | Ammonia, Total (as N) (mg/L) | | 0.0203 | <0.0050 | 0.423 |
| | Chloride (Cl) (mg/L) | | 4.75 | 6.49 | 17.7 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.323 | 0.614 | 2.42 |
| | Nitrate (as N) (mg/L) | | 0.323 | 0.614 | 1.92 |
| | Nitrite (as N) (mg/L) | | <0.0010 | <0.0010 | 0.500 |
| | Sulfate (SO4) (mg/L) | | 56.5 | 54.8 | 226 |
| | Anion Sum (meq/L) | | 6.06 | 5.83 | 20.2 |
| | Cation Sum (meq/L) | | 6.16 | 5.97 | 20.5 |
| | Cation - Anion Balance (%) | | 0.8 | 1.2 | 0.8 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 4.59 | 8.11 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0233 | 0.0053 | 0.0312 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | <0.00010 | 0.00017 |
| | Arsenic (As)-Total (mg/L) | | 0.00027 | 0.00036 | 0.00066 |
| | Barium (Ba)-Total (mg/L) | | 0.0794 | 0.0780 | 0.217 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | 0.000022 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.025 | 0.034 | 0.040 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000087 | <0.0000050 | 0.000336 |
| | Calcium (Ca)-Total (mg/L) | | 57.5 | 68.4 | 235 |
| | Chromium (Cr)-Total (mg/L) | | 0.00013 | 0.00013 | 0.00113 |
| | Cobalt (Co)-Total (mg/L) | | 0.00012 | <0.00010 | 0.00156 |
| | Copper (Cu)-Total (mg/L) | | 0.00308 | 0.00616 | 0.127 |
| | Iron (Fe)-Total (mg/L) | | 0.094 | <0.010 | 2.10 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | <0.000050 | 0.000076 |
| | Lithium (Li)-Total (mg/L) | | 0.0033 | 0.0017 | 0.0053 |
| | Magnesium (Mg)-Total (mg/L) | | 29.6 | 21.3 | 74.3 |
| | Manganese (Mn)-Total (mg/L) | | 0.160 | 0.0453 | 6.23 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1880962-1 WATER 17-JAN-17 10:55 W3 | L1880962-2 WATER 17-JAN-17 11:10 W17 | L1880962-3 WATER 17-JAN-17 11:25 W8A | | |
|---|---|--|--|------------|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00480 | 0.00567 | 0.0104 | |
| | Nickel (Ni)-Total (mg/L) | 0.00101 | 0.00070 | 0.00200 | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | 0.089 | |
| | Potassium (K)-Total (mg/L) | 2.31 | 3.83 | 9.14 | |
| | Selenium (Se)-Total (mg/L) | 0.000298 | 0.000357 | 0.00375 | |
| | Silicon (Si)-Total (mg/L) | 6.77 | 5.52 | 9.60 | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000037 | |
| | Sodium (Na)-Total (mg/L) | 18.7 | 16.2 | 54.8 | |
| | Strontium (Sr)-Total (mg/L) | 0.740 | 0.781 | 3.37 | |
| | Sulfur (S)-Total (mg/L) | 20.3 | 19.4 | 90.4 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | 0.00021 | |
| | Titanium (Ti)-Total (mg/L) | 0.00110 | <0.00030 | 0.00209 | |
| | Uranium (U)-Total (mg/L) | 0.00277 | 0.00252 | 0.00431 | |
| | Vanadium (V)-Total (mg/L) | <0.00050 | <0.00050 | 0.00323 | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | 0.250 | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | 0.00088 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0016 | <0.0010 | 0.0095 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00010 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00026 | 0.00033 | 0.00057 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0823 | 0.0811 | 0.218 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | 0.021 | 0.029 | 0.033 | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000076 | 0.0000052 | 0.000311 | |
| | Calcium (Ca)-Dissolved (mg/L) | 57.3 | 68.0 | 234 | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00075 | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00011 | <0.00010 | 0.00156 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00251 | 0.00525 | 0.0587 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.046 | <0.010 | 0.285 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0032 | 0.0017 | 0.0049 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 29.3 | 21.3 | 72.6 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.150 | 0.0425 | 6.37 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1880962-1 | L1880962-2 | L1880962-3 | | |
|-------------------------|----------------------------------|--------------|--------------|------------------------|---|--|--|--|--|
| | | | | | L1880962-1 WATER 17-JAN-17 10:55 W3 | L1880962-2 WATER 17-JAN-17 11:10 W17 | L1880962-3 WATER 17-JAN-17 11:25 W8A | | |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00441 | 0.00518 | 0.00938 | | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00092 | 0.00074 | 0.00191 | | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | | | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.28 | 3.89 | 8.99 | | | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000329 | 0.000446 | 0.00488 ^{DTC} | | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.02 | 5.10 | 8.75 | | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 18.9 | 16.6 | 54.4 | | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.734 | 0.780 | 3.38 | | | | | |
| | Sulfur (S)-Dissolved (mg/L) | 18.7 | 17.7 | 80.9 | | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00079 | | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00249 | 0.00232 | 0.00396 | | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00144 | | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | 0.255 | | | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00087 | | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Iron (Fe)-Total | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Total | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1880962-1, -2, -3 |
| Matrix Spike | Titanium (Ti)-Total | MS-B | L1880962-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| | | Hardness | APHA 2340B |

Reference Information

| | | | |
|---|-------|--|---|
| HARDNESS-CALC-VA | Water | | |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-01-18A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 25-JAN-17
Report Date: 06-FEB-17 17:36 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1883599
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-01-25 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1883599-1 | L1883599-2 | L1883599-3 | L1883599-4 |
|-----------------------------|---|---------------------------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 24-JAN-17 | 25-JAN-17 | 24-JAN-17 | |
| | | Sampled Time | 11:05 | 11:20 | 13:00 | |
| | | Client ID | W3 | W17 | W8A | DUP |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 524 | 517 | 1540 | 519 |
| | Hardness (as CaCO3) (mg/L) | | 256 | 256 | 891 | 248 |
| | pH (pH) | | 8.01 | 8.12 | 7.79 | 8.07 |
| | Total Suspended Solids (mg/L) | | 17.7 | <3.0 | 37.3 | <3.0 |
| | TDS (Calculated) (mg/L) | | 308 | 310 | 1100 | 305 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 232 | 227 | 769 | 225 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 232 | 227 | 769 | 225 |
| | Ammonia, Total (as N) (mg/L) | | 0.0219 | <0.0050 | 0.375 | <0.0050 |
| | Chloride (Cl) (mg/L) | | 4.72 | 6.58 | 18.1 | 6.58 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.311 | 0.535 | 2.07 | 0.536 |
| | Nitrate (as N) (mg/L) | | 0.311 | 0.535 | 1.52 | 0.536 |
| | Nitrite (as N) (mg/L) | | <0.0010 | <0.0010 | 0.547 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 56.7 | 55.4 | 233 | 55.4 |
| | Anion Sum (meq/L) | | 5.98 | 5.91 | 20.9 | 5.88 |
| | Cation Sum (meq/L) | | 6.00 | 5.95 | 20.9 | 5.75 |
| | Cation - Anion Balance (%) | | 0.2 | 0.3 | 0.0 | -1.1 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 4.70 | 8.53 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.598 | 0.0164 | 0.102 | 0.0343 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | 0.00012 | 0.00037 | 0.00015 |
| | Arsenic (As)-Total (mg/L) | | 0.00057 | 0.00036 | 0.00069 | 0.00038 |
| | Barium (Ba)-Total (mg/L) | | 0.0938 | 0.0806 | 0.218 | 0.0868 |
| | Beryllium (Be)-Total (mg/L) | | 0.000024 | <0.000020 | 0.000022 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.022 | 0.031 | 0.036 | 0.032 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000329 | 0.0000117 | 0.000335 | 0.0000192 |
| | Calcium (Ca)-Total (mg/L) | | 54.9 | 66.2 | 227 | 69.8 |
| | Chromium (Cr)-Total (mg/L) | | 0.00103 | <0.00010 | 0.00128 | 0.00049 |
| | Cobalt (Co)-Total (mg/L) | | 0.00059 | 0.00010 | 0.00178 | 0.00017 |
| | Copper (Cu)-Total (mg/L) | | 0.00989 | 0.00655 | 0.148 | 0.00962 |
| | Iron (Fe)-Total (mg/L) | | 1.04 | 0.021 | 2.93 | 0.050 |
| | Lead (Pb)-Total (mg/L) | | 0.000296 | <0.000050 | 0.000121 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | 0.0027 | <0.0010 | 0.0043 | 0.0017 |
| | Magnesium (Mg)-Total (mg/L) | | 28.6 | 21.2 | 73.8 | 20.8 |
| | Manganese (Mn)-Total (mg/L) | | 0.441 | 0.222 | 6.77 | 0.503 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1883599-1 | L1883599-2 | L1883599-3 | L1883599-4 |
|-------------------------|---------------------------------------|--------------|--------------|-----------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water |
| | | 24-JAN-17 | 11:05 | W3 | 24-JAN-17 | 11:20 | 24-JAN-17 | 13:00 |
| | | | | | W3 | W17 | W8A | DUP |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | 0.0000058 | <0.0000050 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00480 | 0.00589 | 0.0101 | 0.00638 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00230 | 0.00088 | 0.00206 | 0.00112 | | | |
| | Phosphorus (P)-Total (mg/L) | 0.051 | <0.050 | 0.084 | <0.050 | | | |
| | Potassium (K)-Total (mg/L) | 2.32 | 3.88 | 8.91 | 3.79 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000346 | 0.000354 | 0.00304 | 0.000378 | | | |
| | Silicon (Si)-Total (mg/L) | 7.33 | 5.39 | 9.66 | 5.67 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000073 | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 18.5 | 16.5 | 55.6 | 15.9 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.738 | 0.800 | 3.48 | 0.795 | | | |
| | Sulfur (S)-Total (mg/L) | 20.3 | 20.1 | 84.5 | 20.3 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | 0.00011 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.0261 | 0.00070 | 0.00550 | 0.00149 | | | |
| | Uranium (U)-Total (mg/L) | 0.00267 | 0.00257 | 0.00437 | 0.00253 | | | |
| | Vanadium (V)-Total (mg/L) | 0.00222 | <0.00050 | 0.00372 | 0.00063 | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0061 | <0.0030 | 0.254 | <0.0030 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | 0.00102 | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0024 | 0.0015 | 0.0087 | 0.0015 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00012 | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00026 | 0.00031 | 0.00058 | 0.00031 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0792 | 0.0778 | 0.218 | 0.0777 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.024 | 0.034 | 0.040 | 0.030 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000100 | 0.0000051 | 0.000248 | <0.0000050 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 56.0 | 67.2 | 232 | 64.7 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00092 | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00014 | <0.00010 | 0.00173 | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00388 | 0.00542 | 0.0522 | 0.00508 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.058 | <0.010 | 0.501 | <0.010 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0029 | 0.0013 | 0.0048 | 0.0019 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 28.3 | 21.4 | 75.4 | 21.1 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.200 | 0.0627 | 6.98 | 0.0593 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1883599-1 | L1883599-2 | L1883599-3 | L1883599-4 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 24-JAN-17 | 25-JAN-17 | 24-JAN-17 | |
| | | Sampled Time | 11:05 | 11:20 | 13:00 | |
| | | Client ID | W3 | W17 | W8A | DUP |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00434 | 0.00545 | 0.00937 | 0.00553 |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00103 | 0.00080 | 0.00201 | 0.00073 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 2.14 | 3.81 | 9.12 | 3.61 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000273 | 0.000336 | 0.00281 | 0.000399 |
| | Silicon (Si)-Dissolved (mg/L) | | 6.21 | 5.23 | 9.47 | 5.36 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | 0.000016 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 18.7 | 17.0 | 58.1 | 16.0 |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.728 | 0.789 | 3.43 | 0.776 |
| | Sulfur (S)-Dissolved (mg/L) | | 19.3 | 18.7 | 80.8 | 19.2 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00020 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | 0.00085 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.00258 | 0.00247 | 0.00432 | 0.00253 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | 0.00192 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | <0.0010 | <0.0010 | 0.219 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | 0.00102 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|------------------------------|-----------|-----------------------------|
| Method Blank | Alkalinity, Total (as CaCO3) | B | L1883599-4 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1883599-1, -2, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Silicon (Si)-Total | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1883599-1, -2, -3, -4 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1883599-1, -2, -3, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| B | Method Blank exceeds ALS DQO. All associated sample results are at least 5 times greater than blank levels and are considered reliable. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-01-25 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Whitehorse Receive
LOGGED IN

Chain of Custody (COC) / Analytical Request Form



L1883599-COFC

COC Number: 2017-01-25 A

Page of

Canada Toll Free: 1 800 668 9878

| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
|--|---|--|--|--|---|-------------|---|------------------------------|---|-----------------------------|--|-------------------------|--|---------------------------|--------------------------------|----------------------|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT If received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> | | | | EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | | Analysis Request | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | |
| Project Information | | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | | APE/Cost Center: | | | PO# | | | | | | | | | | |
| Job #: | | | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | |
| PO / AFE: 224162 (WUL) | | | | Requisitioner: | | | | | | | | | | | | | |
| LSD: | | | | Location: | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | ALS Contact: Ariel Tang | | | Sampler: SR | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (1) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | |
| W3 | | | | 24-Jan-17 | 11:05 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| W17 | | | | 24-Jan-17 | 11:20 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| W8A | | | | 24-Jan-17 | 13:00 | Water | R | R | R | R | R | R | R | R | R | 6 | |
| Dup | | | | 24-Jan-17 | | Water | R | R | R | R | R | R | R | R | R | 7 | |
| Drinking Water (DW) Samples ¹ (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | |
| | | | | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | |
| | | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | FINAL COOLER TEMPERATURES °C | | | | |
| | | | | | | | | | 5.0 | | | | 4 | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-01-25 | | Time: 12:00 | Received by: <i>EHF</i> | | Date: 25 Jan 2017 | | Time: 15:53 | Received by: <i>SF</i> | | Date: Jan 26 | | Time: 3:20 | | | |

Short Holding Time
Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 01-FEB-17
Report Date: 14-FEB-17 15:14 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1886060
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-02-01 A
Legal Site Desc:

Ariel McDonnell, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1886060-1 | L1886060-2 | L1886060-3 | L1886060-4 |
|-----------------------------|---|---------------------------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 31-JAN-17 | 31-JAN-17 | 31-JAN-17 | 31-JAN-17 |
| | | Sampled Time | 10:00 | 10:15 | 13:45 | |
| | | Client ID | W3 | W17 | W8A | DUP |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 529 | 531 | 1630 | 542 |
| | Hardness (as CaCO3) (mg/L) | | 250 | 252 | 907 | 253 |
| | pH (pH) | | 8.12 | 8.15 | 7.44 | 8.02 |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | 16.4 | 3.0 |
| | TDS (Calculated) (mg/L) | | 311 | 309 | 1110 | 311 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 240 | 228 | 807 | 238 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 240 | 228 | 807 | 238 |
| | Ammonia, Total (as N) (mg/L) | | 0.0102 | <0.0050 | 0.420 | 0.0094 |
| | Chloride (Cl) (mg/L) | | 4.64 | 6.52 | 17.7 | 4.65 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.327 | 0.455 | 0.835 | 0.329 |
| | Nitrate (as N) (mg/L) | | 0.327 | 0.455 | 0.512 | 0.329 |
| | Nitrite (as N) (mg/L) | | <0.0010 | <0.0010 | 0.323 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 57.1 | 55.7 | 213 | 57.3 |
| | Anion Sum (meq/L) | | 6.14 | 5.93 | 21.1 | 6.11 |
| | Cation Sum (meq/L) | | 5.88 | 5.85 | 21.3 | 5.95 |
| | Cation - Anion Balance (%) | | -2.2 | -0.6 | 0.3 | -1.3 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 4.22 | 8.48 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0350 | 0.0062 | 0.106 | 0.0280 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | 0.00014 | 0.00040 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00035 | 0.00038 | 0.00081 | 0.00035 |
| | Barium (Ba)-Total (mg/L) | | 0.0771 | 0.0757 | 0.225 | 0.0770 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | 0.000028 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.030 | 0.039 | 0.046 | 0.030 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000060 | 0.0000140 | 0.000344 | 0.0000081 |
| | Calcium (Ca)-Total (mg/L) | | 56.8 | 68.9 | 237 | 56.7 |
| | Chromium (Cr)-Total (mg/L) | | 0.00012 | 0.00011 | 0.00132 | 0.00011 |
| | Cobalt (Co)-Total (mg/L) | | 0.00010 | <0.00010 | 0.00234 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | | 0.00335 | 0.00615 | 0.168 | 0.00339 |
| | Iron (Fe)-Total (mg/L) | | 0.085 | <0.010 | 2.79 | 0.072 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | <0.000050 | 0.000142 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | 0.0048 | 0.0027 | 0.0066 | 0.0047 |
| | Magnesium (Mg)-Total (mg/L) | | 31.2 | 21.5 | 77.4 | 29.4 |
| | Manganese (Mn)-Total (mg/L) | | 0.0995 | 0.0700 | 7.41 | 0.0935 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1886060-1 Water 31-JAN-17 10:00 W3 | L1886060-2 Water 31-JAN-17 10:15 W17 | L1886060-3 Water 31-JAN-17 13:45 W8A | L1886060-4 Water 31-JAN-17 DUP |
|---|---------------------------------------|---|--|--|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | 0.0000067 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00467 | 0.00600 | 0.0111 | 0.00477 |
| | Nickel (Ni)-Total (mg/L) | 0.00086 | 0.00077 | 0.00191 | 0.00084 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | 0.100 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.32 | 3.90 | 9.19 | 2.26 |
| | Selenium (Se)-Total (mg/L) | 0.000310 | 0.000387 | 0.00246 | 0.000309 |
| | Silicon (Si)-Total (mg/L) | 6.85 | 5.76 | 10.4 | 6.81 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000054 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 20.1 | 17.1 | 58.1 | 19.3 |
| | Strontium (Sr)-Total (mg/L) | 0.778 | 0.818 | 3.60 | 0.775 |
| | Sulfur (S)-Total (mg/L) | 21.6 | 20.6 | 80.6 | 21.0 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.00137 | <0.00030 | 0.00643 | 0.00106 |
| | Uranium (U)-Total (mg/L) | 0.00283 | 0.00261 | 0.00438 | 0.00290 |
| | Vanadium (V)-Total (mg/L) | 0.00072 | 0.00056 | 0.00393 | 0.00069 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | 0.223 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | 0.00113 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0013 | 0.0023 | 0.0099 | 0.0010 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00015 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00032 | 0.00039 | 0.00069 | 0.00030 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0771 | 0.0780 | 0.222 | 0.0771 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.023 | 0.030 | 0.036 | 0.023 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000052 | 0.0000089 | 0.000310 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 56.2 | 68.0 | 242 | 56.4 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00010 | 0.00092 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00231 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00167 | 0.00633 | 0.0596 | 0.00169 |
| | Iron (Fe)-Dissolved (mg/L) | 0.026 | <0.010 | 0.651 | 0.026 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0036 | 0.0018 | 0.0053 | 0.0035 |
| | Magnesium (Mg)-Dissolved (mg/L) | 26.7 | 19.9 | 73.3 | 27.3 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0798 | 0.0567 | 7.88 | 0.0794 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1886060-1 | L1886060-2 | L1886060-3 | L1886060-4 |
|-------------------------|----------------------------------|--------------|--------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water |
| | | 31-JAN-17 | 10:00 | W3 | 31-JAN-17 | 10:15 | 31-JAN-17 | 31-JAN-17 |
| | | | | | W3 | W17 | W8A | DUP |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00451 | 0.00553 | 0.0106 | 0.00452 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00059 | 0.00065 | 0.00180 | 0.00060 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | 0.051 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.31 | 3.88 | 9.58 | 2.31 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000341 | 0.000436 | 0.00242 | 0.000382 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.33 | 5.35 | 9.84 | 6.30 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000016 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 18.6 | 16.5 | 58.5 | 18.9 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.737 | 0.765 | 3.48 | 0.737 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 20.3 | 19.7 | 80.9 | 20.0 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | 0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00096 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00272 | 0.00240 | 0.00430 | 0.00273 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00204 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | 0.166 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00111 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Method Blank | Silicon (Si)-Total | MB-LOR | L1886060-1, -2, -3, -4 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1886060-1, -2, -4 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1886060-1, -2, -4 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1886060-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1886060-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1886060-1, -2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1886060-1, -2, -3, -4 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1886060-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1886060-1, -2, -3, -4 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1886060-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1886060-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1886060-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1886060-1, -2, -3, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |

Reference Information

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

Reference Information

VA

ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2017-02-01 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 10-FEB-17
Report Date: 22-FEB-17 15:38 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1889375
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-02-08 A
Legal Site Desc:

Ariel McDonnell, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

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ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1889375-1 | L1889375-2 | L1889375-3 | | |
|-----------------------------|---|---------------------------------|-------------------------|-------------------------|------------|------|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 07-FEB-17 | 07-FEB-17 | 07-FEB-17 | | |
| | | Sampled Time | 10:00 | 10:15 | 11:10 | | |
| | | Client ID | W3 | W17 | W8A | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 548 | 542 | 1610 | | |
| | Hardness (as CaCO3) (mg/L) | | 262 | 264 | 918 | | |
| | pH (pH) | | 8.16 | 8.28 | 7.83 | | |
| | Total Suspended Solids (mg/L) | | 9.3 | <3.0 | 106 | | |
| | Total Dissolved Solids (mg/L) | | 339 | 336 | 1160 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 245 | 237 | 805 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 245 | 237 | 805 | | |
| | Ammonia, Total (as N) (mg/L) | | 0.0161 | 0.0060 | 0.432 | | |
| | Bromide (Br) (mg/L) | | <0.050 | <0.050 | <0.25 | DLDS | |
| | Chloride (Cl) (mg/L) | | 4.82 | 6.70 | 18.9 | | |
| | Fluoride (F) (mg/L) | | 0.551 | 0.360 | 0.55 | | |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.345 | 0.398 | 0.289 | | |
| | Nitrate (as N) (mg/L) | | 0.345 | 0.398 | 0.126 | | |
| | Nitrite (as N) (mg/L) | | <0.0010 | <0.0010 | 0.163 | | |
| | Sulfate (SO4) (mg/L) | | 57.8 | 57.1 | 213 | | |
| | Anion Sum (meq/L) | | 6.30 | 6.16 | 21.1 | | |
| | Cation Sum (meq/L) | | 6.12 | 6.10 | 21.5 | | |
| | Cation - Anion Balance (%) | | -1.5 | -0.5 | 0.8 | | |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 4.33 | 8.61 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.244 | 0.0345 | 0.147 | | |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | <0.00010 | 0.00029 | | |
| | Arsenic (As)-Total (mg/L) | | 0.00037 | 0.00034 | 0.00081 | | |
| | Barium (Ba)-Total (mg/L) | | 0.0791 | 0.0842 | 0.235 | | |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | 0.000028 | | |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | | |
| | Boron (B)-Total (mg/L) | | 0.023 | 0.031 | 0.035 | | |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000126 | 0.0000152 | 0.000326 | | |
| | Calcium (Ca)-Total (mg/L) | | 54.6 | 67.5 | 234 | | |
| | Chromium (Cr)-Total (mg/L) | | <0.00080 ^{DLB} | <0.00040 ^{DLB} | 0.00151 | | |
| | Cobalt (Co)-Total (mg/L) | | 0.00023 | 0.00013 | 0.00313 | | |
| | Copper (Cu)-Total (mg/L) | | 0.00367 | 0.0145 | 0.198 | | |
| | Iron (Fe)-Total (mg/L) | | 0.357 | 0.053 | 5.10 | | |
| | Lead (Pb)-Total (mg/L) | | 0.000113 | 0.000055 | 0.000160 | | |
| | Lithium (Li)-Total (mg/L) | | 0.0038 | 0.0021 | 0.0050 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1889375-1 | L1889375-2 | L1889375-3 |
|-------------------------|---------------------------------------|--------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 07-FEB-17 | 07-FEB-17 | 07-FEB-17 |
| | | Sampled Time | 10:00 | 10:15 | 11:10 |
| | | Client ID | W3 | W17 | W8A |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Magnesium (Mg)-Total (mg/L) | | 28.2 | 21.0 | 74.1 |
| | Manganese (Mn)-Total (mg/L) | | 0.124 | 0.325 | 8.44 |
| | Mercury (Hg)-Total (mg/L) | | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Total (mg/L) | | 0.00443 | 0.00584 | 0.0122 |
| | Nickel (Ni)-Total (mg/L) | | 0.00142 | 0.00122 | 0.00211 |
| | Phosphorus (P)-Total (mg/L) | | <0.050 | <0.050 | 0.101 |
| | Potassium (K)-Total (mg/L) | | 2.11 | 3.62 | 8.48 |
| | Selenium (Se)-Total (mg/L) | | 0.000299 | 0.000321 | 0.00168 |
| | Silicon (Si)-Total (mg/L) | | 6.57 | 5.39 | 9.89 |
| | Silver (Ag)-Total (mg/L) | | <0.000010 | <0.000010 | 0.000063 |
| | Sodium (Na)-Total (mg/L) | | 17.8 | 15.9 | 52.8 |
| | Strontium (Sr)-Total (mg/L) | | 0.735 | 0.781 | 3.47 |
| | Sulfur (S)-Total (mg/L) | | 18.5 | 18.5 | 71.8 |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | | 0.0110 | 0.00161 | 0.00851 |
| | Uranium (U)-Total (mg/L) | | 0.00280 | 0.00262 | 0.00430 |
| | Vanadium (V)-Total (mg/L) | | 0.00104 | 0.00055 | 0.00449 |
| | Zinc (Zn)-Total (mg/L) | | 0.0056 | <0.0030 | 0.320 |
| | Zirconium (Zr)-Total (mg/L) | | <0.00030 | <0.00030 | 0.00102 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0018 | 0.0017 | 0.0080 |
| | Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | <0.00010 | 0.00011 |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00023 | 0.00033 | 0.00069 |
| | Barium (Ba)-Dissolved (mg/L) | | 0.0782 | 0.0814 | 0.234 |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | 0.024 | 0.031 | 0.037 |
| | Cadmium (Cd)-Dissolved (mg/L) | | 0.0000063 | 0.0000081 | 0.000230 |
| | Calcium (Ca)-Dissolved (mg/L) | | 56.5 | 69.5 | 242 |
| | Chromium (Cr)-Dissolved (mg/L) | | <0.00010 | <0.00010 | 0.00081 |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | 0.00317 |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00186 | 0.00599 | 0.0450 |
| | Iron (Fe)-Dissolved (mg/L) | | 0.030 | <0.010 | 1.60 |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | | 0.0033 | 0.0017 | 0.0048 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1889375-1 | L1889375-2 | L1889375-3 | | |
|-------------------------|----------------------------------|--------------|------------|------------|------------------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 07-FEB-17 | 07-FEB-17 | 07-FEB-17 | | |
| | | Sampled Time | 10:00 | 10:15 | 11:10 | | |
| | | Client ID | W3 | W17 | W8A | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Magnesium (Mg)-Dissolved (mg/L) | | 29.4 | 22.0 | 76.4 | | |
| | Manganese (Mn)-Dissolved (mg/L) | | 0.0906 | 0.0749 | 9.02 | | |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00454 | 0.00578 | 0.0121 | | |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00087 | 0.00080 | 0.00210 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | 0.053 | | |
| | Potassium (K)-Dissolved (mg/L) | | 2.25 | 3.85 | 9.22 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000318 | 0.000409 | 0.00232 ^{DTC} | | |
| | Silicon (Si)-Dissolved (mg/L) | | 6.13 | 5.35 | 9.52 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | 0.000014 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 18.8 | 16.6 | 55.7 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.778 | 0.813 | 3.60 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 19.2 | 19.8 | 75.2 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | 0.00011 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | 0.00097 | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.00269 | 0.00246 | 0.00430 | | |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | 0.00196 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | <0.0010 | <0.0010 | 0.260 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | 0.00112 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Method Blank | Chromium (Cr)-Total | MB-LOR | L1889375-1, -2, -3 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1889375-1, -2 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Boron (B)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Iron (Fe)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Uranium (U)-Total | MS-B | L1889375-1, -2, -3 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1889375-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLB | Detection Limit Raised. Analyte detected at comparable level in Method Blank. |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-02-08 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Whitehorse Receive
Not Logged In

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1889375-COFC

COC Number: 2017-02-08 A

Page 1 of 1

| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
|--|---|--|--------------|---------------|--|------------------------------|-------------------------------------|-----------------------------|--|------------------------------|--|---------------------------|--------------------------------|--------------|--|----------------------|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PROPERTY (Business Days) | | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | | 1 Business day [E1] <input type="checkbox"/> | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 224162 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Ariel McDonnell | | Sampler: CH | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Ammonia | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (1) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | Number of Containers | |
| W3 | | 7-Feb-17 | 10:00 | Water | R | R | R | R | R | R | R | R | R | | | 7 | |
| W17 | | 7-Feb-17 | 10:15 | Water | R | R | R | R | R | R | R | R | R | | | 7 | |
| W8A | | 7-Feb-17 | 11:10 | Water | R | R | R | R | R | R | R | R | R | | | 6 | |
| | | | | | <div style="background-color: black; color: white; padding: 10px; border-radius: 10px; display: inline-block;"> Short Holding Time <i>Rush Processing</i> </div> | | | | | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | -2.0! | | | | | 26.0, 9.1, 3.2, 0.4 | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-02-08 8:30 | | Time: | | Received by: EHF | | Date: 8 Feb 2017 | | Time: 15:25 | | Received by: Shayon | | Date: Feb 10 | | Time: 11am | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 15-FEB-17
Report Date: 27-FEB-17 15:54 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1891149
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-02-15 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1891149-1 Water 13-FEB-17 09:40 UG1 | L1891149-2 Water 14-FEB-17 11:45 W15 | L1891149-3 Water 14-FEB-17 13:30 W3 | L1891149-4 Water 14-FEB-17 13:40 W17 | L1891149-5 Water 14-FEB-17 13:55 W8A | |
|---|--|--|---|--|--|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 2480 | 1960 | 537 | 526 | 1610 |
| | Hardness (as CaCO3) (mg/L) | 1270 | 1050 | 256 | 254 | 853 |
| | pH (pH) | 8.06 | 7.92 | 8.24 | 8.28 | 7.60 |
| | Total Suspended Solids (mg/L) | 21.5 | 6.1 | <3.0 | <3.0 | 46.3 |
| | Total Dissolved Solids (mg/L) | 2050 | 1520 | 340 | 340 | 1170 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 237 | 583 | 247 | 231 | 833 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 237 | 583 | 247 | 231 | 833 |
| | Ammonia, Total (as N) (mg/L) | 32.2 | 1.03 | <0.0050 | <0.0050 | 0.422 |
| | Chloride (Cl) (mg/L) | <10 ^{DLDS} | 26 | 5.04 | 6.67 | 20.0 |
| | Nitrate and Nitrite (as N) (mg/L) | 61.1 | 59.0 | 0.276 | 0.342 | 0.273 |
| | Nitrate (as N) (mg/L) | 59.6 | 58.8 | 0.274 | 0.342 | 0.194 |
| | Nitrite (as N) (mg/L) | 1.58 | 0.195 | 0.0019 | <0.0010 ^{HTD} | 0.079 |
| | Sulfate (SO4) (mg/L) | 1080 | 398 | 58.6 | 55.7 | 203 |
| | Anion Sum (meq/L) | 31.6 | 24.9 | 6.31 | 5.98 | 21.5 |
| | Cation Sum (meq/L) | 30.8 | 23.2 | 5.99 | 5.89 | 19.7 |
| | Cation - Anion Balance (%) | -1.2 | -3.6 | -2.6 | -0.8 | -4.4 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 2.12 | 18.5 | 5.10 | 8.31 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.468 | 0.0257 ^{DLA} | 0.0338 | 0.0062 | 0.0806 |
| | Antimony (Sb)-Total (mg/L) | 0.00075 | <0.00020 ^{DLA} | 0.00017 | 0.00010 | 0.00038 |
| | Arsenic (As)-Total (mg/L) | 0.00117 | 0.00058 | 0.00033 | 0.00039 | 0.00094 |
| | Barium (Ba)-Total (mg/L) | 0.0412 | 0.369 | 0.0787 | 0.0817 | 0.259 |
| | Beryllium (Be)-Total (mg/L) | <0.000040 ^{DLA} | <0.000040 ^{DLA} | <0.000020 | <0.000020 | 0.000032 |
| | Bismuth (Bi)-Total (mg/L) | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.708 | 0.033 | 0.024 | 0.032 | 0.039 |
| | Cadmium (Cd)-Total (mg/L) | 0.000394 | 0.000068 | 0.0000130 | 0.0000081 | 0.000316 |
| | Calcium (Ca)-Total (mg/L) | 429 | 300 | 56.7 | 67.5 | 239 |
| | Chromium (Cr)-Total (mg/L) | 0.00032 | 0.00024 | 0.00013 | 0.00011 | 0.00161 |
| | Cobalt (Co)-Total (mg/L) | 0.00279 | 0.00156 | 0.00012 | <0.00010 | 0.00422 |
| | Copper (Cu)-Total (mg/L) | 0.0963 | 0.0471 | 0.0108 | 0.00616 | 0.144 |
| | Iron (Fe)-Total (mg/L) | 1.01 | 0.337 | 0.106 | <0.010 | 4.07 |
| | Lead (Pb)-Total (mg/L) | 0.00243 | <0.00010 ^{DLA} | <0.000050 | <0.000050 | 0.000122 |
| | Lithium (Li)-Total (mg/L) | 0.0098 | 0.0038 | 0.0030 | 0.0014 | 0.0052 |
| | Magnesium (Mg)-Total (mg/L) | 49.1 | 81.6 | 27.1 | 20.2 | 75.8 |
| | Manganese (Mn)-Total (mg/L) | 0.181 | 3.06 | 0.163 | 0.104 | 9.90 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1891149-1 | L1891149-2 | L1891149-3 | L1891149-4 | L1891149-5 |
|-------------------------|---------------------------------------|--------------------------|--------------------------|------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 13-FEB-17 | 09:40 | UG1 | 13-FEB-17 | 14-FEB-17 | 14-FEB-17 | 14-FEB-17 | 14-FEB-17 |
| | | | | | 09:40 | 11:45 | 13:30 | 13:40 | 13:55 |
| | | | | | UG1 | W15 | W3 | W17 | W8A |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000068 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.0201 | 0.00699 | 0.00443 | 0.00604 | 0.0134 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.0063 | 0.0021 | 0.00091 | 0.00084 | 0.00215 | | | |
| | Phosphorus (P)-Total (mg/L) | 0.31 | <0.10 ^{DLA} | <0.050 | <0.050 | 0.098 | | | |
| | Potassium (K)-Total (mg/L) | 11.2 | 11.8 | 2.57 | 3.96 | 9.37 | | | |
| | Selenium (Se)-Total (mg/L) | 0.00083 | 0.0121 | 0.000313 | 0.000324 | 0.00148 | | | |
| | Silicon (Si)-Total (mg/L) | 8.73 | 13.4 | 6.71 | 5.67 | 10.6 | | | |
| | Silver (Ag)-Total (mg/L) | 0.000028 | <0.000020 ^{DLA} | <0.000010 | <0.000010 | 0.000049 | | | |
| | Sodium (Na)-Total (mg/L) | 62.1 | 40.1 | 17.9 | 15.7 | 56.2 | | | |
| | Strontium (Sr)-Total (mg/L) | 9.90 | 3.32 | 0.746 | 0.794 | 3.56 | | | |
| | Sulfur (S)-Total (mg/L) | 412 | 146 | 21.3 | 20.5 | 78.3 | | | |
| | Thallium (Tl)-Total (mg/L) | 0.000023 | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.0257 | 0.00136 | 0.00189 | <0.00030 | 0.00499 | | | |
| | Uranium (U)-Total (mg/L) | 0.0128 | 0.00659 | 0.00267 | 0.00262 | 0.00453 | | | |
| | Vanadium (V)-Total (mg/L) | 0.0022 | <0.0010 ^{DLA} | <0.00050 | <0.00050 | 0.00419 | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0198 | 0.0265 | 0.0037 | <0.0030 | 0.212 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00060 ^{DLA} | <0.00060 ^{DLA} | <0.00030 | <0.00030 | 0.00111 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0089 | 0.0040 | 0.0027 | 0.0023 | 0.0061 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00075 | <0.00020 ^{DLA} | <0.00010 | <0.00010 | 0.00018 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00118 | 0.00044 | 0.00025 | 0.00035 | 0.00063 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0346 | 0.351 | 0.0811 | 0.0842 | 0.204 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000040 ^{DLA} | <0.000040 ^{DLA} | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.677 | 0.026 | 0.022 | 0.030 | 0.038 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000379 | 0.000068 | 0.0000132 | 0.0000061 | 0.000198 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 420 | 293 | 56.6 | 67.1 | 237 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | <0.00010 | 0.00072 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00232 | 0.00147 | 0.00010 | <0.00010 | 0.00341 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0198 | 0.0378 | 0.00893 | 0.00568 | 0.0311 | | | |
| | Iron (Fe)-Dissolved (mg/L) | <0.020 ^{DLA} | 0.056 | 0.048 | <0.010 | 0.443 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0090 | 0.0038 | 0.0032 | 0.0014 | 0.0053 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 52.9 | 78.0 | 27.8 | 21.1 | 63.3 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.164 | 2.90 | 0.158 | 0.0776 | 8.14 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1891149-1 | L1891149-2 | L1891149-3 | L1891149-4 | L1891149-5 |
|-------------------------|----------------------------------|--------------------------|--------------------------|------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | | | | 13-FEB-17 | 14-FEB-17 | 14-FEB-17 | 14-FEB-17 | 14-FEB-17 |
| | | | | | 09:40 | 11:45 | 13:30 | 13:40 | 13:55 |
| | | | | | UG1 | W15 | W3 | W17 | W8A |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0199 | 0.00668 | 0.00410 | 0.00553 | 0.0122 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0056 | 0.0017 | 0.00106 | 0.00081 | 0.00164 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | 0.33 | <0.10 ^{DLA} | <0.050 | <0.050 | 0.058 | | | |
| | Potassium (K)-Dissolved (mg/L) | 12.0 | 11.3 | 2.64 | 4.09 | 7.92 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00087 | 0.0115 | 0.000319 | 0.000344 | 0.00160 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 7.73 | 12.8 | 6.57 | 5.48 | 10.2 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | 0.000011 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 67.0 | 38.3 | 18.4 | 16.2 | 47.3 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 9.75 | 3.19 | 0.725 | 0.781 | 3.48 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 411 | 140 | 20.6 | 20.4 | 74.7 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLA} | <0.00060 ^{DLA} | <0.00030 | <0.00030 | 0.00074 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.0124 | 0.00635 | 0.00253 | 0.00251 | 0.00430 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 ^{DLA} | <0.0010 ^{DLA} | <0.00050 | <0.00050 | 0.00143 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0118 | 0.0230 | 0.0030 | <0.0010 | 0.147 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00060 ^{DLA} | <0.00060 ^{DLA} | <0.00030 | <0.00030 | 0.00112 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1891149-1, -2, -3, -4 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1891149-1, -2, -3, -4 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1891149-1, -2, -3, -4 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1891149-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1891149-1, -2, -3, -4, -5 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLA | Detection Limit adjusted for required dilution |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| HTD | Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |

Reference Information

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = $\frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

Reference Information

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-02-15 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L1891149-COFC

COC Number: 2017-02-15 A

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| | | | | | | | | | | | | | | | | | | |
|--|---|--|------------------|--|---|------------------------------|--|--|--|-------------------------|---|---------------------------|--------------------------------|--|--|--|--|----------------------|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | Emergency | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | Analysis Request | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | |
| PO / AFE: | 224162 (WUL) | Requisitioner: | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Shane Stack | Sampler: | SR | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | | | Number of Containers |
| | UG1 | 13-Feb-17 | 9:40 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| | W15 | 14-Feb-17 | 11:45 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| | W3 | 14-Feb-17 | 13:30 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| | W17 | 14-Feb-17 | 13:40 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| | WBA | 14-Feb-17 | 13:55 | Water | R | R | R | R | R | R | R | R | R | | | | | 6 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | 3.0 | | | | | | 4 | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | |
| Released by: Shaun Roberts | Date: 2017-02-15 | Time: 10:00 | Received by: EHF | Date: 15 Feb 2017 | Time: 15:53 | Received by: JC | Date: FEB 16 2017 | Time: 13:35 | | | | | | | | | | |

Short Holding Time
Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 22-FEB-17
Report Date: 03-MAR-17 16:59 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1893598
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-02-22 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1893598-1 | L1893598-2 | L1893598-3 |
|-----------------------------|---|---------------------------------|-------------------------|-------------------------|--------------------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 21-FEB-17 | 21-FEB-17 | 21-FEB-17 |
| | | Sampled Time | 14:00 | 14:35 | 14:50 |
| | | Client ID | W3 | W17 | W8A |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 544 | 534 | 1600 |
| | Hardness (as CaCO3) (mg/L) | | 260 | 259 | 927 |
| | pH (pH) | | 8.16 | 8.27 | 7.92 |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | 104 |
| | Total Dissolved Solids (mg/L) | | 322 | 331 | 1140 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 243 | 235 | 817 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 243 | 235 | 817 |
| | Ammonia, Total (as N) (mg/L) | | 0.0189 | <0.0050 | 0.439 |
| | Chloride (Cl) (mg/L) | | 4.84 | 6.66 | 18.3 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.256 | 0.293 | 0.203 |
| | Nitrate (as N) (mg/L) | | 0.256 | 0.293 | 0.131 |
| | Nitrite (as N) (mg/L) | | <0.0010 ^{HTD} | <0.0010 | 0.0718 |
| | Sulfate (SO4) (mg/L) | | 57.7 | 56.1 | 204 |
| | Anion Sum (meq/L) | | 6.22 | 6.06 | 21.1 |
| | Cation Sum (meq/L) | | 6.10 | 6.00 | 22.0 |
| | Cation - Anion Balance (%) | | -1.0 | -0.6 | 2.0 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 5.05 | 8.46 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0105 | 0.0057 | 0.0855 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | 0.00011 | 0.00072 |
| | Arsenic (As)-Total (mg/L) | | 0.00023 | 0.00032 | 0.00101 |
| | Barium (Ba)-Total (mg/L) | | 0.0817 | 0.0809 | 0.279 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | <0.000040 ^{DLA} |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.00010 ^{DLA} |
| | Boron (B)-Total (mg/L) | | 0.023 | 0.031 | 0.038 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000140 | 0.0000067 | 0.000293 |
| | Calcium (Ca)-Total (mg/L) | | 58.1 | 68.8 | 247 |
| | Chromium (Cr)-Total (mg/L) | | <0.00020 ^{DLB} | <0.00020 ^{DLB} | 0.00178 |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | <0.00010 | 0.00527 |
| | Copper (Cu)-Total (mg/L) | | 0.00389 | 0.00671 | 0.174 |
| | Iron (Fe)-Total (mg/L) | | 0.054 | <0.010 | 7.21 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | 0.000056 | 0.00017 |
| | Lithium (Li)-Total (mg/L) | | 0.0033 | 0.0015 | 0.0051 |
| | Magnesium (Mg)-Total (mg/L) | | 28.9 | 21.7 | 79.6 |
| | Manganese (Mn)-Total (mg/L) | | 0.138 | 0.0836 | 11.4 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1893598-1 Water 21-FEB-17 14:00 W3 | L1893598-2 Water 21-FEB-17 14:35 W17 | L1893598-3 Water 21-FEB-17 14:50 W8A | |
|-------------------------|---|---|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | 0.0000089 | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00440 | 0.00610 | 0.0156 | |
| | Nickel (Ni)-Total (mg/L) | 0.00085 | 0.00087 | 0.0023 | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | 0.13 | |
| | Potassium (K)-Total (mg/L) | 2.48 | 3.93 | 9.31 | |
| | Selenium (Se)-Total (mg/L) | 0.000265 | 0.000371 | 0.00147 | |
| | Silicon (Si)-Total (mg/L) | 6.79 | 5.77 | 10.7 | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000057 | |
| | Sodium (Na)-Total (mg/L) | 19.1 | 16.8 | 58.6 | |
| | Strontium (Sr)-Total (mg/L) | 0.748 | 0.795 | 3.62 | |
| | Sulfur (S)-Total (mg/L) | 21.4 | 21.0 | 78.4 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000020 ^{DLA} | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00020 ^{DLA} | |
| | Titanium (Ti)-Total (mg/L) | 0.00039 | <0.00030 | 0.00505 | |
| | Uranium (U)-Total (mg/L) | 0.00265 | 0.00270 | 0.00451 | |
| | Vanadium (V)-Total (mg/L) | <0.00050 | <0.00050 | 0.0056 | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | 0.339 | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | 0.00127 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0011 | 0.0017 | 0.0103 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00020 ^{DLA} | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00022 | 0.00031 | 0.00082 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0793 | 0.0807 | 0.267 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000040 ^{DLA} | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.00010 ^{DLA} | |
| | Boron (B)-Dissolved (mg/L) | 0.021 | 0.029 | 0.036 | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000100 | 0.0000060 | 0.000157 | |
| | Calcium (Ca)-Dissolved (mg/L) | 56.7 | 67.9 | 241 | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00111 | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00510 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00253 | 0.00574 | 0.0424 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.037 | <0.010 | 4.09 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.00010 ^{DLA} | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0032 | 0.0016 | 0.0050 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 28.8 | 21.6 | 78.8 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.134 | 0.0691 | 11.0 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | L1893598-1 | L1893598-2 | L1893598-3 | | |
|-------------------------|----------------------------------|------------|------------|--------------------------|--|--|
| | | Water | Water | Water | | |
| | | 21-FEB-17 | 21-FEB-17 | 21-FEB-17 | | |
| | | 14:00 | 14:35 | 14:50 | | |
| | | W3 | W17 | W8A | | |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00381 | 0.00562 | 0.0140 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00079 | 0.00080 | 0.0021 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.10 ^{DLA} | | |
| | Potassium (K)-Dissolved (mg/L) | 2.42 | 3.89 | 9.24 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000268 | 0.000387 | 0.00172 | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.68 | 5.72 | 10.4 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000020 ^{DLA} | | |
| | Sodium (Na)-Dissolved (mg/L) | 19.0 | 16.7 | 58.1 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.716 | 0.771 | 3.46 | | |
| | Sulfur (S)-Dissolved (mg/L) | 21.0 | 20.5 | 74.8 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000020 ^{DLA} | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00020 ^{DLA} | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00105 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00246 | 0.00252 | 0.00423 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.0033 | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | 0.279 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00127 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|----------------------|-----------|-----------------------------|
| Method Blank | Chromium (Cr)-Total | MB-LOR | L1893598-1, -2, -3 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1893598-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1893598-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1893598-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1893598-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1893598-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1893598-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1893598-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLA | Detection Limit adjusted for required dilution |
| DLB | Detection Limit Raised. Analyte detected at comparable level in Method Blank. |
| HTD | Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| <p>Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.</p> <p>Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:</p> <p style="margin-left: 20px;">Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]</p> | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| <p>Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| <p>Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| <p>This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.</p> | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| <p>This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.</p> | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| <p>This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode</p> <p>It is recommended that this analysis be conducted in the field.</p> | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| <p>This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode</p> <p>It is recommended that this analysis be conducted in the field.</p> | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| TDS-VA | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |
| <p>This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.</p> | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| <p>This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Reference Information

Chain of Custody Numbers:

2017-02-22 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1893598-COFC

COC Number: 2017-02-22 B

Page of

www.alsglobal.com

| | | | | | | | | | | | | | | | | | |
|--|---|--|--|---|--|-----------------|---|---|------------------------------|------------------------------|--|-------------------------|--|---------------------------|--------------------------------|----------------------|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Day) | | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | | | 1 Business day [E1] <input type="checkbox"/> | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | 3 day [P3] <input type="checkbox"/> | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: _____ | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | | |
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 224162 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: SR | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (1) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | |
| W3 | | | | 21-Feb-17 | 14:00 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| W17 | | | | 21-Feb-17 | 14:35 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| W8A | | | | 21-Feb-17 | 14:50 | Water | R | R | R | R | R | R | R | R | R | 6 | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | 2.0°C | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-02-22 | | Time: 11:00 | | Received by: JD | | Date: Feb 22 / 17 | | Time: 14:55 | | Received by: | | Date: | | Time: | |

Short Holding Time
Rush Processing

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCT02R 2016 FROST

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 01-MAR-17
Report Date: 10-MAR-17 18:27 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1896303
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-03-01 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

10-MAR-17 18:27 (MT)

Version: FINAL

| Sample ID Description Sampled Date Sampled Time Client ID | | L1896303-1 Water 28-FEB-17 09:40 W3 | L1896303-2 Water 28-FEB-17 10:00 W17 | L1896303-3 Water 28-FEB-17 10:45 W8A | L1896303-4 Water 28-FEB-17 DUP |
|---|---|---|--|--|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 541 | 531 | 1650 | 544 |
| | Hardness (as CaCO3) (mg/L) | 258 | 256 | 879 | 261 |
| | pH (pH) | 8.10 | 8.22 | 7.60 | 8.11 |
| | Total Suspended Solids (mg/L) | 3.0 | <3.0 | 90.9 | 3.1 |
| | Total Dissolved Solids (mg/L) | 335 | 350 | 1220 | 335 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 237 | 230 | 841 | 241 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 237 | 230 | 841 | 241 |
| | Ammonia, Total (as N) (mg/L) | 0.0213 | <0.0050 | 0.450 | 0.0222 |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.50 ^{DLDS} | <0.050 |
| | Chloride (Cl) (mg/L) | 4.84 | 6.80 | 18.7 | 4.85 |
| | Fluoride (F) (mg/L) | 0.540 | 0.361 | 0.54 | 0.539 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.295 | 0.261 | 0.263 | 0.293 |
| | Nitrate (as N) (mg/L) | 0.295 | 0.261 | 0.212 | 0.293 |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | 0.051 | <0.0010 |
| | Sulfate (SO4) (mg/L) | 58.2 | 57.2 | 197 | 58.3 |
| | Anion Sum (meq/L) | 6.14 | 6.02 | 21.5 | 6.21 |
| | Cation Sum (meq/L) | 6.03 | 5.94 | 20.7 | 6.07 |
| | Cation - Anion Balance (%) | -0.9 | -0.7 | -1.9 | -1.1 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 4.75 | 8.48 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0983 | 0.0070 | 0.120 | 0.0799 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00010 | 0.00043 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00030 | 0.00034 | 0.00107 | 0.00027 |
| | Barium (Ba)-Total (mg/L) | 0.0791 | 0.0792 | 0.298 | 0.0778 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000040 ^{DLA} | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.023 | 0.030 | 0.037 | 0.023 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000129 | 0.0000091 | 0.000261 | 0.0000216 |
| | Calcium (Ca)-Total (mg/L) | 56.7 | 68.2 | 230 | 55.1 |
| | Chromium (Cr)-Total (mg/L) | 0.00023 | 0.00019 | 0.00169 | 0.00024 |
| | Cobalt (Co)-Total (mg/L) | 0.00015 | <0.00010 | 0.00656 | 0.00014 |
| | Copper (Cu)-Total (mg/L) | 0.00358 | 0.00588 | 0.171 | 0.00371 |
| | Iron (Fe)-Total (mg/L) | 0.179 | <0.010 | 8.43 | 0.151 |
| | Lead (Pb)-Total (mg/L) | 0.000061 | <0.000050 | 0.00016 | 0.000055 |
| | Lithium (Li)-Total (mg/L) | 0.0034 | 0.0019 | 0.0051 | 0.0038 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1896303-1 | L1896303-2 | L1896303-3 | L1896303-4 |
|-------------------------|---------------------------------------|--------------|------------|------------|--------------------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 28-FEB-17 | 28-FEB-17 | 28-FEB-17 | 28-FEB-17 |
| | | Sampled Time | 09:40 | 10:00 | 10:45 | |
| | | Client ID | W3 | W17 | W8A | DUP |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Magnesium (Mg)-Total (mg/L) | | 30.0 | 22.4 | 77.9 | 29.6 |
| | Manganese (Mn)-Total (mg/L) | | 0.164 | 0.0825 | 12.3 | 0.161 |
| | Mercury (Hg)-Total (mg/L) | | <0.0000050 | <0.0000050 | 0.0000077 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | | 0.00477 | 0.00640 | 0.0186 | 0.00481 |
| | Nickel (Ni)-Total (mg/L) | | 0.00102 | 0.00085 | 0.0022 | 0.00100 |
| | Phosphorus (P)-Total (mg/L) | | <0.050 | <0.050 | 0.12 | <0.050 |
| | Potassium (K)-Total (mg/L) | | 2.23 | 3.86 | 9.04 | 2.23 |
| | Selenium (Se)-Total (mg/L) | | 0.000299 | 0.000358 | 0.00140 | 0.000351 |
| | Silicon (Si)-Total (mg/L) | | 6.25 | 5.36 | 9.97 | 6.47 |
| | Silver (Ag)-Total (mg/L) | | <0.000010 | <0.000010 | 0.000059 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | | 18.7 | 16.9 | 57.1 | 19.2 |
| | Strontium (Sr)-Total (mg/L) | | 0.800 | 0.860 | 3.95 | 0.831 |
| | Sulfur (S)-Total (mg/L) | | 19.8 | 19.9 | 69.2 | 20.5 |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000010 |
| | Tin (Sn)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00020 ^{DLA} | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | | 0.00382 | <0.00030 | 0.00604 | 0.00266 |
| | Uranium (U)-Total (mg/L) | | 0.00276 | 0.00271 | 0.00423 | 0.00274 |
| | Vanadium (V)-Total (mg/L) | | 0.00071 | <0.00050 | 0.0062 | 0.00065 |
| | Zinc (Zn)-Total (mg/L) | | <0.0030 | <0.0030 | 0.255 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | | <0.00030 | <0.00030 | 0.00145 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0019 | 0.0021 | 0.0079 | 0.0023 |
| | Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00020 ^{DLA} | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00024 | 0.00031 | 0.00085 | 0.00023 |
| | Barium (Ba)-Dissolved (mg/L) | | 0.0743 | 0.0771 | 0.253 | 0.0729 |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000040 ^{DLA} | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | 0.021 | 0.029 | 0.035 | 0.023 |
| | Cadmium (Cd)-Dissolved (mg/L) | | 0.0000098 | 0.0000080 | 0.000148 | 0.0000109 |
| | Calcium (Ca)-Dissolved (mg/L) | | 55.1 | 66.7 | 226 | 56.6 |
| | Chromium (Cr)-Dissolved (mg/L) | | <0.00010 | <0.00010 | 0.00089 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | 0.00620 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00175 | 0.00541 | 0.0278 | 0.00202 |
| | Iron (Fe)-Dissolved (mg/L) | | 0.030 | <0.010 | 1.53 | 0.032 |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | | 0.0029 | 0.0015 | 0.0042 | 0.0031 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1896303-1 | L1896303-2 | L1896303-3 | L1896303-4 |
|-------------------------|----------------------------------|--------------|--------------|--------------------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water |
| | | 28-FEB-17 | 09:40 | W3 | 28-FEB-17 | 10:00 | 28-FEB-17 | 28-FEB-17 |
| | | | | | W3 | W17 | W8A | DUP |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Dissolved Metals | Magnesium (Mg)-Dissolved (mg/L) | 29.3 | 21.8 | 76.6 | 29.0 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.138 | 0.0613 | 11.7 | 0.139 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00456 | 0.00614 | 0.0172 | 0.00452 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00079 | 0.00076 | 0.0019 | 0.00076 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.10 ^{DLA} | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.18 | 3.77 | 8.77 | 2.16 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000313 | 0.000379 | 0.00165 | 0.000317 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.17 | 5.31 | 9.61 | 5.95 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 18.5 | 16.4 | 53.9 | 18.3 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.803 | 0.829 | 3.73 | 0.806 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 19.7 | 19.3 | 69.0 | 19.3 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00020 ^{DLA} | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00096 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00267 | 0.00255 | 0.00410 | 0.00261 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.0022 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | 0.175 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00133 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|---------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1896303-1, -2, -3, -4 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1896303-1, -2, -3, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| F-IC-N-VA | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-VA | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-03-01 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 08-MAR-17
Report Date: 22-MAR-17 16:55 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1898839
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-03-08A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1898839-1 WATER 06-MAR-17 14:15 W62 | L1898839-2 WATER 06-MAR-17 16:25 W14 | L1898839-3 WATER 06-MAR-17 16:30 W12 | L1898839-4 WATER 07-MAR-17 13:55 W3 | L1898839-5 WATER 07-MAR-17 14:10 W17 | |
|---|--|--|--|---|--|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 1060 | 3100 | 2270 | 537 | 540 |
| | Hardness (as CaCO3) (mg/L) | 572 | 1590 | 1080 | 275 | 278 |
| | pH (pH) | 8.28 | 8.16 | 7.90 | 8.14 | 8.26 |
| | Total Suspended Solids (mg/L) | <3.0 | | 3.5 | <3.0 | <3.0 |
| | Total Dissolved Solids (mg/L) | 779 | 2810 | 1910 | 323 | 356 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 349 | 83.8 | 166 | 242 | 237 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 349 | 83.8 | 166 | 242 | 237 |
| | Ammonia, Total (as N) (mg/L) | 0.0092 | 9.69 | 6.94 | 0.0167 | <0.0050 |
| | Chloride (Cl) (mg/L) | 27.6 | 39 | 35 | 4.78 | 6.81 |
| | Nitrate and Nitrite (as N) (mg/L) | 5.54 | 47.4 | 29.0 | 0.321 | 0.212 |
| | Nitrate (as N) (mg/L) | 5.49 | 45.4 | 27.2 | 0.321 | 0.212 |
| | Nitrite (as N) (mg/L) | 0.0532 | 2.06 | 1.84 | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | 234 | 1690 | 1090 | 58.1 | 57.7 |
| | Anion Sum (meq/L) | 13.0 | 41.4 | 29.1 | 6.21 | 6.14 |
| | Cation Sum (meq/L) | 12.9 | 42.8 | 29.1 | 6.42 | 6.41 |
| | Cation - Anion Balance (%) | -0.3 | 1.7 | 0.1 | 1.6 | 2.2 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | | | 4.04 | 7.90 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0129 | | 0.0584 | 0.0460 | 0.0150 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | | 0.00048 | 0.00011 | 0.00014 |
| | Arsenic (As)-Total (mg/L) | 0.00035 | | 0.00049 | 0.00024 | 0.00034 |
| | Barium (Ba)-Total (mg/L) | 0.133 | | 0.107 | 0.0741 | 0.0781 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | | <0.000040 ^{DLA} | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | | <0.00010 ^{DLA} | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.033 | | 0.249 | 0.028 | 0.032 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000188 | | <0.00010 ^{DLM} | 0.0000130 | 0.0000129 |
| | Calcium (Ca)-Total (mg/L) | 159 | | 335 | 53.8 | 67.9 |
| | Chromium (Cr)-Total (mg/L) | 0.00022 | | <0.00020 ^{DLA} | 0.00016 | 0.00013 |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | | 0.00072 | 0.00012 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | 0.0485 | | 0.0561 | 0.00290 | 0.00815 |
| | Iron (Fe)-Total (mg/L) | 0.055 | | 0.108 | 0.101 | 0.021 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | | 0.00039 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0025 | | 0.0123 | 0.0034 | 0.0017 |
| | Magnesium (Mg)-Total (mg/L) | 38.4 | | 42.4 | 30.0 | 22.1 |
| | Manganese (Mn)-Total (mg/L) | 0.0295 | | 0.513 | 0.151 | 0.184 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1898839-6 | L1898839-7 | L1898839-8 | | |
|-----------------------------------|---|--------------------------|--------------|------------------------|------------|------------|------------|-------|--|
| | | | | | WATER | WATER | WATER | | |
| | | 07-MAR-17 | 14:40 | W45 | 07-MAR-17 | 14:50 | 07-MAR-17 | 14:40 | |
| | | | | | W45 | W8A | F-BL | | |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 2910 | 1650 | <2.0 | | | | | |
| | Hardness (as CaCO3) (mg/L) | 1500 | 1010 | <0.50 | | | | | |
| | pH (pH) | 7.91 | 7.80 | 5.40 | | | | | |
| | Total Suspended Solids (mg/L) | 20.7 | 46.7 | <3.0 | | | | | |
| | Total Dissolved Solids (mg/L) | 2340 | 1290 | <10 | | | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 129 | 864 | <1.0 | | | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | | | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | | | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 129 | 864 | <1.0 | | | | | |
| | Ammonia, Total (as N) (mg/L) | 9.02 | 0.461 | <0.0050 | | | | | |
| | Chloride (Cl) (mg/L) | 36 | 18.2 | <0.50 | | | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 33.9 | 0.236 | <0.0051 | | | | | |
| | Nitrate (as N) (mg/L) | 33.4 | 0.194 | <0.0050 | | | | | |
| | Nitrite (as N) (mg/L) | 0.433 | 0.0419 | <0.0010 | | | | | |
| | Sulfate (SO4) (mg/L) | 1570 | 186 | <0.30 | | | | | |
| | Anion Sum (meq/L) | 38.6 | 21.7 | <0.10 | | | | | |
| | Cation Sum (meq/L) | 39.1 | 24.0 | <0.10 | | | | | |
| | Cation - Anion Balance (%) | 0.6 | 5.2 | 0.0 | | | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | | | | | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.248 | 0.231 | 0.0031 ^{RRV} | | | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00065 | 0.00036 | <0.00010 | | | | | |
| | Arsenic (As)-Total (mg/L) | 0.00056 | 0.00124 | <0.00010 | | | | | |
| | Barium (Ba)-Total (mg/L) | 0.162 | 0.315 | 0.000051 | | | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000040 ^{DLA} | 0.000037 | <0.000020 | | | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.00010 ^{DLA} | <0.000050 | <0.000050 | | | | | |
| | Boron (B)-Total (mg/L) | 0.316 | 0.040 | <0.010 | | | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.00012 ^{DLM} | 0.000233 | <0.000050 | | | | | |
| | Calcium (Ca)-Total (mg/L) | 485 | 248 | <0.050 | | | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00026 | 0.00181 | <0.00010 | | | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00151 | 0.00635 | <0.00010 | | | | | |
| | Copper (Cu)-Total (mg/L) | 0.0582 | 0.215 | 0.00121 ^{RRV} | | | | | |
| | Iron (Fe)-Total (mg/L) | 0.480 | 8.47 | <0.010 | | | | | |
| | Lead (Pb)-Total (mg/L) | 0.00040 | 0.000217 | <0.000050 | | | | | |
| | Lithium (Li)-Total (mg/L) | 0.0183 | 0.0047 | <0.0010 | | | | | |
| | Magnesium (Mg)-Total (mg/L) | 45.3 | 73.6 | <0.10 | | | | | |
| | Manganese (Mn)-Total (mg/L) | 1.35 | 11.1 | 0.00012 ^{RRV} | | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1898839-1 WATER 06-MAR-17 14:15 W62 | L1898839-2 WATER 06-MAR-17 16:25 W14 | L1898839-3 WATER 06-MAR-17 16:30 W12 | L1898839-4 WATER 07-MAR-17 13:55 W3 | L1898839-5 WATER 07-MAR-17 14:10 W17 |
|---|---------------------------------------|--|--|--|---|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00703 | | 0.0860 | 0.00452 | 0.00625 |
| | Nickel (Ni)-Total (mg/L) | 0.00105 | | 0.0031 | 0.00093 | 0.00092 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | | <0.10 ^{DLA} | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 6.03 | | 46.4 | 2.17 | 3.81 |
| | Selenium (Se)-Total (mg/L) | 0.00234 | | 0.0129 | 0.000288 | 0.000343 |
| | Silicon (Si)-Total (mg/L) | 7.75 | | 2.97 | 6.22 | 5.22 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | <0.000020 ^{DLA} | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 29.8 | | 130 | 19.1 | 16.7 |
| | Strontium (Sr)-Total (mg/L) | 1.60 | | 7.37 | 0.827 | 0.887 |
| | Sulfur (S)-Total (mg/L) | 88.2 | | 344 | 19.4 | 18.3 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | <0.000020 ^{DLA} | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | | <0.00020 ^{DLA} | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.00062 | | 0.00273 | 0.00230 | 0.00038 |
| | Uranium (U)-Total (mg/L) | 0.00521 | | 0.00427 | 0.00261 | 0.00252 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | | <0.0010 ^{DLA} | 0.00057 | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | 0.153 | | <0.0060 ^{DLA} | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | | <0.00060 ^{DLA} | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0025 | 0.0236 | 0.0065 | 0.0020 | 0.0019 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00046 | 0.00035 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00035 | 0.00037 | 0.00042 | 0.00027 | 0.00036 |
| | Barium (Ba)-Dissolved (mg/L) | 0.140 | 0.278 | 0.117 | 0.0820 | 0.0837 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000040 ^{DLA} | <0.000040 ^{DLA} | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.029 | 0.256 | 0.223 | 0.023 | 0.030 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000164 | 0.000028 | <0.000050 ^{DLM} | 0.0000100 | 0.0000104 |
| | Calcium (Ca)-Dissolved (mg/L) | 163 | 555 | 366 | 57.7 | 74.2 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00015 | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00077 | 0.00064 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0459 | 0.00175 | 0.0260 | 0.00182 | 0.00593 |
| | Iron (Fe)-Dissolved (mg/L) | 0.021 | <0.020 ^{DLA} | 0.031 | 0.026 | <0.010 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | 0.00015 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0032 | 0.0280 | 0.0124 | 0.0036 | 0.0022 |
| | Magnesium (Mg)-Dissolved (mg/L) | 40.3 | 50.4 | 41.0 | 31.8 | 22.5 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0302 | 1.64 | 0.472 | 0.146 | 0.0783 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1898839-6 WATER 07-MAR-17 14:40 W45 | L1898839-7 WATER 07-MAR-17 14:50 W8A | L1898839-8 WATER 07-MAR-17 14:40 F-BL | | |
|---|---------------------------------------|--|--|---|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | 0.0000064 | <0.0000050 | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.0934 | 0.0169 | <0.000050 | | |
| | Nickel (Ni)-Total (mg/L) | 0.0057 | 0.00224 | <0.00050 | | |
| | Phosphorus (P)-Total (mg/L) | <0.10 ^{DLA} | 0.151 | <0.050 | | |
| | Potassium (K)-Total (mg/L) | 54.4 | 8.98 | <0.10 | | |
| | Selenium (Se)-Total (mg/L) | 0.0168 | 0.00134 | <0.000050 | | |
| | Silicon (Si)-Total (mg/L) | 2.71 | 11.3 | <0.050 | | |
| | Silver (Ag)-Total (mg/L) | 0.000021 | 0.000097 | <0.000010 | | |
| | Sodium (Na)-Total (mg/L) | 155 | 53.2 | <0.050 | | |
| | Strontium (Sr)-Total (mg/L) | 11.7 | 3.56 | <0.00020 | | |
| | Sulfur (S)-Total (mg/L) | 504 | 74.1 | <0.50 | | |
| | Thallium (Tl)-Total (mg/L) | <0.000020 ^{DLA} | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Total (mg/L) | <0.00020 ^{DLA} | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Total (mg/L) | 0.0104 | 0.0158 | 0.00042 | | |
| | Uranium (U)-Total (mg/L) | 0.00470 | 0.00424 | <0.000010 | | |
| | Vanadium (V)-Total (mg/L) | <0.0010 ^{DLA} | 0.00810 | <0.00050 | | |
| | Zinc (Zn)-Total (mg/L) | <0.0060 ^{DLA} | 0.196 | <0.0030 | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00060 ^{DLA} | 0.00148 | <0.00030 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0095 | 0.0168 | <0.0010 | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00039 | <0.00020 ^{DLA} | <0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00047 | 0.00142 | <0.00010 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.166 | 0.349 | <0.000050 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000040 ^{DLA} | <0.000040 ^{DLA} | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | 0.267 | 0.038 | <0.010 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000050 ^{DLM} | 0.000148 | <0.0000050 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 528 | 262 | <0.050 | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00020 ^{DLA} | 0.00151 | <0.00010 | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00136 | 0.00743 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00320 | 0.0586 | <0.00020 | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.022 | 6.92 | <0.010 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0181 | 0.0051 | <0.0010 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 44.2 | 86.1 | <0.10 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 1.19 | 12.3 | <0.00010 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1898839-1 | L1898839-2 | L1898839-3 | L1898839-4 | L1898839-5 |
|-------------------------|----------------------------------|--------------|--------------------------|--------------------------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 06-MAR-17 | 06-MAR-17 | 06-MAR-17 | 07-MAR-17 | 07-MAR-17 |
| | | | | | 14:15 | 16:25 | 16:30 | 13:55 | 14:10 |
| | | | | | W62 | W14 | W12 | W3 | W17 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00696 | 0.117 | 0.0835 | 0.00438 | 0.00617 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00093 | 0.0025 | 0.0030 | 0.00083 | 0.00082 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.10 ^{DLA} | <0.10 ^{DLA} | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 5.95 | 66.8 | 47.7 | 2.46 | 4.02 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00271 | 0.0193 | 0.0138 | 0.000332 | 0.000442 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 7.68 | 1.91 | 3.12 | 6.39 | 5.48 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000050 ^{DLM} | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 31.0 | 194 | 133 | 19.5 | 17.5 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 1.67 | 11.9 | 7.11 | 0.774 | 0.856 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 81.7 | 641 | 383 | 19.8 | 20.2 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00060 ^{DLA} | <0.00060 ^{DLA} | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00467 | 0.00686 | 0.00465 | 0.00271 | 0.00256 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.0010 ^{DLA} | <0.0010 ^{DLA} | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.160 | <0.0020 ^{DLA} | 0.0022 | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00060 ^{DLA} | <0.00060 ^{DLA} | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1898839-6 WATER 07-MAR-17 14:40 W45 | L1898839-7 WATER 07-MAR-17 14:50 W8A | L1898839-8 WATER 07-MAR-17 14:40 F-BL |
|-------------------------|---|--|--|---|
| Grouping | Analyte | | | |
| WATER | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0891 | 0.0171 | <0.000050 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0044 | 0.0024 | <0.00050 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.10 ^{DLA} | <0.10 ^{DLA} | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 55.7 | 9.80 | <0.10 |
| | Selenium (Se)-Dissolved (mg/L) | 0.0166 | 0.00158 | <0.000050 |
| | Silicon (Si)-Dissolved (mg/L) | 2.41 | 11.6 | <0.050 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 161 | 63.0 | <0.050 |
| | Strontium (Sr)-Dissolved (mg/L) | 11.0 | 3.85 | <0.00020 |
| | Sulfur (S)-Dissolved (mg/L) | 572 | 73.1 | <0.50 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLA} | 0.00149 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | 0.00495 | 0.00428 | <0.000010 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 ^{DLA} | 0.0062 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0020 ^{DLA} | 0.131 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00060 ^{DLA} | 0.00162 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1898839-4, -5 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1898839-4, -5 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1898839-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1898839-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Iron (Fe)-Dissolved | MS-B | L1898839-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1898839-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1898839-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1898839-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1898839-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1898839-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1898839-1, -7, -8 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1898839-3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1898839-1, -7, -8 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1898839-3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1898839-1, -7, -8 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1898839-1, -7, -8 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1898839-3, -4, -5, -6 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1898839-1, -7, -8 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1898839-3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1898839-1, -7, -8 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |
| RRV | Reported Result Verified By Repeat Analysis |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| $\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$ | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-VA | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-03-08A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L1898839-COFC

| | | | | | | | | |
|--|--|--|-----------------|--|--|----------------------|-----------------|---|
| Report To Contact and company name below will appear on the final report | | Report Form Confirm all E&P TATs with your AM - surcharges will apply | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDP (DIGITAL) | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: PO# | | | | | | |
| Job #: | | Major/Minor Code: Routing Code: | | | | | | |
| PO / AFE: 224162 (WUL) | | Requisitioner: | | | | | | |
| LSD: | | Location: | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Ariel McDonnell Sampler: CH/EB | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions Total Suspended Solids (TSS) Total Dissolved Solids (TDS) Total Metals (TM), Hardness Dissolved Metals (DM) (filtered and preserved) Total Mercury, Hardness Dissolved Mercury [1] (filtered + preserved) Total Nutrients (Ammonia) Dissolved Organic Carbon (DOC) | Number of Containers | | |
| 1 | W62 | 6-Mar-17 | 14:15 | Water | | | R R R R R R R R | 6 |
| 2 | W14 | 6-Mar-17 | 16:25 | Water | | | R R R R R R R R | 4 |
| 3 | W12 | 6-Mar-17 | 16:30 | Water | | | R R R R R R R R | 6 |
| 4 | W3 | 7-Mar-17 | 13:55 | Water | | | R R R R R R R R | 7 |
| 5 | W17 | 7-Mar-17 | 14:10 | Water | | | R R R R R R R R | 7 |
| 6 | W45 | 7-Mar-17 | 14:40 | Water | | | R R R R R R R R | 6 |
| 7 | W8A | 7-Mar-17 | 14:50 | Water | | | R R R R R R R R | 6 |
| 8 | F-BL | 7-Mar-17 | 14:40 | Water | | | R R R R R R R R | 6 |
| Drinking Water (DW) Sampling (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | |
| | | | | Cooling Initiated <input type="checkbox"/> | | | | |
| | | | | INITIAL COOLER TEMPERATURES °C: 2.5°C | | | | |
| | | | | FINAL COOLER TEMPERATURES °C: | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | FINAL SHIPMENT RECEPTION (lab use only) | | | | |
| Released by: Emilie Bouchard Date: 8-Mar-2017 8:30 Time: | | Received by: VO. Date: Mar 8 / 17 Time: | | Received by: Date: Time: | | | | |

Short Holding Time
Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 15-MAR-17
Report Date: 31-MAR-17 10:40 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1901651
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-03-15 A
Legal Site Desc:

Comments: Please note, the ALS Fort Collins Ra226 detailed analysis report can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1901651-1 | L1901651-2 | L1901651-3 | L1901651-4 | L1901651-5 |
|-----------------------------------|---|--------------|--------------|-----------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 13-MAR-17 | 14-MAR-17 | 14-MAR-17 | 14-MAR-17 | 14-MAR-17 |
| | | | | | 14:55 | 09:30 | 14:35 | 16:15 | 17:50 |
| | | | | | W4 | W16 | W3 | W8A | W17 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 276 | 563 | 581 | 1740 | 561 | | | |
| | Hardness (as CaCO3) (mg/L) | 136 | 265 | 281 | 858 | 249 | | | |
| | pH (pH) | 7.98 | 7.91 | 8.00 | 7.80 | 8.13 | | | |
| | Total Suspended Solids (mg/L) | <3.0 | 3.2 | <3.0 | 40.4 | 14.8 | | | |
| | Total Dissolved Solids (mg/L) | 176 | 375 | 349 | 1250 | 360 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 131 | 204 | 245 | 883 | 236 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 131 | 204 | 245 | 883 | 236 | | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.0879 | 0.0491 | 0.422 | 0.0061 | | | |
| | Chloride (Cl) (mg/L) | 0.70 | 7.23 | 5.55 | 20.2 | 7.04 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.150 | 3.91 | 0.153 | 0.673 | 0.194 | | | |
| | Nitrate (as N) (mg/L) | 0.150 | 3.89 | 0.150 | 0.635 | 0.194 | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | 0.0199 | 0.0023 | 0.038 | <0.0010 | | | |
| | Sulfate (SO4) (mg/L) | 14.0 | 71.5 | 61.1 | 201 | 58.5 | | | |
| | Anion Sum (meq/L) | 2.94 | 6.05 | 6.33 | 22.4 | 6.16 | | | |
| | Cation Sum (meq/L) | 2.92 | 6.17 | 6.61 | 20.3 | 5.76 | | | |
| | Cation - Anion Balance (%) | -0.4 | 1.0 | 2.1 | -5.1 | -3.3 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 1.84 | 11.4 | 5.63 | | 8.66 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0224 | 0.0193 | 0.0202 | 0.0890 | 0.0915 | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00011 | 0.00012 | 0.00013 | 0.00044 | 0.00025 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00044 | 0.00040 | 0.00029 | 0.00132 | 0.00039 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0913 | 0.0933 | 0.0896 | 0.310 | 0.0992 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | 0.000026 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | <0.010 | 0.037 | 0.022 | 0.036 | 0.031 | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | 0.0000136 | 0.0000258 | 0.000227 | 0.0000428 | | | |
| | Calcium (Ca)-Total (mg/L) | 44.1 | 77.5 | 66.5 | 262 | 75.3 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00019 | 0.00014 | 0.00013 | 0.00173 | 0.00021 | | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | <0.00010 | 0.00020 | 0.00644 | 0.00020 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00147 | 0.0181 | 0.00619 | 0.177 | 0.0314 | | | |
| | Iron (Fe)-Total (mg/L) | 0.047 | 0.125 | 0.084 | 7.48 | 0.136 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | 0.000147 | 0.000077 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0010 | 0.0014 | 0.0031 | 0.0045 | 0.0016 | | | |
| | Magnesium (Mg)-Total (mg/L) | 9.78 | 22.4 | 32.0 | 78.7 | 24.1 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.00311 | 0.231 | 0.398 | 12.0 | 0.663 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1901651-1 | L1901651-2 | L1901651-3 | L1901651-4 | L1901651-5 |
|-------------------------|---------------------------------------|------------------------|--------------|------------|---|--|---|--|--|
| | | | | | L1901651-1 WATER 13-MAR-17 14:55 W4 | L1901651-2 WATER 14-MAR-17 09:30 W16 | L1901651-3 WATER 14-MAR-17 14:35 W3 | L1901651-4 WATER 14-MAR-17 16:15 W8A | L1901651-5 WATER 14-MAR-17 17:50 W17 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000067 | <0.0000050 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.000885 | 0.00454 | 0.00392 | 0.0167 | 0.00565 | | | |
| | Nickel (Ni)-Total (mg/L) | <0.00050 | 0.00076 | 0.00127 | 0.00220 | 0.00134 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | 0.149 | <0.050 | | | |
| | Potassium (K)-Total (mg/L) | 1.11 | 3.87 | 2.58 | 8.60 | 4.00 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000155 | 0.00118 | 0.000137 | 0.00123 | 0.000363 | | | |
| | Silicon (Si)-Total (mg/L) | 5.26 | 4.80 | 7.00 | 10.4 | 5.64 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | 0.000054 | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 4.41 | 17.5 | 20.6 | 53.4 | 17.1 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.243 | 0.792 | 0.784 | 3.63 | 0.841 | | | |
| | Sulfur (S)-Total (mg/L) | 5.06 | 25.8 | 22.0 | 68.5 | 20.6 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.00094 | 0.00103 | 0.00098 | 0.00542 | 0.00435 | | | |
| | Uranium (U)-Total (mg/L) | 0.000751 | 0.00183 | 0.00242 | 0.00423 | 0.00275 | | | |
| | Vanadium (V)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00770 | 0.00106 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0047 | 0.0104 | 0.134 | 0.0059 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00147 | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0025 | 0.0057 | 0.0039 | 0.0129 | 0.0028 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00020 ^{DLA} | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00043 | 0.00037 | 0.00031 | 0.00117 | 0.00034 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0888 | 0.0935 | 0.0876 | 0.303 | 0.0837 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000040 ^{DLA} | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.036 | 0.022 | 0.035 | 0.029 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000168 | 0.0000267 | 0.000134 | 0.0000148 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 39.1 | 69.8 | 60.2 | 223 | 65.3 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00012 | 0.00012 | <0.00010 | 0.00120 | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00012 | 0.00019 | 0.00623 | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00819 ^{DTC} | 0.0173 | 0.00392 | 0.0371 | 0.00699 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.015 | 0.088 | 0.056 | 4.68 | <0.010 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | 0.0012 | 0.0030 | 0.0046 | 0.0020 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 9.24 | 22.0 | 31.8 | 73.2 | 21.0 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00248 | 0.226 | 0.390 | 11.1 | 0.0928 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1901651-1 | L1901651-2 | L1901651-3 | L1901651-4 | L1901651-5 |
|--------------------------------|----------------------------------|--------------|--------------|------------|---|--|---|--|--|
| | | | | | L1901651-1 WATER 13-MAR-17 14:55 W4 | L1901651-2 WATER 14-MAR-17 09:30 W16 | L1901651-3 WATER 14-MAR-17 14:35 W3 | L1901651-4 WATER 14-MAR-17 16:15 W8A | L1901651-5 WATER 14-MAR-17 17:50 W17 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000814 | 0.00415 | 0.00364 | 0.0149 | 0.00540 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | 0.00080 | 0.00132 | 0.0021 | 0.00080 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.10 ^{DLA} | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 1.10 | 3.97 | 2.67 | 8.27 | 3.76 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000165 | 0.00135 | 0.000167 | 0.00130 | 0.000415 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.28 | 4.80 | 6.91 | 9.99 ^{DLA} | 5.25 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 4.16 | 17.3 | 20.7 | 51.2 | 15.5 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.227 | 0.758 | 0.748 | 3.33 | 0.784 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 4.82 | 25.5 | 21.9 | 66.3 ^{DLA} | 19.1 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00020 ^{DLA} | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00036 | <0.00030 | 0.00118 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000716 | 0.00174 | 0.00230 | 0.00407 | 0.00240 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.0046 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0012 | 0.0045 | 0.0054 | 0.0927 | 0.0037 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00146 | <0.00030 | | | |
| Radiological Parameters | Ra-226 (Bq/L) | | | 0.070 | | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|----------------------|-----------|-----------------------------|
| Matrix Spike | Boron (B)-Total | MS-B | L1901651-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1901651-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1901651-1, -2, -3, -4, -5 |
| Matrix Spike | Silicon (Si)-Total | MS-B | L1901651-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1901651-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1901651-1, -2, -3, -4, -5 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |

Reference Information

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

RA226-MMER-FC Water Ra226 by Alpha Scint, MDC=0.01 Bq/L EPA 903.1

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| FC | ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

Reference Information

2017-03-15 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Thursday, March 30, 2017

Selam Worku
ALS Environmental
8081 Lougheed Hwy, Suite 100
Burnaby, BC V5A 1W9

Re: ALS Workorder: 1703321
Project Name:
Project Number: L1901651

Dear Ms. Worku:

One water sample was received from ALS Environmental, on 3/17/2017. The sample was scheduled for the following analysis:

Radium-226

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Shiloh J. Summy
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

| ALS Environmental – Fort Collins | |
|----------------------------------|---------------------------------|
| Accreditation Body | License or Certification Number |
| AIHA | 214884 |
| Alaska (AK) | UST-086 |
| Alaska (AK) | CO01099 |
| Arizona (AZ) | AZ0742 |
| California (CA) | 06251CA |
| Colorado (CO) | CO01099 |
| Connecticut (CT) | PH-0232 |
| Florida (FL) | E87914 |
| Idaho (ID) | CO01099 |
| Kansas (KS) | E-10381 |
| Kentucky (KY) | 90137 |
| L-A-B (DoD ELAP/ISO 170250) | L2257 |
| Louisiana (LA) | 05057 |
| Maryland (MD) | 285 |
| Missouri (MO) | 175 |
| Nebraska(NE) | NE-OS-24-13 |
| Nevada (NV) | CO000782008A |
| New York (NY) | 12036 |
| North Dakota (ND) | R-057 |
| Oklahoma (OK) | 1301 |
| Pennsylvania (PA) | 68-03116 |
| Tennessee (TN) | 2976 |
| Texas (TX) | T104704241 |
| Utah (UT) | CO01099 |
| Washington (WA) | C1280 |



1703321

Radium-226:

The sample was prepared and analyzed according to the current revision of SOP 783.

All acceptance criteria were met, with the following exception:

The requested MDC for ^{226}Ra was not met for RE170322-2MB. The activity for the sample is 5 times greater than the achieved MDC of the method blank. Results are submitted without further qualification.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1703321

Client Name: ALS Environmental

Client Project Name:

Client Project Number: L1901651

Client PO Number: L1901651

| Client Sample Number | Lab Sample Number | COC Number | Matrix | Date Collected | Time Collected |
|----------------------|-------------------|------------|--------|----------------|----------------|
| L1901651-3 | 1703321-1 | | WATER | 14-Mar-17 | |



L1901651

VANCOUVER

170332¹ SS 3/17/17

Subcontract Request Form

Subcontract To:

ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA

225 COMMERCE DRIVE
FORT COLLINS, CO 80524

NOTES: Please reference on final report and invoice: PO# L1901651
ALS requires QC data to be provided with your final results.

Please see enclosed 1 sample(s) in 1 Container(s)

Table with columns: SAMPLE NUMBER, ANALYTICAL REQUIRED, DATE SAMPLED, DUE DATE, Priority Flag. Row 1: L1901651-3 W3, Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1), 3/14/2017, 3/28/2017

Subcontract Info Contact: Walter Lin (604) 253-4188
Analysis and reporting info contact: Ariel McDonnell, B.Sc.
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9
Phone: (604) 253-4188 Email: Ariel.McDonnell@alsglobal.com

Please email confirmation of receipt to: Ariel.McDonnell@alsglobal.com

Shipped By: _____ Date Shipped: _____
Received By: [Signature] Date Received: 3/17/17 @ 0950
Verified By: _____ Date Verified: _____
Temperature: _____

Sample Integrity Issues: _____



ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

1 SS 3/17/17

Client: ALS BURNABY

Workorder No: 170332

Project Manager: XAVA SJS

Initials: JA Date: 3/17/17

| | | | |
|---|---|--------------------------------------|-------------------------------------|
| 1. Does this project require any special handling in addition to standard ALS procedures? | | YES | <input checked="" type="radio"/> NO |
| 2. Are custody seals on shipping containers intact? | <input checked="" type="radio"/> NONE | YES | NO |
| 3. Are Custody seals on sample containers intact? | <input checked="" type="radio"/> NONE | YES | NO |
| 4. Is there a COC (Chain-of-Custody) present or other representative documents? | | <input checked="" type="radio"/> YES | NO |
| 5. Are the COC and bottle labels complete and legible? | | <input checked="" type="radio"/> YES | NO |
| 6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.) | | <input checked="" type="radio"/> YES | NO |
| 7. Were airbills / shipping documents present and/or removable? | DROP OFF | <input checked="" type="radio"/> YES | NO |
| 8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles) | N/A | YES | <input checked="" type="radio"/> NO |
| 9. Are all aqueous non-preserved samples pH 4-9? | <input checked="" type="radio"/> N/A | YES | NO |
| 10. Is there sufficient sample for the requested analyses? | | <input checked="" type="radio"/> YES | NO |
| 11. Were all samples placed in the proper containers for the requested analyses? | | <input checked="" type="radio"/> YES | NO |
| 12. Are all samples within holding times for the requested analyses? | | <input checked="" type="radio"/> YES | NO |
| 13. Were all sample containers received intact? (not broken or leaking, etc.) | | <input checked="" type="radio"/> YES | NO |
| 14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ___ < green pea ___ > green pea | <input checked="" type="radio"/> N/A | YES | NO |
| 15. Do any water samples contain sediment? Amount Amount of sediment: ___ dusting ___ moderate ___ heavy | N/A | YES | <input checked="" type="radio"/> NO |
| 16. Were the samples shipped on ice? | | <input checked="" type="radio"/> YES | NO |
| 17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4 | <input checked="" type="radio"/> RAD ONLY | YES | NO |
| Cooler #: <u>1</u> | | | |
| Temperature (°C): <u>5.8</u> | | | |
| No. of custody seals on cooler: <u>0</u> | | | |
| External µR/hr reading: <u>10</u> | | | |
| Background µR/hr reading: _____ | | | |
| Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? <input checked="" type="radio"/> YES / NO / NA (If no, see Form 008.) | | | |

DOT Survey/
Acceptance
Information

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? YES / NO / NA Contact: Shiloh Summy Date/Time: _____

Project Manager Signature / Date: Shiloh Summy

170 33 21
~~170 33 23~~ VA 3117

DEFINITIONS: On the Air Waybill 'We', 'Our', 'us' and 'FedEx' refer to Federal Express Corporation, its subsidiaries and branches and their respective employees, agents and independent contractors. 'You' and 'your' refer to the shipper, its employees, principals and agents. If your shipment originates outside the United States, your contract of carriage is with the Federal Express subsidiary, branch or independent contractor who originally accepts the shipment from you. 'Package' means any container or envelope that is accepted by us for delivery, including any such items tendered by you utilizing our automated systems, meters, manifests or waybills. 'Shipment' means all packages, which are tendered to and accepted by us on a single Air Waybill.

AGREEMENT TO TERMS: By giving us your shipment, you agree, regardless of whether you sign the front of this Air Waybill, for yourself and as agent for and on behalf of any other person having an interest in this shipment, to all terms on this NON-NEGOTIABLE Air Waybill. In any applicable tariff, and in our current Service Guide or Standard Conditions of Carriage, copies of which are available upon request. If there is a conflict between this Air Waybill and either the tariff, Service Guide or Standard Conditions then in effect, the tariff and the terms of any customer automation agreement between the shipper and Federal Express will control (the Service Guide or Standard Conditions have secondary priority). No one is authorized to alter or modify the terms of our agreement. This Air Waybill shall be binding on us when the shipment is accepted.

YOUR OBLIGATIONS: You warrant that each article in the shipment is properly described on this Air Waybill and is acceptable for transport by us, and that the shipment is properly marked, addressed (including postal codes) and packaged to ensure safe transportation with ordinary care in handling.

NOTE CONCERNING LIMITATIONS OF LIABILITY - Air Carriage Notice. If the carriage of your shipment by air involves an ultimate destination or stop in a country other than the country of departure, the Warsaw Convention, an international treaty relating to international carriage by air, may be applicable, which treaty would then govern and in most cases limit our liability for loss or delay of or damage to your shipment. In the U.S. the Warsaw Convention limits our liability to U.S. \$8.07 per pound (U.S. \$20.38 per kilogram). Unless you declare a higher value for carriage as described below. The interpretation of the Warsaw Convention liability limits may vary in other countries. There are no stopping places which are agreed at the time of tender of the shipment and we reserve the right to route shipments in any way we deem appropriate.

Road Transport Notice. Shipments transported partly or solely by road be it explicit agreement to do so or not-in, to, from a country which is party to the Convention on the International Carriage of Goods by Road (the 'CMR') are subject to the terms and conditions of the CMR, notwithstanding any other provisions of this Agreement to the contrary. For these shipments transported solely by road, if a conflict arises between the provisions of the CMR and this Air Waybill the terms of the CMR shall prevail.

Limitation of Liability, if not governed by the Warsaw Convention or the CMR as described above, our maximum liability for loss, damage or delay is limited by this Air Waybill to U.S. \$100 per shipment or U.S. \$9.07 per pound (U.S. \$20.38 per kilogram) (or equivalent local currency), whichever is greater, unless you declare a higher value for carriage as described below. FedEx does not provide cargo liability or all-risk insurance, but you may pay an additional charge to each additional U.S. \$100 (or equivalent local currency) of declared value for carriage. If a higher value for carriage is declared and the additional charge is paid, FedEx maximum liability will be the lesser of the declared value for carriage or your actual damages.

LIABILITIES NOT ASSUMED, IN ANY EVENT, WE WON'T BE LIABLE FOR ANY DAMAGES WHETHER DIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL, IN EXCESS OF THE DECLARED VALUE FOR CARRIAGE (INCLUDING BUT NOT LIMITED TO LOSS OF INCOME OR PROFITS) WHETHER OR NOT WE HAD ANY KNOWLEDGE THAT SUCH DAMAGES MIGHT BE INCURRED, UNLESS SUCH DAMAGES WERE CAUSED BY OUR OWN WILLFUL MICONDUCT OR GROSS NEGLIGENCE.

We won't be liable for your actions or omissions, including but not limited to incorrect declaration of cargo, improper or insufficient packing, securing, marking or addressing of the shipment, or for the acts or omissions of the recipient or anyone else with an interest in the shipment. Also we won't be liable if you (or) the recipient violate any of the terms of our agreement. We won't be liable for loss of or damage to shipments of cash, currency or other prohibited items. We won't be liable for loss, damages or delay caused by events we cannot control, including but not limited to acts of God, perils of the air, weather conditions mechanical delays, acts of public enemies, war, strikes, civil commotions, or acts or omissions of public authorities (including customs and health officials) with actual or apparent authority.

NO WARRANTIES. We make no warranties, express or implied.
CLAIM FOR LOSS, DAMAGE FOR DELAY. ALL CLAIMS MUST BE NOTIFIED TO US WITHIN 15 DAYS AFTER DELIVERY OF THE SHIPMENT FAILING WHICH NO ACTION FOR DAMAGES MAY BE BROUGHT. All claims for loss, non-delivery or mis-delivery must be received by us within 90 days after the shipment is accepted by us. The right to damages against us shall be extinguished unless an action is brought within two years from the date of delivery of the shipment or from date on which the shipment should have been delivered. Within 30 days after notification to us (of) the claim, it must be documented by sending us all relevant information about it. We are not obligated to act on any claim until all transportation charges have been paid; the claim amount may not be deducted from those charges. If the recipient accepts the shipment without noting any damage on the delivery record, we will assume the shipment was delivered in good condition. In order for us to consider a claim for damages, the contents, original shipping cartons, and packing must be available to us for inspection.

RIGHT TO INSPECT. Your shipment may, at our option or at the request of governmental authorities, be opened and inspected by us or such authorities or us at any time.
CUSTOMS CLEARANCE. It is your responsibility to provide proper customs documentation and confirmation, where required.
EXPORT CONTROL. You authorize Federal Express to act as forwarding agent for you for export control and customs purposes. You hereby certify that all statements and information contained in this air waybill relating to exportation are true and correct. Furthermore, you understand that civil and criminal penalties, including forfeiture and sale, may be imposed for making false or fraudulent statements or for the violation of any United States laws on exportation, including but not limited to, 13 USC Sec. 305; 22 USC Sec. 401; 19 USC Sec. 1001; 50 USC app. 2410.
MANDATORY LAW. Insofar as any provision contained or referred to in this air Waybill may be contrary to any applicable international treaty, law government regulations, orders or requirements such provision shall remain in effect as a part of our agreement to the extent that it is not overridden. The invalidity or unenforceability of any provision shall not affect any other part of this Air Waybill. Unless otherwise indicated the Sender's address indicated on the face of this Waybill is the place of execution and the place of departure, and Recipient's address listed on the face of this Waybill is the place of destination. Unless otherwise indicated Federal Express Corporation, P.O. Box 727, Memphis, TN 38194 USA is the first carrier of this shipment.

After printing this label:
CONSIGNEE COPY - PLEASE PLACE IN FRONT OF POUCH
 1. Fold the printed page along the horizontal line.
 2. Place label in shipping pouch and affix it to your shipment.

ORIGIN ID: YBVA (604) 253-4188
 HARGIT GILL
 ALS ENVIRONMENTAL LAB GROUP
 LOUGHREED HIGHWAY
 BURNABY, BC V5A1W9
 CANADA CA

SHIP DATE: 16MAR17
 ACTING: 10 00 13 MANI
 CAD: 03474191CAF E3011

BILL SENDER

TO SAMPLE RECEIVING
ALS ENVIRONMENTAL
225 COMMERCE DRIVE

FORT COLLINS CO 80524
 (970) 490-1511
 DEPT. SUBLET

REF: SUBLETS

10-0
5.8 (US)

540C31 ADB/727F

TRK# 7012 5069 2779
 0430

XH FTCA

CO-US DEN

10:30A
 INTL PRIORITY

80524




J161216101002uy

Client: ALS Environmental

Date: 30-Mar-17

Project: L1901651

Work Order: 1703321

Sample ID: L1901651-3

Lab ID: 1703321-1

Legal Location:

Matrix: WATER

Collection Date: 3/14/2017

Percent Moisture:

| Analyses | Result | Qual | Report Limit | Units | Dilution Factor | Date Analyzed |
|---|--------------------------|------|----------------|-------------|-----------------------------|--------------------|
| Radium-226 by Radon Emanation - Method 903.1 | | | PAI 783 | | Prep Date: 3/22/2017 | PrepBy: RLM |
| Ra-226 | 0.070 (+/- 0.022) | | 0.0096 | BQ/l | NA | 3/28/2017 13:54 |
| <i>Carr: BARIUM</i> | <i>97</i> | | <i>40-110</i> | <i>%REC</i> | DL = NA | 3/28/2017 13:54 |

Client: ALS Environmental
Project: L1901651
Sample ID: L1901651-3
Legal Location:
Collection Date: 3/14/2017

Date: 30-Mar-17
Work Order: 1703321
Lab ID: 1703321-1
Matrix: WATER
Percent Moisture:

| Analyses | Result | Qual | Report Limit | Units | Dilution Factor | Date Analyzed |
|----------|--------|------|--------------|-------|-----------------|---------------|
|----------|--------|------|--------------|-------|-----------------|---------------|

Explanation of Qualifiers

Radiochemistry:

- U or ND - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- Y2 - Chemical Yield outside default limits.
- W - DER is greater than Warning Limit of 1.42
- * - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
- # - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.
- G - Sample density differs by more than 15% of LCS density.
- D - DER is greater than Control Limit
- M - Requested MDC not met.
- LT - Result is less than requested MDC but greater than achieved MDC.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS, Matrix Spike Recovery within control limits.
- N - Matrix Spike Recovery outside control limits
- NC - Not Calculated for duplicate results less than 5 times MDC
- B - Analyte concentration greater than MDC.
- B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

- B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).
- U or ND - Indicates that the compound was analyzed for but not detected.
- E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.
- M - Duplicate injection precision was not met.
- N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.
- Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.
- * - Duplicate analysis (relative percent difference) not within control limits.
- S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

- U or ND - Indicates that the compound was analyzed for but not detected.
- B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.
- E - Analyte concentration exceeds the upper level of the calibration range.
- J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).
- A - A tentatively identified compound is a suspected aldol-condensation product.
- X - The analyte was diluted below an accurate quantitation level.
- * - The spike recovery is equal to or outside the control criteria used.
- + - The relative percent difference (RPD) equals or exceeds the control criteria.
- G - A pattern resembling gasoline was detected in this sample.
- D - A pattern resembling diesel was detected in this sample.
- M - A pattern resembling motor oil was detected in this sample.
- C - A pattern resembling crude oil was detected in this sample.
- 4 - A pattern resembling JP-4 was detected in this sample.
- 5 - A pattern resembling JP-5 was detected in this sample.
- H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.
- L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.
- Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
 - gasoline
 - JP-8
 - diesel
 - mineral spirits
 - motor oil
 - Stoddard solvent
 - bunker C

ALS -- Fort Collins

Date: 3/30/2017 7:43:

Client: ALS Environmental

QC BATCH REPORT

Work Order: 1703321

Project: L1901651

Batch ID: RE170322-2-2

Instrument ID: Alpha Scin

Method: Radium-226 by Radon Emanation

| LCS | | Sample ID: RE170322-2 | | | Units: BQ/I | | | Analysis Date: 3/28/2017 13:54 | | | | |
|--------------|------------------|-----------------------|---------|---------------|----------------------|---------------|----------------|--------------------------------|-----|-----------|------|--|
| Client ID: | | Run ID: RE170322-2B | | | Prep Date: 3/22/2017 | | | DF: NA | | | | |
| Analyte | Result | ReportLimit | SPK Val | SPK Ref Value | %REC | Control Limit | Decision Level | DER Ref | DER | DER Limit | Qual | |
| Ra-226 | 1.68 (+/- 0.417) | 0.00792 | 1.703 | | 98.6 | 67-120 | | | | | P | |
| Carr: BARIUM | 15700 | | 16680 | | 93.9 | 40-110 | | | | | | |

| LCSD | | Sample ID: RE170322-2 | | | Units: BQ/I | | | Analysis Date: 3/28/2017 13:54 | | | | |
|--------------|------------------|-----------------------|---------|---------------|----------------------|---------------|----------------|--------------------------------|-----|-----------|------|--|
| Client ID: | | Run ID: RE170322-2B | | | Prep Date: 3/22/2017 | | | DF: NA | | | | |
| Analyte | Result | ReportLimit | SPK Val | SPK Ref Value | %REC | Control Limit | Decision Level | DER Ref | DER | DER Limit | Qual | |
| Ra-226 | 1.88 (+/- 0.468) | 0.00879 | 1.703 | | 111 | 67-120 | | 1.68 | 0.3 | 2.1 | P | |
| Carr: BARIUM | 15700 | | 16680 | | 94 | 40-110 | | 15700 | | | | |

| MB | | Sample ID: RE170322-2 | | | Units: BQ/I | | | Analysis Date: 3/28/2017 13:54 | | | | |
|--------------|----------------------|-----------------------|---------|---------------|----------------------|---------------|----------------|--------------------------------|-----|-----------|------|--|
| Client ID: | | Run ID: RE170322-2B | | | Prep Date: 3/22/2017 | | | DF: NA | | | | |
| Analyte | Result | ReportLimit | SPK Val | SPK Ref Value | %REC | Control Limit | Decision Level | DER Ref | DER | DER Limit | Qual | |
| Ra-226 | -0.0012 (+/- 0.0052) | 0.011 | | | | | | | | | U,M | |
| Carr: BARIUM | 16100 | | 16680 | | 96.7 | 40-110 | | | | | | |

The following samples were analyzed in this batch:

1703321-1



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 22-MAR-17
Report Date: 31-MAR-17 15:07 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1904255
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-03-22 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1904255-1 | L1904255-2 | L1904255-3 | L1904255-4 |
|---|---|---------------------------------|------------|-------------------------|------------|
| | | Water | Water | Water | Water |
| | | 21-MAR-17 | 21-MAR-17 | 21-MAR-17 | 21-MAR-17 |
| | | 11:00 | 14:20 | 15:33 | |
| | | W3 | W17 | STP-E | DUP |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 554 | 571 | 1260 | 544 |
| | Hardness (as CaCO3) (mg/L) | 245 | 261 | 187 | 254 |
| | pH (pH) | 8.30 | 8.36 | 8.11 | 8.28 |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | 12.0 | <3.0 |
| | Total Dissolved Solids (mg/L) | 316 | 370 | 719 | 356 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 226 | 228 | 115 | 231 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 2.4 | 7.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 229 | 235 | 115 | 231 |
| | Ammonia, Total (as N) (mg/L) | 0.0551 | <0.0050 | 0.0072 | 0.0535 |
| | Chloride (Cl) (mg/L) | 5.01 | 6.73 | 241 | 5.02 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.106 | 0.158 | 8.59 | 0.105 |
| | Nitrate (as N) (mg/L) | 0.106 | 0.158 | 8.59 | 0.105 |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | <0.0050 ^{DLDS} | <0.0010 |
| | Sulfate (SO4) (mg/L) | 53.9 | 56.3 | 62.1 | 54.0 |
| | Anion Sum (meq/L) | 5.84 | 6.07 | 11.0 | 5.88 |
| | Cation Sum (meq/L) | 5.70 | 6.00 | 10.7 | 5.88 |
| | Cation - Anion Balance (%) | -1.2 | -0.5 | -1.5 | 0.0 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 4.94 | 8.16 | 5.39 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0181 | 0.0184 | 0.803 | 0.0185 |
| | Antimony (Sb)-Total (mg/L) | 0.00011 | <0.00010 | 0.00065 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00029 | 0.00032 | 0.00022 | 0.00025 |
| | Barium (Ba)-Total (mg/L) | 0.0786 | 0.0862 | 0.0164 | 0.0781 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | 0.000200 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.021 | 0.032 | 0.158 | 0.024 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000191 | 0.0000117 | 0.0000624 | 0.0000200 |
| | Calcium (Ca)-Total (mg/L) | 56.8 | 70.1 | 54.2 | 52.7 |
| | Chromium (Cr)-Total (mg/L) | <0.00010 | <0.00010 | 0.00157 | 0.00010 |
| | Cobalt (Co)-Total (mg/L) | 0.00020 | <0.00010 | 0.00053 | 0.00020 |
| | Copper (Cu)-Total (mg/L) | 0.00280 | 0.00751 | 0.0573 | 0.00299 |
| | Iron (Fe)-Total (mg/L) | 0.082 | 0.023 | 0.397 | 0.075 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | 0.000322 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0024 | 0.0013 | 0.0021 | 0.0026 |
| | Magnesium (Mg)-Total (mg/L) | 25.5 | 21.7 | 11.1 | 25.8 |
| | Manganese (Mn)-Total (mg/L) | 0.412 | 0.197 | 0.0438 | 0.420 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1904255-1 Water 21-MAR-17 11:00 W3 | L1904255-2 Water 21-MAR-17 14:20 W17 | L1904255-3 Water 21-MAR-17 15:33 STP-E | L1904255-4 Water 21-MAR-17 DUP |
|---|---------------------------------------|---|--|--|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00410 | 0.00664 | 0.00301 | 0.00436 |
| | Nickel (Ni)-Total (mg/L) | 0.00122 | 0.00098 | 0.00527 | 0.00135 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | 2.52 | 0.054 |
| | Potassium (K)-Total (mg/L) | 2.22 | 4.04 | 24.8 | 2.49 |
| | Selenium (Se)-Total (mg/L) | 0.000096 | 0.000362 | 0.000240 | 0.000094 |
| | Silicon (Si)-Total (mg/L) | 6.40 | 5.73 | 7.47 | 6.44 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000040 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 16.5 | 15.2 | 140 | 18.1 |
| | Strontium (Sr)-Total (mg/L) | 0.718 | 0.842 | 0.345 | 0.663 |
| | Sulfur (S)-Total (mg/L) | 20.4 | 21.6 | 24.9 | 20.5 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | 0.00035 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.00066 | 0.00092 | 0.00384 | 0.00038 |
| | Uranium (U)-Total (mg/L) | 0.00224 | 0.00301 | 0.000215 | 0.00221 |
| | Vanadium (V)-Total (mg/L) | 0.00051 | <0.00050 | 0.00115 | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | 0.0211 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0029 | 0.0033 | 0.0200 | 0.0069 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00052 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00024 | 0.00030 | 0.00015 | 0.00024 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0720 | 0.0758 | 0.00423 | 0.0730 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.020 | 0.029 | 0.153 | 0.021 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000207 | 0.0000086 | 0.0000400 | 0.0000177 |
| | Calcium (Ca)-Dissolved (mg/L) | 54.6 | 67.6 | 55.5 | 57.3 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00012 | <0.00010 | 0.00020 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00018 | <0.00010 | 0.00047 | 0.00019 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00274 | 0.00625 | 0.0174 | 0.00219 |
| | Iron (Fe)-Dissolved (mg/L) | 0.062 | <0.010 | 0.030 | 0.068 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0023 | 0.0015 | 0.0023 | 0.0024 |
| | Magnesium (Mg)-Dissolved (mg/L) | 26.4 | 22.3 | 11.6 | 26.9 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.422 | 0.0703 | 0.0369 | 0.438 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1904255-1 | L1904255-2 | L1904255-3 | L1904255-4 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 21-MAR-17 | 21-MAR-17 | 21-MAR-17 | 21-MAR-17 |
| | | Sampled Time | 11:00 | 14:20 | 15:33 | |
| | | Client ID | W3 | W17 | STP-E | DUP |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00371 | 0.00594 | 0.00264 | 0.00357 |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00126 | 0.00079 | 0.00478 | 0.00117 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | 1.85 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 2.00 | 3.87 | 24.1 | 2.02 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000108 | 0.000431 | 0.000139 | 0.000095 |
| | Silicon (Si)-Dissolved (mg/L) | | 6.27 | 5.60 | 7.04 | 6.32 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 16.7 | 15.9 | 146 | 16.8 |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.729 | 0.827 | 0.333 | 0.717 |
| | Sulfur (S)-Dissolved (mg/L) | | 19.0 | 20.4 | 22.6 | 18.9 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00012 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.00203 | 0.00264 | 0.000048 | 0.00202 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | 0.00087 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | <0.0010 | <0.0010 | 0.0082 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1904255-1, -2, -3, -4 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1904255-1, -2, -3, -4 |
| Matrix Spike | Boron (B)-Total | MS-B | L1904255-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1904255-1, -2, -3, -4 |
| Matrix Spike | Iron (Fe)-Total | MS-B | L1904255-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1904255-1, -2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1904255-1, -2, -3, -4 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1904255-1, -2, -3, -4 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1904255-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1904255-1, -2, -3, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |

Reference Information

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

Reference Information

2017-03-22 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L1904255-COFC

COC Number: 2017-03-22 A

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| | | | | | | | | | | | | | | | | | | | | |
|--|---|--|-------------------|-----------------|--|------------------------------|--|-----------------------------|--|-------------------------|--|---------------------------|--|-------|--|-------|--------------------------------|----------------------|------------------------------|-------|
| Report To Contact and company name below will appear on the final report | | Report Format | | | <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply m all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> | | EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | | | | | | | | | | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | | | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | | | | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | | | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | | | | |
| PO / AFE: | 224162 (WUL) | Requisitioner: | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Ariel McDonnell | | | Sampler: | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | | | Number of Containers | | |
| | W3 | 21-Mar-17 | 11:00 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 | | |
| | W17 | 21-Mar-17 | 14:20 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 | | |
| | STP-E | 20-Mar-17 | 15:33 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 | | |
| | DUP | 21-Mar-17 | | Water | R | R | R | R | R | R | R | R | R | | | | | 7 | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Some samples Frozen | | | Frozen <input type="checkbox"/> | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | Ice Packs <input type="checkbox"/> | | Ice Cubes <input type="checkbox"/> | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | Cooling Initiated <input type="checkbox"/> | | INITIAL COOLER TEMPERATURES °C | | FINAL COOLER TEMPERATURES °C | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | -2 | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | |
| Released by: Shelby Black | 22-Mar-17 | Time: | Received by: V.D. | Date: Mar 22/17 | Time: 1505 | Received by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: |

Short Holding Time
Rush Processing

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

01/15/2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-MAR-17
Report Date: 07-APR-17 16:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1906733
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-03-29 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1906733-1 WATER 28-MAR-17 10:05 W3 | L1906733-2 WATER 28-MAR-17 10:05 T-BL | L1906733-3 WATER 28-MAR-17 10:45 W17 | L1906733-4 WATER 28-MAR-17 11:00 W8A | |
|---|---|---|--|--|-----------|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 540 | <2.0 | 536 | 1680 |
| | Hardness (as CaCO3) (mg/L) | 238 | <0.50 ^{HTC} | 250 | 911 |
| | pH (pH) | 8.09 | 5.76 | 8.33 | 7.83 |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | <3.0 | 41.5 |
| | Total Dissolved Solids (mg/L) | 342 | <10 | 361 | 1150 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 227 | <1.0 | 229 | 866 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | 5.8 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 227 | <1.0 | 234 | 866 |
| | Ammonia, Total (as N) (mg/L) | 0.0508 | <0.0050 | <0.0050 | 0.408 |
| | Chloride (Cl) (mg/L) | 5.17 | <0.50 | 6.90 | 19.6 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.131 | <0.0051 | 0.146 | 0.481 |
| | Nitrate (as N) (mg/L) | 0.131 | <0.0050 | 0.146 | 0.465 |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | <0.0010 | 0.0157 |
| | Sulfate (SO4) (mg/L) | 54.7 | <0.30 | 57.6 | 191 |
| | Anion Sum (meq/L) | 5.84 | <0.10 | 6.09 | 21.9 |
| | Cation Sum (meq/L) | 5.61 | <0.10 | 5.80 | 21.7 |
| | Cation - Anion Balance (%) | -1.9 | 0.0 | -2.4 | -0.4 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 4.75 | | 8.27 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0121 | <0.0030 | 0.0079 | 0.326 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | 0.00010 | 0.00055 |
| | Arsenic (As)-Total (mg/L) | 0.00024 | <0.00010 | 0.00035 | 0.00149 |
| | Barium (Ba)-Total (mg/L) | 0.0781 | <0.000050 | 0.0855 | 0.340 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | 0.000047 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.021 | <0.010 | 0.031 | 0.039 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000191 | <0.0000050 | 0.0000114 | 0.000217 |
| | Calcium (Ca)-Total (mg/L) | 55.4 | <0.050 | 68.6 | 244 |
| | Chromium (Cr)-Total (mg/L) | <0.00010 | <0.00010 | 0.00010 | 0.00194 |
| | Cobalt (Co)-Total (mg/L) | 0.00017 | <0.00010 | <0.00010 | 0.00564 |
| | Copper (Cu)-Total (mg/L) | 0.00293 | <0.00050 | 0.00691 | 0.283 |
| | Iron (Fe)-Total (mg/L) | 0.082 | <0.010 | <0.010 | 9.54 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | 0.000318 |
| | Lithium (Li)-Total (mg/L) | 0.0029 | <0.0010 | 0.0017 | 0.0048 |
| | Magnesium (Mg)-Total (mg/L) | 26.8 | <0.10 | 22.6 | 75.6 |
| | Manganese (Mn)-Total (mg/L) | 0.426 | <0.00010 | 0.0818 | 10.9 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1906733-1 WATER 28-MAR-17 10:05 W3 | L1906733-2 WATER 28-MAR-17 10:05 T-BL | L1906733-3 WATER 28-MAR-17 10:45 W17 | L1906733-4 WATER 28-MAR-17 11:00 W8A |
|---|---------------------------------------|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000067 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00380 | <0.000050 | 0.00646 | 0.0159 |
| | Nickel (Ni)-Total (mg/L) | 0.00127 | <0.00050 | 0.00084 | 0.00253 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | 0.196 |
| | Potassium (K)-Total (mg/L) | 2.08 | <0.10 | 4.02 | 9.03 |
| | Selenium (Se)-Total (mg/L) | 0.000158 | <0.000050 | 0.000398 | 0.00152 |
| | Silicon (Si)-Total (mg/L) | 6.32 | <0.050 | 5.60 | 11.1 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | 0.000104 |
| | Sodium (Na)-Total (mg/L) | 17.2 | <0.050 | 16.9 | 54.0 |
| | Strontium (Sr)-Total (mg/L) | 0.695 | <0.00020 | 0.815 | 3.57 |
| | Sulfur (S)-Total (mg/L) | 18.7 | <0.50 | 19.8 | 71.3 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.00044 | <0.00030 | 0.00038 | 0.0208 |
| | Uranium (U)-Total (mg/L) | 0.00220 | <0.000010 | 0.00293 | 0.00448 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00936 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | 0.567 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00143 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0029 | | 0.0023 | 0.0180 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | | <0.00010 | <0.00020 ^{DLA} |
| | Arsenic (As)-Dissolved (mg/L) | 0.00024 | | 0.00032 | 0.00145 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0727 | | 0.0743 | 0.286 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | | <0.000020 | <0.000040 ^{DLA} |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | | <0.000050 | <0.00010 ^{DLA} |
| | Boron (B)-Dissolved (mg/L) | 0.019 | | 0.028 | 0.038 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000209 | | 0.0000074 | 0.000110 |
| | Calcium (Ca)-Dissolved (mg/L) | 52.6 | | 64.7 | 234 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | | <0.00010 | 0.00141 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00018 | | <0.00010 | 0.00572 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00184 | | 0.00620 | 0.0457 |
| | Iron (Fe)-Dissolved (mg/L) | 0.061 | | <0.010 | 7.00 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | | <0.000050 | <0.00010 ^{DLA} |
| | Lithium (Li)-Dissolved (mg/L) | 0.0025 | | 0.0014 | 0.0043 |
| | Magnesium (Mg)-Dissolved (mg/L) | 26.0 | | 21.5 | 79.3 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.400 | | 0.0542 | 10.8 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1906733-1 | L1906733-2 | L1906733-3 | L1906733-4 |
|-------------------------|----------------------------------|--------------|--------------|-----------|---|---|--|--|
| | | | | | L1906733-1 WATER 28-MAR-17 10:05 W3 | L1906733-2 WATER 28-MAR-17 10:05 T-BL | L1906733-3 WATER 28-MAR-17 10:45 W17 | L1906733-4 WATER 28-MAR-17 11:00 W8A |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | | | <0.0000050 | | | 0.0000058 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00338 | | | 0.00559 | | | 0.0142 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00122 | | | 0.00078 | | | 0.0023 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | | | <0.050 | | | <0.10 ^{DLA} |
| | Potassium (K)-Dissolved (mg/L) | 2.11 | | | 3.83 | | | 9.16 |
| | Selenium (Se)-Dissolved (mg/L) | <0.000050 | | | 0.000344 | | | 0.00148 |
| | Silicon (Si)-Dissolved (mg/L) | 6.26 | | | 5.34 | | | 10.9 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | | | <0.000010 | | | <0.000020 ^{DLA} |
| | Sodium (Na)-Dissolved (mg/L) | 17.9 | | | 16.0 | | | 56.0 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.688 | | | 0.784 | | | 3.59 |
| | Sulfur (S)-Dissolved (mg/L) | 18.6 | | | 19.1 | | | 70.6 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | | | <0.000010 | | | <0.000020 ^{DLA} |
| | Tin (Sn)-Dissolved (mg/L) | <0.000010 | | | <0.000010 | | | <0.000020 ^{DLA} |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | | | <0.00030 | | | 0.00140 |
| | Uranium (U)-Dissolved (mg/L) | 0.00200 | | | 0.00253 | | | 0.00430 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | | | <0.00050 | | | 0.0070 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | | | <0.0010 | | | 0.181 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | | | <0.00030 | | | 0.00163 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Cadmium (Cd)-Total | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Copper (Cu)-Total | MS-B | L1906733-2 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Zinc (Zn)-Total | MS-B | L1906733-1, -3, -4 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1906733-1, -2, -3, -4 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1906733-1, -2, -3, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |
| HTC | Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Reference Information

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-03-29 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 05-APR-17
Report Date: 13-APR-17 19:43 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1909606
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-04-05 A
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

13-APR-17 19:43 (MT)

Version: FINAL

| Sample ID Description Sampled Date Sampled Time Client ID | L1909606-1 WATER 04-APR-17 09:45 W3 | L1909606-2 WATER 04-APR-17 10:00 W17 | L1909606-3 WATER 04-APR-17 10:25 W8A | L1909606-4 WATER 04-APR-17 04:30 T-BL | L1909606-5 WATER 04-APR-17 04:30 W12 | |
|---|---|--|--|---|--|--------------------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 526 | 558 | 1730 | <2.0 | 2440 |
| | Hardness (as CaCO3) (mg/L) | 247 | 264 | 954 | | 1090 |
| | pH (pH) | 8.03 | 8.27 | 7.53 | 5.61 | 8.03 |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | 35.4 | <3.0 | 4.7 |
| | Total Dissolved Solids (mg/L) | 314 | 350 | 1250 | <10 | 1980 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 230 | 238 | 907 | <1.0 | 167 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 230 | 238 | 907 | <1.0 | 167 |
| | Ammonia, Total (as N) (mg/L) | 0.0579 | <0.0050 | 0.477 | | 6.66 |
| | Chloride (Cl) (mg/L) | 5.23 | 6.96 | 20.1 | <0.50 | 36 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.126 | 0.132 | 0.917 | <0.0051 ^{HTD} | 27.8 |
| | Nitrate (as N) (mg/L) | 0.125 | 0.132 | 0.852 | <0.0050 ^{HTD} | 25.8 |
| | Nitrite (as N) (mg/L) | 0.0016 | <0.0010 | 0.066 | <0.0010 ^{HTD} | 2.04 |
| | Sulfate (SO4) (mg/L) | 56.3 | 58.7 | 172 | <0.30 | 1160 |
| | Anion Sum (meq/L) | 5.91 | 6.19 | 22.3 | <0.10 | 30.5 |
| | Cation Sum (meq/L) | 5.79 | 6.04 | 22.1 | <0.10 | 28.7 |
| | Cation - Anion Balance (%) | -1.1 | -1.2 | -0.4 | 0.0 | -3.0 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 5.35 | 8.51 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0084 | 0.0074 | 0.311 | <0.0030 | 0.0949 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | 0.00047 | <0.00010 | 0.00030 |
| | Arsenic (As)-Total (mg/L) | 0.00027 | 0.00033 | 0.00158 | <0.00010 | 0.00045 |
| | Barium (Ba)-Total (mg/L) | 0.0765 | 0.0796 | 0.321 | <0.000050 | 0.111 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | 0.000047 | <0.000020 | <0.000040 ^{DLA} |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} |
| | Boron (B)-Total (mg/L) | 0.021 | 0.032 | 0.042 | <0.010 | 0.257 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000196 | 0.0000077 | 0.000316 | <0.0000050 | 0.000086 |
| | Calcium (Ca)-Total (mg/L) | 56.0 | 69.0 | 264 | <0.050 | 356 |
| | Chromium (Cr)-Total (mg/L) | 0.00044 | 0.00012 | 0.00215 | <0.00010 | <0.00020 ^{DLA} |
| | Cobalt (Co)-Total (mg/L) | 0.00022 | <0.00010 | 0.00480 | <0.00010 | 0.00097 |
| | Copper (Cu)-Total (mg/L) | 0.00192 | 0.00712 | 0.331 | <0.00050 | 0.0778 |
| | Iron (Fe)-Total (mg/L) | 0.072 | <0.010 | 7.82 | <0.010 | 0.214 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | 0.000379 | <0.000050 | 0.00061 |
| | Lithium (Li)-Total (mg/L) | 0.0031 | 0.0019 | 0.0053 | <0.0010 | 0.0140 |
| | Magnesium (Mg)-Total (mg/L) | 28.3 | 23.6 | 86.4 | <0.10 | 46.0 |
| | Manganese (Mn)-Total (mg/L) | 0.433 | 0.0782 | 10.2 | <0.00010 | 0.714 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1909606-6 | L1909606-7 | L1909606-8 |
|-----------------------------|---|---------------------------------|------------|------------|------------|
| | | Description | WATER | WATER | WATER |
| | | Sampled Date | 04-APR-17 | 04-APR-17 | 04-APR-17 |
| | | Sampled Time | 04:30 | 11:25 | 02:15 |
| | | Client ID | W14 | W62 | MC1 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 2700 | 998 | 567 | |
| | Hardness (as CaCO3) (mg/L) | 1060 | 532 | 277 | |
| | pH (pH) | 8.19 | 8.22 | 8.22 | |
| | Total Suspended Solids (mg/L) | | <3.0 | 5.1 | |
| | Total Dissolved Solids (mg/L) | 2200 | 730 | 409 | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 74.2 | 365 | 269 | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 74.2 | 365 | 269 | |
| | Ammonia, Total (as N) (mg/L) | 4.25 | <0.0050 | 0.0102 | |
| | Chloride (Cl) (mg/L) | 40 | 28.1 | 5.16 | |
| | Nitrate and Nitrite (as N) (mg/L) | 37.3 | 4.18 | 0.0109 | |
| | Nitrate (as N) (mg/L) | 35.1 | 4.17 | 0.0109 | |
| | Nitrite (as N) (mg/L) | 2.18 | 0.0085 | <0.0010 | |
| | Sulfate (SO4) (mg/L) | 1310 | 191 | 65.3 | |
| | Anion Sum (meq/L) | 32.6 | 12.4 | 6.87 | |
| | Cation Sum (meq/L) | 30.4 | 11.9 | 6.63 | |
| | Cation - Anion Balance (%) | -3.5 | -1.8 | -1.8 | |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | | 20.2 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0054 | 0.0195 | |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | <0.00010 | |
| | Arsenic (As)-Total (mg/L) | | 0.00034 | 0.00073 | |
| | Barium (Ba)-Total (mg/L) | | 0.123 | 0.0909 | |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | |
| | Boron (B)-Total (mg/L) | | 0.033 | <0.010 | |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000150 | 0.0000197 | |
| | Calcium (Ca)-Total (mg/L) | | 150 | 64.6 | |
| | Chromium (Cr)-Total (mg/L) | | 0.00017 | 0.00040 | |
| | Cobalt (Co)-Total (mg/L) | | 0.00013 | <0.00010 | |
| | Copper (Cu)-Total (mg/L) | | 0.0479 | 0.00859 | |
| | Iron (Fe)-Total (mg/L) | | 0.045 | 0.037 | |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | <0.000050 | |
| | Lithium (Li)-Total (mg/L) | | 0.0031 | 0.0037 | |
| | Magnesium (Mg)-Total (mg/L) | | 41.3 | 30.3 | |
| | Manganese (Mn)-Total (mg/L) | | 0.0433 | 0.0141 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1909606-1 WATER 04-APR-17 09:45 W3 | L1909606-2 WATER 04-APR-17 10:00 W17 | L1909606-3 WATER 04-APR-17 10:25 W8A | L1909606-4 WATER 04-APR-17 04:30 T-BL | L1909606-5 WATER 04-APR-17 04:30 W12 | |
|---|---|--|--|---|--|--------------------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | 0.0000112 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00385 | 0.00657 | 0.0121 | <0.000050 | 0.0819 |
| | Nickel (Ni)-Total (mg/L) | 0.00181 | 0.00083 | 0.00278 | <0.00050 | 0.0042 ^{DLA} |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | 0.171 | <0.050 | <0.10 |
| | Potassium (K)-Total (mg/L) | 2.14 | 3.95 | 9.28 | <0.10 | 46.7 |
| | Selenium (Se)-Total (mg/L) | 0.000130 | 0.000415 | 0.00150 | <0.000050 | 0.0128 |
| | Silicon (Si)-Total (mg/L) | 6.55 | 5.81 | 11.7 | <0.050 | 3.36 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000259 | 0.000201 | <0.000010 | 0.000041 |
| | Sodium (Na)-Total (mg/L) | 18.4 | 17.4 | 61.6 | <0.050 | 134 |
| | Strontium (Sr)-Total (mg/L) | 0.739 | 0.864 | 4.06 | <0.00020 | 7.86 |
| | Sulfur (S)-Total (mg/L) | 20.3 | 21.3 | 65.3 | <0.50 | 412 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} |
| | Tin (Sn)-Total (mg/L) | <0.00010 ^{DLM} | <0.00010 | <0.00010 | <0.00010 | <0.00020 ^{DLA} |
| | Titanium (Ti)-Total (mg/L) | <0.00060 | 0.00035 | 0.0167 | <0.00030 | 0.00408 |
| | Uranium (U)-Total (mg/L) | 0.00210 | 0.00282 | 0.00476 | <0.000010 | 0.00527 ^{DLA} |
| | Vanadium (V)-Total (mg/L) | <0.00050 | <0.00050 | 0.00846 | <0.00050 | <0.0010 ^{DLA} |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | 0.437 | <0.0030 | 0.0084 ^{DLA} |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | 0.00162 | <0.00030 | <0.00060 ^{DLA} |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0027 | 0.0023 | 0.0127 | | 0.0057 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00018 | | 0.00028 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00024 | 0.00033 | 0.00119 | | 0.00039 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0762 | 0.0763 | 0.279 | | 0.110 ^{DLA} |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | 0.000022 | | <0.000040 ^{DLA} |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | | <0.00010 ^{DLA} |
| | Boron (B)-Dissolved (mg/L) | 0.018 | 0.026 | 0.034 | | 0.214 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000211 | 0.0000068 | 0.000168 | | 0.000077 |
| | Calcium (Ca)-Dissolved (mg/L) | 52.3 | 68.0 | 247 | | 362 ^{DLA} |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00113 | | <0.00020 ^{DLA} |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00018 | <0.00010 | 0.00408 | | 0.00091 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00233 | 0.00583 | 0.0396 | | 0.0256 |
| | Iron (Fe)-Dissolved (mg/L) | 0.058 | <0.010 | 2.43 | | 0.047 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | | 0.00021 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0023 | 0.0018 | 0.0046 | | 0.0124 |
| | Magnesium (Mg)-Dissolved (mg/L) | 28.1 | 22.8 | 82.0 | | 44.1 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.423 | 0.0438 | 9.04 | | 0.705 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1909606-6 WATER 04-APR-17 04:30 W14 | L1909606-7 WATER 04-APR-17 11:25 W62 | L1909606-8 WATER 04-APR-17 02:15 MC1 | | |
|---|--|--|--|-------------------------|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Total (mg/L) | | 0.00801 | 0.00115 | |
| | Nickel (Ni)-Total (mg/L) | | 0.00113 | 0.00092 | |
| | Phosphorus (P)-Total (mg/L) | | <0.050 | 0.121 | |
| | Potassium (K)-Total (mg/L) | | 6.03 | 7.64 | |
| | Selenium (Se)-Total (mg/L) | | 0.00171 | 0.000694 | |
| | Silicon (Si)-Total (mg/L) | | 8.10 | 12.2 | |
| | Silver (Ag)-Total (mg/L) | | 0.000032 | 0.000018 | |
| | Sodium (Na)-Total (mg/L) | | 28.9 | 23.5 | |
| | Strontium (Sr)-Total (mg/L) | | 1.73 | 0.619 | |
| | Sulfur (S)-Total (mg/L) | | 71.1 | 23.8 | |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | |
| | Tin (Sn)-Total (mg/L) | | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Total (mg/L) | | <0.00030 | <0.00060 ^{DLM} | |
| | Uranium (U)-Total (mg/L) | | 0.00482 | 0.00258 | |
| | Vanadium (V)-Total (mg/L) | | 0.00052 | <0.00050 | |
| | Zinc (Zn)-Total (mg/L) | | 0.136 | <0.0030 | |
| | Zirconium (Zr)-Total (mg/L) | | <0.00030 | <0.00030 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0229 | 0.0049 | 0.0127 | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00025 | <0.00010 | <0.00010 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00033 | 0.00035 | 0.00073 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.216 | 0.122 | 0.0886 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000040 ^{DLA} | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00010 ^{DLA} | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | 0.148 | 0.024 | <0.010 | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000050 ^{DLM} | 0.0000174 | 0.0000162 | |
| | Calcium (Ca)-Dissolved (mg/L) | 363 | 147 | 63.8 | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00020 ^{DLA} | 0.00018 | 0.00033 | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00086 | 0.00012 | <0.00010 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00468 | 0.0519 | 0.00704 | |
| | Iron (Fe)-Dissolved (mg/L) | <0.020 ^{DLA} | 0.031 | 0.029 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.00010 ^{DLA} | 0.000064 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0226 | 0.0023 | 0.0032 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 38.0 | 39.8 | 28.6 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.603 | 0.0406 | 0.0126 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1909606-1 WATER 04-APR-17 09:45 W3 | L1909606-2 WATER 04-APR-17 10:00 W17 | L1909606-3 WATER 04-APR-17 10:25 W8A | L1909606-4 WATER 04-APR-17 04:30 T-BL | L1909606-5 WATER 04-APR-17 04:30 W12 |
|---|---|--|--|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | 0.0000051 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00340 | 0.00629 | 0.0113 | 0.0801 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00125 | 0.00075 | 0.00231 | 0.0034 ^{DLA} |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | 0.074 | <0.10 |
| | Potassium (K)-Dissolved (mg/L) | 2.15 | 3.76 | 8.63 | 44.9 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000095 | 0.000478 | 0.00175 | 0.0132 |
| | Silicon (Si)-Dissolved (mg/L) | 6.29 | 5.55 | 11.2 | 3.15 ^{DLA} |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000018 | <0.000020 |
| | Sodium (Na)-Dissolved (mg/L) | 18.1 | 15.4 | 54.2 | 122 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.688 | 0.808 | 3.79 | 7.57 |
| | Sulfur (S)-Dissolved (mg/L) | 19.6 | 20.1 | 61.4 | 431 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00020 ^{DLA} |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00108 | <0.00060 ^{DLA} |
| | Uranium (U)-Dissolved (mg/L) | 0.00201 | 0.00272 | 0.00452 | 0.00526 ^{DLA} |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00365 | <0.0010 ^{DLA} |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0014 | <0.0010 | 0.182 | 0.0052 ^{DLA} |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00165 | <0.00060 ^{DLA} |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1909606-6 WATER 04-APR-17 04:30 W14 | L1909606-7 WATER 04-APR-17 11:25 W62 | L1909606-8 WATER 04-APR-17 02:15 MC1 | |
|-------------------------|---|--|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.000050 ^{DLM} | <0.000050 | <0.000050 | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.119 | 0.00747 | 0.00103 | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0019 | 0.00124 | 0.00088 | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.10 ^{DLA} | <0.050 | 0.081 | |
| | Potassium (K)-Dissolved (mg/L) | 59.7 | 5.95 | 7.30 | |
| | Selenium (Se)-Dissolved (mg/L) | 0.0207 | 0.00209 ^{DTC} | 0.000715 | |
| | Silicon (Si)-Dissolved (mg/L) | 2.23 | 7.78 | 12.2 | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000010 | <0.000010 | |
| | Sodium (Na)-Dissolved (mg/L) | 169 | 25.8 | 20.9 | |
| | Strontium (Sr)-Dissolved (mg/L) | 12.2 | 1.64 | 0.579 | |
| | Sulfur (S)-Dissolved (mg/L) | 495 | 68.2 | 22.7 | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000010 | <0.000010 | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00020 ^{DLA} | 0.00033 ^{DTC} | <0.00010 | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLA} | <0.00030 | 0.00045 | |
| | Uranium (U)-Dissolved (mg/L) | 0.00821 | 0.00469 | 0.00245 | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 ^{DLA} | <0.00050 | <0.00050 | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0020 ^{DLA} | 0.139 | 0.0014 | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00060 ^{DLA} | <0.00030 | <0.00030 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|------------------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1909606-1, -2, -8 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1909606-1, -2, -8 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1909606-1, -2, -3, -5, -6, -7, -8 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1909606-1, -2, -3, -5, -6, -7, -8 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1909606-1, -2, -3, -5, -6, -7, -8 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1909606-1, -2, -3, -5, -6, -7, -8 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1909606-1, -2, -3, -5, -6, -7, -8 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1909606-1, -2, -3, -5, -6, -7, -8 |
| Matrix Spike | Ammonia, Total (as N) | MS-B | L1909606-1, -2, -3, -5, -6, -7, -8 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| HTD | Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |

Reference Information

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

Reference Information

VA

ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2017-04-05 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L1909606-COFC

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| | | | | | | | | | | | | | | | | | | | |
|--|---|--|--|---|--------------|-------------------------------------|---|---|------------------------------|--|--|--|--|---------------------------|--------------------------------|----------------------|--|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / D Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | <small>all E&P TATs with your AM - surcharges will apply</small> | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | EMERGENCY | | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | |
| Contact: Minto Environment - Coordinator | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | |
| Phone: 1-604-759-4659 | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | Date and Time Required for all E&P TATs: <small>00-mm-yy 00:00</small> | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | Analysis Request | | | | | | | | | | | | | | | |
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | | | |
| Project Information | | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO#: | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | |
| PO / AFE: 224162 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Ariel McDonnell | | Sampler: CH | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | | |
| 1 | W3 | | | 4-Apr-17 | 9:45 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| 2 | W17 | | | 4-Apr-17 | 10:00 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| 3 | W8A | | | 4-Apr-17 | 10:25 | Water | R | R | R | R | R | R | R | R | R | 6 | | | |
| 4 | T-BL | | | 4-Apr-17 | 16:30 | Water | R | R | R | R | R | R | R | R | R | 4 | | | |
| 5 | W12 | | | 4-Apr-17 | 16:30 | Water | R | R | R | R | R | R | R | R | R | 6 | | | |
| 6 | W14 | | | 4-Apr-17 | 16:30 | Water | R | R | R | R | R | R | R | R | R | 4 | | | |
| 7 | W62 | | | 4-Apr-17 | 11:25 | Water | R | R | R | R | R | R | R | R | R | 6 | | | |
| 8 | MC1 | | | 4-Apr-17 | 14:15 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| | | | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | |
| | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | |
| | | | | | | | | 3.0 | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-04-05 7:15 | | Time: | | Received by: <i>ENF</i> | | Date: <i>5 Apr 2017</i> | | Time: <i>15:30</i> | | Received by: | | Date: | | Time: | | | |

Short Holding Time
Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 12-APR-17
Report Date: 24-APR-17 17:04 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1912879
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-04-12 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1912879-1 | L1912879-2 | L1912879-3 | L1912879-4 | L1912879-5 |
|-----------------------------------|---|--------------|--------------|-----------|------------------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 10-APR-17 | 10-APR-17 | 11-APR-17 | 11-APR-17 | 11-APR-17 |
| | | | | | 15:55 | 16:25 | 08:30 | 08:45 | 09:00 |
| | | | | | W10 | W15 | W2 | W3 | W8A |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | | | 1250 | 1040 | 381 | 537 | 1600 |
| | Hardness (as CaCO3) (mg/L) | | | | 692 | 503 | 179 | 265 | 913 |
| | pH (pH) | | | | 6.95 | 8.11 | 8.25 | 8.25 | 7.84 |
| | Total Suspended Solids (mg/L) | | | | 143 | 291 | <3.0 | <3.0 | 67.3 |
| | Total Dissolved Solids (mg/L) | | | | 967 | 771 | 273 | 343 | 1180 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | | | 809 | 182 | 173 | 240 | 842 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | | | 809 | 182 | 173 | 240 | 842 |
| | Ammonia, Total (as N) (mg/L) | | | | 3.25 | 0.0715 | 0.0074 | 0.0178 | 0.356 |
| | Chloride (Cl) (mg/L) | | | | <2.5 ^{DLDS} | 17.5 | 3.16 | 5.32 | 17.7 |
| | Nitrate and Nitrite (as N) (mg/L) | | | | <0.025 | 41.6 | <0.0051 | 0.258 | 1.33 |
| | Nitrate (as N) (mg/L) | | | | <0.025 ^{DLDS} | 41.4 | <0.0050 | 0.256 | 1.22 |
| | Nitrite (as N) (mg/L) | | | | 0.0170 | 0.229 | <0.0010 | 0.0019 | 0.109 |
| | Sulfate (SO4) (mg/L) | | | | <3.9 | 237 | 36.3 | 60.5 | 182 |
| | Anion Sum (meq/L) | | | | 16.2 | 12.0 | 4.30 | 6.23 | 21.2 |
| | Cation Sum (meq/L) | | | | 19.5 | 11.3 | 4.22 | 6.09 | 21.1 |
| | Cation - Anion Balance (%) | | | | 9.2 | -3.2 | -0.9 | -1.1 | -0.3 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | | | | 16.0 | 19.6 | 5.95 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | | | 0.173 | 11.9 | 0.0350 | 0.0261 | 0.955 |
| | Antimony (Sb)-Total (mg/L) | | | | 0.00027 | 0.00018 | <0.00010 | <0.00010 | 0.00115 |
| | Arsenic (As)-Total (mg/L) | | | | 0.00252 | 0.00208 | 0.00053 | 0.00026 | 0.00144 |
| | Barium (Ba)-Total (mg/L) | | | | 0.923 | 0.202 | 0.0594 | 0.0739 | 0.284 |
| | Beryllium (Be)-Total (mg/L) | | | | 0.000030 | 0.000337 | <0.000020 | <0.000020 | 0.000058 |
| | Bismuth (Bi)-Total (mg/L) | | | | <0.000050 | 0.000058 | <0.000050 | <0.000050 | 0.000106 |
| | Boron (B)-Total (mg/L) | | | | <0.010 | 0.027 | <0.010 | 0.027 | 0.039 |
| | Cadmium (Cd)-Total (mg/L) | | | | 0.0000059 | 0.000101 | 0.0000164 | 0.0000169 | 0.000288 |
| | Calcium (Ca)-Total (mg/L) | | | | 222 | 139 | 42.6 | 60.1 | 245 |
| | Chromium (Cr)-Total (mg/L) | | | | 0.00277 | 0.00373 | 0.00033 | 0.00016 | 0.00352 |
| | Cobalt (Co)-Total (mg/L) | | | | 0.00878 | 0.00367 | <0.00010 | <0.00010 | 0.00351 |
| | Copper (Cu)-Total (mg/L) | | | | 0.00990 | 0.516 | 0.00933 | 0.00779 | 0.671 |
| | Iron (Fe)-Total (mg/L) | | | | 83.4 | 12.2 | 0.057 | 0.052 | 7.40 |
| | Lead (Pb)-Total (mg/L) | | | | 0.000056 | 0.00319 | <0.000050 | <0.000050 | 0.000718 |
| | Lithium (Li)-Total (mg/L) | | | | <0.0010 | 0.0081 | 0.0025 | 0.0033 | 0.0055 |
| | Magnesium (Mg)-Total (mg/L) | | | | 48.0 | 50.2 | 20.9 | 31.2 | 82.4 |
| | Manganese (Mn)-Total (mg/L) | | | | 4.33 | 0.359 | 0.0196 | 0.136 | 8.35 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1912879-6 | L1912879-7 | L1912879-8 | L1912879-9 |
|-----------------------------------|---|--------------|---------------------|-----------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER |
| | | 11-APR-17 | 09:20 | | 11-APR-17 | 11-APR-17 | 11-APR-17 | 11-APR-17 |
| | | | 09:20 | | 09:20 | 16:05 | 10:00 | |
| | | | | | W35 | MC1 | W17 | DUP |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 452 | 411 | 543 | 416 | | |
| | Hardness (as CaCO3) (mg/L) | | 196 | 197 | 270 | 196 | | |
| | pH (pH) | | 7.78 | 8.38 | 8.47 | 8.38 | | |
| | Total Suspended Solids (mg/L) | | 4.0 | <3.0 | <3.0 | <3.0 | | |
| | Total Dissolved Solids (mg/L) | | 364 | 282 | 348 | 276 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 88.8 | 187 | 225 | 183 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | 6.6 | 14.6 | 6.2 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 88.8 | 193 | 240 | 190 | | |
| | Ammonia, Total (as N) (mg/L) | | 0.0980 | <0.0050 | <0.0050 | <0.0050 | | |
| | Chloride (Cl) (mg/L) | | 5.00 | 3.37 | 7.17 | 3.38 | | |
| | Nitrate and Nitrite (as N) (mg/L) | | 25.2 | <0.0051 | 0.131 | <0.0051 | | |
| | Nitrate (as N) (mg/L) | | 25.1 ^{HTD} | <0.0050 | 0.131 | <0.0050 | | |
| | Nitrite (as N) (mg/L) | | 0.0851 | <0.0010 | <0.0010 | <0.0010 | | |
| | Sulfate (SO4) (mg/L) | | 34.7 | 39.7 | 59.9 | 39.5 | | |
| | Anion Sum (meq/L) | | 4.43 | 4.78 | 6.25 | 4.70 | | |
| | Cation Sum (meq/L) | | 4.42 | 4.62 | 6.14 | 4.59 | | |
| | Cation - Anion Balance (%) | | -0.2 | -1.8 | -0.9 | -1.2 | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 24.2 | 19.0 | 8.75 | 18.9 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.472 | 0.0251 | 0.0174 | 0.0282 | | |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Total (mg/L) | | 0.00077 | 0.00050 | 0.00035 | 0.00051 | | |
| | Barium (Ba)-Total (mg/L) | | 0.102 | 0.0649 | 0.0793 | 0.0660 | | |
| | Beryllium (Be)-Total (mg/L) | | 0.000025 | <0.000020 | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | |
| | Boron (B)-Total (mg/L) | | <0.010 | <0.010 | 0.030 | <0.010 | | |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000482 | 0.0000237 | 0.0000080 | 0.0000269 | | |
| | Calcium (Ca)-Total (mg/L) | | 49.4 | 45.1 | 71.4 | 45.3 | | |
| | Chromium (Cr)-Total (mg/L) | | 0.00045 | 0.00023 | 0.00013 | 0.00024 | | |
| | Cobalt (Co)-Total (mg/L) | | 0.00048 | <0.00010 | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Total (mg/L) | | 0.0886 | 0.0146 | 0.00889 | 0.0114 | | |
| | Iron (Fe)-Total (mg/L) | | 0.630 | 0.052 | 0.026 | 0.051 | | |
| | Lead (Pb)-Total (mg/L) | | 0.000234 | <0.000050 | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Total (mg/L) | | 0.0011 | 0.0023 | 0.0015 | 0.0020 | | |
| | Magnesium (Mg)-Total (mg/L) | | 19.8 | 22.2 | 22.7 | 22.3 | | |
| | Manganese (Mn)-Total (mg/L) | | 0.202 | 0.0162 | 0.126 | 0.0163 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1912879-1 WATER 10-APR-17 15:55 W10 | L1912879-2 WATER 10-APR-17 16:25 W15 | L1912879-3 WATER 11-APR-17 08:30 W2 | L1912879-4 WATER 11-APR-17 08:45 W3 | L1912879-5 WATER 11-APR-17 09:00 W8A |
|---|---------------------------------------|--|--|---|---|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.000050 ^{DLM} | <0.0000050 | <0.0000050 | 0.0000121 |
| | Molybdenum (Mo)-Total (mg/L) | 0.000191 | 0.0138 | 0.00114 | 0.00467 | 0.00658 |
| | Nickel (Ni)-Total (mg/L) | 0.00625 | 0.00260 | 0.00082 | 0.00093 | 0.00367 |
| | Phosphorus (P)-Total (mg/L) | 0.377 | 0.182 | 0.060 | <0.050 | 0.204 |
| | Potassium (K)-Total (mg/L) | 2.62 | 9.83 | 3.95 | 2.53 | 8.95 |
| | Selenium (Se)-Total (mg/L) | 0.000544 | 0.0129 | 0.000290 | 0.000289 | 0.00137 |
| | Silicon (Si)-Total (mg/L) | 18.1 | 31.4 | 7.15 | 6.45 | 12.7 |
| | Silver (Ag)-Total (mg/L) | 0.000013 | 0.000197 | <0.000010 | <0.000010 | 0.000322 |
| | Sodium (Na)-Total (mg/L) | 26.6 | 25.8 | 13.3 | 17.8 | 53.8 |
| | Strontium (Sr)-Total (mg/L) | 1.40 | 2.33 | 0.425 | 0.806 | 3.67 |
| | Sulfur (S)-Total (mg/L) | 1.17 | 76.1 | 12.1 | 20.4 | 61.7 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | 0.000069 | <0.000010 | <0.000010 | 0.000017 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | 0.00047 | <0.000010 | <0.000010 | 0.00041 |
| | Titanium (Ti)-Total (mg/L) | 0.0128 | 0.842 | 0.00096 | <0.0012 ^{DLM} | 0.0582 |
| | Uranium (U)-Total (mg/L) | 0.000164 | 0.00442 | 0.00154 | 0.00290 | 0.00464 |
| | Vanadium (V)-Total (mg/L) | 0.00312 | 0.0343 | <0.00050 | <0.00050 | 0.00943 |
| | Zinc (Zn)-Total (mg/L) | 0.0035 | 0.0432 | <0.0030 | <0.0030 | 0.529 |
| | Zirconium (Zr)-Total (mg/L) | 0.00204 | 0.00268 | <0.00030 | <0.00030 | 0.00135 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.107 | 0.0106 | 0.0108 | 0.0078 | 0.0133 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00021 | <0.00010 | <0.00010 | <0.00010 | 0.00014 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00268 | 0.00036 | 0.00052 | 0.00023 | 0.00096 |
| | Barium (Ba)-Dissolved (mg/L) | 0.879 | 0.0781 | 0.0578 | 0.0711 | 0.233 |
| | Beryllium (Be)-Dissolved (mg/L) | 0.000024 | <0.000020 | <0.000020 | <0.000020 | 0.000022 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.023 | <0.010 | 0.024 | 0.036 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000239 | 0.0000172 | 0.0000085 | 0.000175 |
| | Calcium (Ca)-Dissolved (mg/L) | 203 | 128 | 39.7 | 56.3 | 236 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00241 | <0.00010 | 0.00017 | <0.00010 | 0.00104 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00809 | 0.00016 | <0.00010 | <0.00010 | 0.00279 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00080 | 0.0368 | 0.00806 | 0.00450 | 0.0546 |
| | Iron (Fe)-Dissolved (mg/L) | 76.5 | 0.010 | 0.028 | 0.024 | 0.725 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | 0.0042 | 0.0021 | 0.0031 | 0.0049 |
| | Magnesium (Mg)-Dissolved (mg/L) | 45.0 | 44.9 | 19.5 | 30.2 | 78.8 |
| | Manganese (Mn)-Dissolved (mg/L) | 4.15 | 0.0840 | 0.0178 | 0.122 | 7.96 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1912879-6 | L1912879-7 | L1912879-8 | L1912879-9 |
|-------------------------|---------------------------------------|--------------|-------------------------|-------------------------|------------------------|------------|
| | | Description | WATER | WATER | WATER | WATER |
| | | Sampled Date | 11-APR-17 | 11-APR-17 | 11-APR-17 | 11-APR-17 |
| | | Sampled Time | 09:20 | 16:05 | 10:00 | |
| | | Client ID | W35 | MC1 | W17 | DUP |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | 0.0000081 | 0.0000059 | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00203 | 0.00127 | 0.00647 | 0.00132 | |
| | Nickel (Ni)-Total (mg/L) | 0.00129 | 0.00074 | 0.00092 | 0.00074 | |
| | Phosphorus (P)-Total (mg/L) | 0.086 | <0.050 | <0.050 | <0.050 | |
| | Potassium (K)-Total (mg/L) | 7.46 | 3.89 | 3.71 | 3.91 | |
| | Selenium (Se)-Total (mg/L) | 0.000522 | 0.000334 | 0.000397 | 0.000346 | |
| | Silicon (Si)-Total (mg/L) | 4.47 | 7.63 | 5.39 | 7.56 | |
| | Silver (Ag)-Total (mg/L) | 0.000035 | <0.000010 | <0.000010 | <0.000010 | |
| | Sodium (Na)-Total (mg/L) | 7.28 | 13.6 | 15.1 | 13.6 | |
| | Strontium (Sr)-Total (mg/L) | 0.657 | 0.477 | 0.842 | 0.482 | |
| | Sulfur (S)-Total (mg/L) | 11.5 | 13.0 | 19.5 | 12.8 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Total (mg/L) | 0.0255 | <0.00090 ^{DLM} | <0.00090 ^{DLM} | <0.0015 ^{DLM} | |
| | Uranium (U)-Total (mg/L) | 0.000421 | 0.00168 | 0.00283 | 0.00164 | |
| | Vanadium (V)-Total (mg/L) | 0.00185 | <0.00050 | <0.00050 | <0.00050 | |
| | Zinc (Zn)-Total (mg/L) | 0.0044 | <0.0030 | <0.0030 | 0.0034 | |
| | Zirconium (Zr)-Total (mg/L) | 0.00031 | <0.00030 | <0.00030 | <0.00030 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0291 | 0.0103 | 0.0030 | 0.0099 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00056 | 0.00050 | 0.00034 | 0.00049 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0970 | 0.0641 | 0.0750 | 0.0649 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | 0.029 | <0.010 | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000288 | 0.0000221 | <0.0000050 | 0.0000204 | |
| | Calcium (Ca)-Dissolved (mg/L) | 47.3 | 43.0 | 71.5 | 43.4 | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00018 | 0.00018 | <0.00010 | 0.00018 | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00029 | <0.00010 | <0.00010 | <0.00010 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0570 | 0.00910 | 0.00654 | 0.00900 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.073 | 0.027 | <0.010 | 0.027 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | 0.0019 | 0.0013 | 0.0019 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 18.8 | 21.8 | 22.2 | 21.2 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.182 | 0.0148 | 0.0379 | 0.0149 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1912879-1 | L1912879-2 | L1912879-3 | L1912879-4 | L1912879-5 |
|-------------------------|----------------------------------|-------------------------|--------------|------------|--|--|---|---|--|
| | | | | | L1912879-1 WATER 10-APR-17 15:55 W10 | L1912879-2 WATER 10-APR-17 16:25 W15 | L1912879-3 WATER 11-APR-17 08:30 W2 | L1912879-4 WATER 11-APR-17 08:45 W3 | L1912879-5 WATER 11-APR-17 09:00 W8A |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000062 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000131 | 0.0126 | 0.00105 | 0.00434 | 0.00593 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00573 | <0.00050 | 0.00070 | 0.00080 | 0.00240 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | 0.330 | <0.050 | <0.050 | <0.050 | 0.060 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.48 | 6.87 | 3.78 | 2.42 | 8.34 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000735 ^{DTC} | 0.0128 | 0.000290 | 0.000322 | 0.00166 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 17.6 | 4.84 | 6.78 | 6.13 | 10.3 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000021 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 24.5 | 23.9 | 12.4 | 16.8 | 51.6 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 1.29 | 2.12 | 0.411 | 0.755 | 3.51 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 0.94 | 73.8 | 11.5 | 19.3 | 59.1 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00835 | 0.00092 | <0.00030 | <0.00030 | <0.00090 ^{DLM} | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000145 | 0.00405 | 0.00144 | 0.00279 | 0.00443 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00266 | <0.00050 | <0.00050 | <0.00050 | 0.00232 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0020 | <0.0010 | 0.0019 | 0.0016 | 0.145 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00213 | <0.00030 | <0.00030 | <0.00030 | 0.00133 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1912879-6 | L1912879-7 | L1912879-8 | L1912879-9 |
|-------------------------|----------------------------------|------------------------|--------------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER |
| | | | | | 11-APR-17 | 11-APR-17 | 11-APR-17 | 11-APR-17 |
| | | | | | 09:20 | 16:05 | 10:00 | |
| | | | | | W35 | MC1 | W17 | DUP |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00183 | 0.00119 | 0.00610 | 0.00121 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00097 | 0.00064 | 0.00081 | 0.00080 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 7.08 | 3.77 | 3.65 | 3.83 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000466 | 0.000343 | 0.000476 | 0.000326 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 3.50 | 7.36 | 5.23 | 7.28 | | | |
| | Silver (Ag)-Dissolved (mg/L) | 0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 6.99 | 13.2 | 14.8 | 13.3 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.637 | 0.472 | 0.819 | 0.474 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 10.9 | 12.2 | 18.7 | 12.1 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.0024 ^{DLM} | 0.00032 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000376 | 0.00157 | 0.00264 | 0.00155 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0016 | 0.0016 | <0.0010 | 0.0024 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|----------------------|-----------|--|
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1912879-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1912879-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1912879-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1912879-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1912879-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1912879-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1912879-1, -2, -3, -4, -5, -6, -7, -8, -9 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| HTD | Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| <p>This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.</p> | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| <p>Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.</p> | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| <p>Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| <p>Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| <p>This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.</p> | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| <p>This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.</p> | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| <p>Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.</p> | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| <p>Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.</p> | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| <p>Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.</p> | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| <p>Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.</p> | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |

Reference Information

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |

Reference Information

VA

ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2017-04-12 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 19-APR-17
Report Date: 28-APR-17 20:02 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1914885
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-04-19A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1914885-1 | L1914885-2 | L1914885-3 | L1914885-4 | L1914885-5 |
|-----------------------------------|---|--------------|--------------|-----------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 18-APR-17 | 08:10 | W3 | 18-APR-17 | 08:30 | 08:40 | 08:50 | 09:00 |
| | | | | | W3 | W8A | W35 | W15 | RO |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 539 | 1500 | 187 | 1120 | 134 | | | |
| | Hardness (as CaCO3) (mg/L) | 281 | 850 | 95.9 | 577 | 27.5 | | | |
| | pH (pH) | 8.24 | 7.70 | 7.68 | 8.25 | 7.23 | | | |
| | Total Suspended Solids (mg/L) | <3.0 | 48.3 | <3.0 | 4.7 | <3.0 | | | |
| | Total Dissolved Solids (mg/L) | 358 | 1080 | 187 | 833 | 87 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 253 | 742 | 73.8 | 227 | 17.6 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 253 | 742 | 73.8 | 227 | 17.6 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0155 | 0.312 | 0.0321 | 0.0362 | 0.423 | | | |
| | Chloride (Cl) (mg/L) | 5.08 | 17.1 | 2.87 | 6.9 | 1.96 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.286 | 0.682 | 1.19 | 39.2 | 2.81 | | | |
| | Nitrate (as N) (mg/L) | 0.285 | 0.587 | 1.18 | 38.7 | 2.60 | | | |
| | Nitrite (as N) (mg/L) | 0.0011 | 0.094 | 0.0095 | 0.438 | 0.208 | | | |
| | Sulfate (SO4) (mg/L) | 59.0 | 216 | 12.9 | 241 | 29.1 | | | |
| | Anion Sum (meq/L) | 6.47 | 19.9 | 1.91 | 12.5 | 1.22 | | | |
| | Cation Sum (meq/L) | 6.49 | 19.8 | 2.17 | 12.6 | 1.21 | | | |
| | Cation - Anion Balance (%) | 0.1 | -0.3 | 6.2 | 0.4 | -0.1 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 4.53 | | 39.0 | 16.3 | 3.79 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0139 | 0.137 | 0.0915 | 0.176 | 0.0071 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00019 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00024 | 0.00103 | 0.00055 | 0.00043 | <0.00010 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0733 | 0.258 | 0.0652 | 0.0839 | 0.00261 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | 0.000033 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | 0.030 | 0.039 | <0.010 | 0.021 | 0.107 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000101 | 0.000263 | 0.0000246 | 0.0000231 | <0.0000050 | | | |
| | Calcium (Ca)-Total (mg/L) | 58.6 | 229 | 28.1 | 149 | 8.61 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00012 | 0.00134 | 0.00036 | 0.00016 | <0.00010 | | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00306 | 0.00024 | 0.00027 | <0.00010 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00901 | 0.160 | 0.0935 | 0.0436 | 0.00253 | | | |
| | Iron (Fe)-Total (mg/L) | 0.042 | 3.75 | 0.166 | 0.238 | <0.010 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.000167 | <0.000050 | 0.000082 | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0033 | 0.0047 | <0.0010 | 0.0026 | <0.0010 | | | |
| | Magnesium (Mg)-Total (mg/L) | 30.7 | 69.2 | 6.62 | 46.6 | 1.50 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.127 | 7.18 | 0.0854 | 0.145 | 0.0190 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1914885-6 | L1914885-7 | L1914885-8 | L1914885-9 | L1914885-10 |
|-----------------------------------|---|--------------------------|--------------|-----------|------------|------------|------------|------------|-------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 18-APR-17 | 09:05 | WTPI | 18-APR-17 | 18-APR-17 | 18-APR-17 | 18-APR-17 | 18-APR-17 |
| | | | | | 09:05 | 15:10 | 15:25 | 16:00 | |
| | | | | | WTPI | W2 | MC1 | W17 | DUP |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 2150 | 337 | 391 | 538 | 539 | | | |
| | Hardness (as CaCO3) (mg/L) | 1020 | 173 | 204 | 276 | 274 | | | |
| | pH (pH) | 7.95 | 8.28 | 8.28 | 8.27 | 8.24 | | | |
| | Total Suspended Solids (mg/L) | 5.1 | <3.0 | <3.0 | <3.0 | <3.0 | | | |
| | Total Dissolved Solids (mg/L) | 1800 | 256 | 282 | 340 | 317 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 174 | 169 | 190 | 241 | 238 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 174 | 169 | 190 | 241 | 238 | | | |
| | Ammonia, Total (as N) (mg/L) | 5.84 | 0.0082 | 0.0084 | <0.0050 | <0.0050 | | | |
| | Chloride (Cl) (mg/L) | 34 | 2.45 | 2.90 | 7.08 | 7.09 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 25.5 | <0.0051 | <0.0051 | 0.123 | 0.123 | | | |
| | Nitrate (as N) (mg/L) | 23.5 | <0.0050 | <0.0050 | 0.123 | 0.123 | | | |
| | Nitrite (as N) (mg/L) | 2.01 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | | |
| | Sulfate (SO4) (mg/L) | 1040 | 21.6 | 28.0 | 58.2 | 58.4 | | | |
| | Anion Sum (meq/L) | 28.1 | 3.91 | 4.48 | 6.25 | 6.19 | | | |
| | Cation Sum (meq/L) | 27.0 | 3.99 | 4.71 | 6.35 | 6.29 | | | |
| | Cation - Anion Balance (%) | -2.0 | 1.0 | 2.6 | 0.8 | 0.8 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 41.4 | 24.6 | 25.7 | 8.27 | 8.21 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0890 | 0.0626 | 0.0221 | 0.0138 | 0.0076 | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00028 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00044 | 0.00060 | 0.00063 | 0.00036 | 0.00036 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0963 | 0.0613 | 0.0694 | 0.0794 | 0.0771 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000040 ^{DLA} | <0.000020 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | 0.222 | 0.011 | 0.010 | 0.031 | 0.031 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.000092 | 0.0000182 | 0.0000241 | <0.000050 | <0.000050 | | | |
| | Calcium (Ca)-Total (mg/L) | 329 | 42.2 | 46.8 | 71.6 | 71.7 | | | |
| | Chromium (Cr)-Total (mg/L) | <0.00020 ^{DLA} | 0.00038 | 0.00045 | 0.00011 | 0.00011 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00090 | 0.00015 | 0.00011 | <0.00010 | <0.00010 | | | |
| | Copper (Cu)-Total (mg/L) | 0.0718 | 0.0108 | 0.0115 | 0.00696 | 0.00902 | | | |
| | Iron (Fe)-Total (mg/L) | 0.137 | 0.124 | 0.088 | 0.021 | 0.010 | | | |
| | Lead (Pb)-Total (mg/L) | 0.00030 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0117 | 0.0018 | 0.0019 | 0.0013 | 0.0014 | | | |
| | Magnesium (Mg)-Total (mg/L) | 41.8 | 16.3 | 19.0 | 22.6 | 22.7 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.630 | 0.0356 | 0.0226 | 0.0502 | 0.0361 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1914885-1 | L1914885-2 | L1914885-3 | L1914885-4 | L1914885-5 |
|-------------------------|---------------------------------------|-------------------------|------------------------|------------------------|------------------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 18-APR-17 | 18-APR-17 | 18-APR-17 | 18-APR-17 | 18-APR-17 |
| | | | | | 08:10 | 08:30 | 08:40 | 08:50 | 09:00 |
| | | | | | W3 | W8A | W35 | W15 | RO |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | 0.0000086 | 0.0000064 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00499 | 0.00680 | 0.000758 | 0.00858 | 0.00258 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00092 | 0.00221 | 0.00142 | 0.00052 | <0.00050 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.119 | 0.067 | <0.050 | <0.050 | | | |
| | Potassium (K)-Total (mg/L) | 2.51 | 8.43 | 3.78 | 7.96 | 2.59 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000317 | 0.00125 | 0.000181 | 0.0131 | 0.000541 | | | |
| | Silicon (Si)-Total (mg/L) | 6.38 | 10.2 | 4.77 | 7.19 | 0.15 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000063 | 0.000028 | 0.000015 | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 20.0 | 54.3 | 3.55 | 22.0 | 13.7 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.791 | 3.23 | 0.171 | 2.27 | 0.178 | | | |
| | Sulfur (S)-Total (mg/L) | 21.3 | 78.3 | 5.03 | 90.5 | 10.3 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | 0.00026 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | <0.00090 ^{DLM} | <0.0060 ^{DLM} | <0.0060 ^{DLM} | <0.0090 ^{DLM} | <0.00030 | | | |
| | Uranium (U)-Total (mg/L) | 0.00323 | 0.00424 | 0.000109 | 0.00460 | 0.000152 | | | |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00463 | 0.00067 | 0.00099 | <0.00050 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.181 | <0.0030 | 0.0032 | 0.0040 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | 0.00097 | <0.00030 | <0.00030 | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0031 | 0.143 | 0.0347 | 0.0112 | 0.0038 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00013 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00023 | 0.00083 | 0.00051 | 0.00037 | <0.00010 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0736 | 0.241 | 0.0604 | 0.0830 | 0.00261 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | 0.000028 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.023 | 0.028 | <0.010 | 0.014 | 0.099 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000086 | 0.000245 | 0.0000210 | 0.0000214 | <0.0000050 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 59.3 | 220 | 28.0 | 149 | 8.57 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00089 | 0.00030 | <0.00010 | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00289 | 0.00020 | 0.00021 | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00290 | 0.106 | 0.0836 | 0.0321 | 0.00069 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.022 | 0.389 | 0.104 | 0.029 | <0.010 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | 0.00102 ^{DTC} | <0.000050 | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0036 | 0.0047 | <0.0010 | 0.0027 | <0.0010 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 32.2 | 72.9 | 6.33 | 49.8 | 1.49 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.118 | 6.98 | 0.0698 | 0.134 | 0.0181 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1914885-6 | L1914885-7 | L1914885-8 | L1914885-9 | L1914885-10 |
|-------------------------|---------------------------------------|--------------------------|--------------|-------------------------|------------|------------|------------|------------|-------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 18-APR-17 | 18-APR-17 | 18-APR-17 | 18-APR-17 | 18-APR-17 |
| | | | | | 09:05 | 15:10 | 15:25 | 16:00 | |
| | | | | | WTPI | W2 | MC1 | W17 | DUP |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.0732 | 0.00114 | 0.00135 | 0.00665 | 0.00643 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.0027 | 0.00119 | 0.00120 | 0.00078 | 0.00076 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.10 ^{DLA} | <0.050 | 0.056 | <0.050 | <0.050 | | | |
| | Potassium (K)-Total (mg/L) | 40.5 | 3.68 | 3.87 | 4.05 | 3.99 | | | |
| | Selenium (Se)-Total (mg/L) | 0.0112 | 0.000207 | 0.000249 | 0.000370 | 0.000363 | | | |
| | Silicon (Si)-Total (mg/L) | 3.26 | 7.74 | 8.48 | 5.51 | 5.44 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 118 | 10.6 | 12.9 | 17.1 | 16.6 | | | |
| | Strontium (Sr)-Total (mg/L) | 6.73 | 0.389 | 0.483 | 0.848 | 0.828 | | | |
| | Sulfur (S)-Total (mg/L) | 366 | 8.07 | 10.2 | 21.4 | 21.3 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.00020 ^{DLA} | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.00366 | 0.00201 | <0.00060 ^{DLM} | 0.00152 | <0.00030 | | | |
| | Uranium (U)-Total (mg/L) | 0.00537 | 0.00139 | 0.00179 | 0.00296 | 0.00291 | | | |
| | Vanadium (V)-Total (mg/L) | <0.0010 ^{DLA} | 0.00066 | 0.00052 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0060 ^{DLA} | <0.0030 | <0.0030 | <0.0030 | <0.0030 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0054 | 0.0156 | 0.0159 | 0.0027 | 0.0040 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00026 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00039 | 0.00054 | 0.00057 | 0.00032 | 0.00034 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0979 | 0.0610 | 0.0714 | 0.0803 | 0.0782 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000040 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00010 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.192 | <0.010 | <0.010 | 0.026 | 0.026 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000091 | 0.0000161 | 0.0000213 | <0.0000050 | <0.0000050 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 335 | 41.2 | 47.7 | 70.6 | 71.5 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00020 | 0.00027 | 0.00031 | <0.00010 | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00083 | 0.00012 | 0.00010 | <0.00010 | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0315 | 0.00933 | 0.0106 | 0.00653 | 0.00696 | | | |
| | Iron (Fe)-Dissolved (mg/L) | <0.020 | 0.057 | 0.059 | <0.010 | <0.010 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.00010 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0121 | 0.0021 | 0.0022 | 0.0017 | 0.0016 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 45.5 | 17.0 | 20.5 | 24.3 | 23.2 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.617 | 0.0314 | 0.0209 | 0.0197 | 0.0201 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1914885-1 | L1914885-2 | L1914885-3 | L1914885-4 | L1914885-5 |
|-------------------------|----------------------------------|--------------|------------------------|-----------|---|--|--|--|---|
| | | | | | L1914885-1 WATER 18-APR-17 08:10 W3 | L1914885-2 WATER 18-APR-17 08:30 W8A | L1914885-3 WATER 18-APR-17 08:40 W35 | L1914885-4 WATER 18-APR-17 08:50 W15 | L1914885-5 WATER 18-APR-17 09:00 RO |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | 0.0000079 | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00458 | 0.00603 | 0.000731 | 0.00780 | 0.00238 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00077 | 0.00212 | 0.00113 | <0.00050 | <0.00050 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | 0.099 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.34 | 8.08 | 3.50 | 7.92 | 2.43 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000315 | 0.00102 | 0.000144 | 0.0132 | 0.000611 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.61 | 10.5 | 4.60 | 7.19 | 0.124 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | 0.000012 | 0.000017 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 18.8 | 52.0 | 3.33 | 21.1 | 13.1 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.789 | 3.11 | 0.178 | 2.27 | 0.181 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 21.6 | 79.6 | 4.48 | 91.8 | 10.7 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.0018 ^{DLM} | 0.00174 | 0.00085 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00318 | 0.00421 | 0.000104 | 0.00452 | 0.000144 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00183 | <0.00050 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | 0.140 | 0.0019 | 0.0021 | 0.0031 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | 0.00098 | 0.00034 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1914885-6 | L1914885-7 | L1914885-8 | L1914885-9 | L1914885-10 |
|-------------------------|----------------------------------|--------------|--------------|-------------------------|------------|------------|------------|------------|-------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 18-APR-17 | 09:05 | WTPI | 18-APR-17 | 18-APR-17 | 18-APR-17 | 18-APR-17 | 18-APR-17 |
| | | | | | | 15:10 | 15:25 | 16:00 | |
| | | | | | | W2 | MC1 | W17 | DUP |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | 0.0000053 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0732 | 0.00104 | 0.00121 | 0.00583 | 0.00594 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0026 | 0.00104 | 0.00108 | 0.00072 | 0.00071 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.10 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 39.4 | 3.43 | 3.72 | 3.96 | 3.93 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.0120 | 0.000254 | 0.000283 | 0.000436 | 0.000404 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 3.33 | 8.09 | 9.06 | 5.68 | 5.44 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 117 | 10.1 | 12.4 | 16.6 | 16.5 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 7.19 | 0.386 | 0.474 | 0.798 | 0.829 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 384 | 8.33 | 10.5 | 21.5 | 21.0 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 | 0.00035 | <0.00060 ^{DLM} | <0.00030 | 0.00035 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00558 | 0.00128 | 0.00171 | 0.00281 | 0.00258 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0025 | 0.0017 | 0.0019 | <0.0010 | 0.0013 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|---|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1914885-10, -9 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1914885-1, -4, -5, -7, -8 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1914885-1, -4, -5, -7, -8 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1914885-1, -4, -5, -7, -8 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1914885-3, -6 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1914885-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1914885-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L1914885-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1914885-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1914885-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1914885-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1914885-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1914885-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Nickel (Ni)-Total | MS-B | L1914885-10, -7, -8, -9 |
| Matrix Spike | Silicon (Si)-Total | MS-B | L1914885-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1914885-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Nitrate (as N) | MS-B | L1914885-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |

Reference Information

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = $\frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

Reference Information

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-04-19A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| | | | | | | | | | | | | | | | | | | |
|--|--|------------------|--|-------------------------|--------------------|---|-------------------------------------|-------------------------------------|------------------------------------|---|---|--|----------------------------------|---------------------------------------|-----------------------------|--|--|--|
| Report To Contact and company name below will appear on the final report | | | Report Format Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | All E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | | 1 Business day [E1] <input type="checkbox"/> | | | | | | |
| Contact: Minto Environment - Coordinator | | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | |
| Phone: 1-604-759-4659 | | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | |
| Company address below will appear on the final report | | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | dd-mmm-yy hh:mm | | | | | | |
| Street: 2100-510 West Georgia St. | | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | | Email 3 | | | Analysis Request | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | | Email 2 | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | | |
| Project Information | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | |
| Job #: | | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | |
| PO / AFE: 224162 (WUL) | | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | ALS Contact: Shane Stack | | | Sampler: SR/SB | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (1) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | | |
| 1 | W3 | | 18-Apr-17 | 8:10 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| 2 | W8A | | 18-Apr-17 | 8:30 | Water | R | R | R | R | R | R | R | R | R | 6 | | | |
| 3 | W35 | | 18-Apr-17 | 8:40 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| 4 | W15 | | 18-Apr-17 | 8:50 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| 5 | RO | | 18-Apr-17 | 9:00 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| 6 | WTPI | | 18-Apr-17 | 9:05 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| 7 | W2 | | 18-Apr-17 | 15:10 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| 8 | MC1 | | 18-Apr-17 | 15:25 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| 9 | W17 | | 18-Apr-17 | 16:00 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| 10 | Dup | | 18-Apr-17 | | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| Drinking Water (DW) Samples¹ (client use) | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Frozen <input type="checkbox"/> | | | | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Ice Packs <input type="checkbox"/> | | | | | Ice Cubes <input type="checkbox"/> | | | | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | |
| | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | | 1.6°C | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-04-19 | Time: 13:00 | Received by: <i>VLD</i> | | Date: 04/19/2017 | | Time: 15:42 | | Received by: | | | Date: | | | Time: | | |

Short Holding Time
Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 26-APR-17
Report Date: 05-MAY-17 16:35 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1917913
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-04-26 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1917913-1 WATER 25-APR-17 07:35 W15 | L1917913-2 WATER 25-APR-17 07:45 W35 | L1917913-3 WATER 25-APR-17 08:25 W16 | L1917913-4 WATER 25-APR-17 11:45 W8A | L1917913-5 WATER 25-APR-17 14:30 W2 | |
|---|--|--|--|--|---|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 731 | 177 | 76.0 | 1570 | 267 |
| | Hardness (as CaCO3) (mg/L) | 343 | 84.6 | 23.9 | 800 | 130 |
| | pH (pH) | 8.17 | 7.86 | 7.55 | 7.90 | 8.17 |
| | Total Suspended Solids (mg/L) | 6.4 | <3.0 | <3.0 | 32.8 | 22.2 |
| | Total Dissolved Solids (mg/L) | 490 | 168 | 47 | 1030 | 195 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 151 | 71.5 | 22.6 | 734 | 129 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 151 | 71.5 | 22.6 | 734 | 129 |
| | Ammonia, Total (as N) (mg/L) | 0.0911 | 0.0207 | 0.130 | 0.363 | 0.0060 |
| | Chloride (Cl) (mg/L) | 4.1 | 2.55 | 1.07 | 19.4 | 1.60 |
| | Nitrate and Nitrite (as N) (mg/L) | 22.0 | 1.36 | 0.851 | 0.648 | <0.0051 |
| | Nitrate (as N) (mg/L) | 21.4 | 1.35 | 0.807 | 0.518 | <0.0050 |
| | Nitrite (as N) (mg/L) | 0.548 | 0.0165 | 0.0438 | 0.130 | <0.0010 |
| | Sulfate (SO4) (mg/L) | 147 | 8.32 | 9.03 | 199 | 14.1 |
| | Anion Sum (meq/L) | 7.77 | 1.77 | 0.73 | 19.4 | 2.93 |
| | Cation Sum (meq/L) | 7.56 | 1.95 | 0.70 | 18.8 | 3.07 |
| | Cation - Anion Balance (%) | -1.4 | 4.8 | -2.0 | -1.6 | 2.5 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 12.8 | 32.4 | 1.91 | | 18.5 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.153 | 0.106 | 0.0684 | 1.02 | 0.524 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00026 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00030 | 0.00049 | 0.00010 | 0.00133 | 0.00069 |
| | Barium (Ba)-Total (mg/L) | 0.0637 | 0.0568 | 0.0139 | 0.286 | 0.0554 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | 0.000060 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | 0.000067 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.011 | <0.010 | 0.029 | 0.035 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000161 | 0.0000196 | 0.0000147 | 0.000243 | 0.0000209 |
| | Calcium (Ca)-Total (mg/L) | 91.3 | 24.6 | 7.44 | 221 | 29.7 |
| | Chromium (Cr)-Total (mg/L) | 0.00015 | 0.00033 | <0.00010 | 0.00218 | 0.00115 |
| | Cobalt (Co)-Total (mg/L) | 0.00041 | 0.00019 | <0.00010 | 0.00371 | 0.00043 |
| | Copper (Cu)-Total (mg/L) | 0.0406 | 0.0653 | 0.0146 | 0.443 | 0.0154 |
| | Iron (Fe)-Total (mg/L) | 0.396 | 0.202 | 0.078 | 6.40 | 0.725 |
| | Lead (Pb)-Total (mg/L) | 0.000079 | 0.000062 | <0.000050 | 0.000640 | 0.000198 |
| | Lithium (Li)-Total (mg/L) | 0.0017 | <0.0010 | <0.0010 | 0.0055 | 0.0016 |
| | Magnesium (Mg)-Total (mg/L) | 29.4 | 6.29 | 1.51 | 71.9 | 13.0 |
| | Manganese (Mn)-Total (mg/L) | 0.191 | 0.0389 | 0.0381 | 7.21 | 0.0645 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1917913-6 WATER 25-APR-17 15:20 MC1 | L1917913-7 WATER 25-APR-17 16:00 W3 | L1917913-8 WATER 25-APR-17 16:15 W17 | L1917913-9 WATER 25-APR-17 DUP | |
|---|--|---|--|---|-----------|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 242 | 519 | 539 | 266 |
| | Hardness (as CaCO3) (mg/L) | 114 | 231 | 266 | 119 |
| | pH (pH) | 8.19 | 8.30 | 8.32 | 8.19 |
| | Total Suspended Solids (mg/L) | 3.2 | <3.0 | <3.0 | 20.4 |
| | Total Dissolved Solids (mg/L) | 168 | 292 | 316 | 161 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 118 | 233 | 226 | 129 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | 3.2 | 5.4 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 118 | 236 | 231 | 129 |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.0118 | <0.0050 | <0.0050 |
| | Chloride (Cl) (mg/L) | 1.45 | 4.66 | 6.82 | 1.60 |
| | Nitrate and Nitrite (as N) (mg/L) | <0.0051 | 0.216 | 0.283 | <0.0051 |
| | Nitrate (as N) (mg/L) | <0.0050 | 0.214 | 0.283 | <0.0050 |
| | Nitrite (as N) (mg/L) | <0.0010 | 0.0013 | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | 12.8 | 53.4 | 56.8 | 14.1 |
| | Anion Sum (meq/L) | 2.66 | 5.98 | 6.01 | 2.91 |
| | Cation Sum (meq/L) | 2.68 | 5.35 | 6.21 | 2.81 |
| | Cation - Anion Balance (%) | 0.5 | -5.6 | 1.6 | -1.7 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 17.9 | 4.86 | 8.06 | 18.0 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0619 | 0.0139 | 0.0096 | 0.543 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00046 | 0.00022 | 0.00035 | 0.00068 |
| | Barium (Ba)-Total (mg/L) | 0.0449 | 0.0703 | 0.0749 | 0.0566 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | <0.010 | 0.022 | 0.029 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000152 | 0.0000078 | <0.0000050 | 0.0000220 |
| | Calcium (Ca)-Total (mg/L) | 26.3 | 52.8 | 66.3 | 29.3 |
| | Chromium (Cr)-Total (mg/L) | 0.00031 | <0.00010 | 0.00012 | 0.00110 |
| | Cobalt (Co)-Total (mg/L) | 0.00012 | <0.00010 | <0.00010 | 0.00044 |
| | Copper (Cu)-Total (mg/L) | 0.0101 | 0.00428 | 0.00774 | 0.0154 |
| | Iron (Fe)-Total (mg/L) | 0.129 | 0.028 | 0.011 | 0.740 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | 0.000197 |
| | Lithium (Li)-Total (mg/L) | <0.0010 | 0.0031 | 0.0016 | 0.0015 |
| | Magnesium (Mg)-Total (mg/L) | 11.4 | 27.3 | 21.9 | 12.7 |
| | Manganese (Mn)-Total (mg/L) | 0.0299 | 0.102 | 0.0514 | 0.0630 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1917913-1 WATER 25-APR-17 07:35 W15 | L1917913-2 WATER 25-APR-17 07:45 W35 | L1917913-3 WATER 25-APR-17 08:25 W16 | L1917913-4 WATER 25-APR-17 11:45 W8A | L1917913-5 WATER 25-APR-17 14:30 W2 |
|---|---------------------------------------|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | 0.0000081 | <0.0000050 | 0.0000115 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00373 | 0.000741 | 0.000676 | 0.00602 | 0.000936 |
| | Nickel (Ni)-Total (mg/L) | 0.00055 | 0.00149 | <0.00050 | 0.00245 | 0.00164 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.062 | <0.050 | 0.231 | 0.070 |
| | Potassium (K)-Total (mg/L) | 5.36 | 3.74 | 0.91 | 9.43 | 3.29 |
| | Selenium (Se)-Total (mg/L) | 0.00724 | 0.000158 | 0.000195 | 0.00136 | 0.000190 |
| | Silicon (Si)-Total (mg/L) | 4.63 | 4.41 | 0.53 | 12.5 | 6.78 |
| | Silver (Ag)-Total (mg/L) | 0.000012 | 0.000018 | <0.000010 | 0.000173 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 13.3 | 3.69 | 4.66 | 54.5 | 8.54 |
| | Strontium (Sr)-Total (mg/L) | 1.23 | 0.145 | 0.0861 | 3.06 | 0.292 |
| | Sulfur (S)-Total (mg/L) | 52.4 | 3.26 | 3.02 | 77.5 | 5.07 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | 0.000013 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00015 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.00699 | 0.00509 | 0.00258 | 0.0536 | 0.0197 |
| | Uranium (U)-Total (mg/L) | 0.00259 | 0.000083 | 0.000116 | 0.00416 | 0.000971 |
| | Vanadium (V)-Total (mg/L) | 0.00075 | 0.00071 | <0.00050 | 0.00816 | 0.00189 |
| | Zinc (Zn)-Total (mg/L) | 0.0031 | 0.0040 | <0.0030 | 0.538 | 0.0037 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00095 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0085 | 0.0326 | 0.0185 | 0.0151 | 0.0147 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00026 | 0.00044 | <0.00010 | 0.00062 | 0.00044 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0602 | 0.0566 | 0.0141 | 0.241 | 0.0507 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | 0.025 | 0.029 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000161 | 0.0000188 | 0.0000105 | 0.000140 | 0.0000116 |
| | Calcium (Ca)-Dissolved (mg/L) | 88.8 | 23.4 | 7.06 | 206 | 29.7 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00029 | <0.00010 | 0.00078 | 0.00023 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00032 | 0.00015 | <0.00010 | 0.00281 | 0.00015 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0255 | 0.0557 | 0.0109 | 0.0343 | 0.00777 |
| | Iron (Fe)-Dissolved (mg/L) | 0.073 | 0.143 | 0.018 | 0.531 | 0.071 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.000123 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0018 | <0.0010 | <0.0010 | 0.0048 | 0.0019 |
| | Magnesium (Mg)-Dissolved (mg/L) | 29.5 | 6.39 | 1.52 | 69.5 | 13.6 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.176 | 0.0348 | 0.0338 | 6.82 | 0.0299 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1917913-6 | L1917913-7 | L1917913-8 | L1917913-9 |
|-------------------------|---------------------------------------|--------------|------------|------------|------------|------------|
| | | Description | WATER | WATER | WATER | WATER |
| | | Sampled Date | 25-APR-17 | 25-APR-17 | 25-APR-17 | 25-APR-17 |
| | | Sampled Time | 15:20 | 16:00 | 16:15 | |
| | | Client ID | MC1 | W3 | W17 | DUP |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000072 |
| | Molybdenum (Mo)-Total (mg/L) | | 0.000809 | 0.00437 | 0.00597 | 0.000903 |
| | Nickel (Ni)-Total (mg/L) | | 0.00099 | 0.00086 | 0.00076 | 0.00165 |
| | Phosphorus (P)-Total (mg/L) | | <0.050 | <0.050 | <0.050 | 0.060 |
| | Potassium (K)-Total (mg/L) | | 2.86 | 2.34 | 3.97 | 3.24 |
| | Selenium (Se)-Total (mg/L) | | 0.000140 | 0.000295 | 0.000383 | 0.000183 |
| | Silicon (Si)-Total (mg/L) | | 5.57 | 6.01 | 5.42 | 6.81 |
| | Silver (Ag)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | | 7.63 | 17.7 | 16.6 | 8.09 |
| | Strontium (Sr)-Total (mg/L) | | 0.267 | 0.719 | 0.780 | 0.291 |
| | Sulfur (S)-Total (mg/L) | | 4.45 | 19.3 | 20.5 | 5.10 |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | | 0.00217 | 0.00073 | 0.00037 | 0.0214 |
| | Uranium (U)-Total (mg/L) | | 0.000811 | 0.00283 | 0.00289 | 0.000958 |
| | Vanadium (V)-Total (mg/L) | | 0.00051 | <0.00050 | <0.00050 | 0.00188 |
| | Zinc (Zn)-Total (mg/L) | | <0.0030 | <0.0030 | <0.0030 | 0.0040 |
| | Zirconium (Zr)-Total (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0139 | 0.0027 | 0.0024 | 0.0153 |
| | Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00039 | 0.00021 | 0.00036 | 0.00041 |
| | Barium (Ba)-Dissolved (mg/L) | | 0.0438 | 0.0649 | 0.0867 | 0.0472 |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | <0.010 | 0.019 | 0.025 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | | 0.0000098 | 0.0000072 | <0.0000050 | 0.0000097 |
| | Calcium (Ca)-Dissolved (mg/L) | | 26.4 | 51.7 | 65.5 | 26.5 |
| | Chromium (Cr)-Dissolved (mg/L) | | 0.00026 | <0.00010 | 0.00012 | 0.00024 |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | 0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00875 | 0.00319 | 0.00772 | 0.00920 |
| | Iron (Fe)-Dissolved (mg/L) | | 0.063 | 0.013 | <0.010 | 0.065 |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | | 0.0016 | 0.0033 | 0.0020 | 0.0017 |
| | Magnesium (Mg)-Dissolved (mg/L) | | 11.6 | 24.8 | 24.9 | 12.7 |
| | Manganese (Mn)-Dissolved (mg/L) | | 0.0283 | 0.0879 | 0.0247 | 0.0313 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1917913-1 | L1917913-2 | L1917913-3 | L1917913-4 | L1917913-5 |
|-------------------------|----------------------------------|--------------|--------------|------------|--|--|--|--|---|
| | | | | | L1917913-1 WATER 25-APR-17 07:35 W15 | L1917913-2 WATER 25-APR-17 07:45 W35 | L1917913-3 WATER 25-APR-17 08:25 W16 | L1917913-4 WATER 25-APR-17 11:45 W8A | L1917913-5 WATER 25-APR-17 14:30 W2 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | 0.0000064 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00356 | 0.000707 | 0.000653 | 0.00531 | 0.000955 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | 0.00144 | <0.00050 | 0.00182 | 0.00087 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 5.05 | 3.50 | 0.90 | 8.27 | 3.06 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00717 | 0.000154 | 0.000145 | 0.00101 | 0.000182 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 3.97 | 4.05 | 0.446 | 9.81 | 5.46 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | 0.000010 | <0.000010 | 0.000015 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 12.8 | 3.56 | 4.31 | 53.0 | 8.84 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 1.21 | 0.144 | 0.0843 | 2.82 | 0.295 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 50.3 | 3.24 | 2.95 | 74.5 | 5.55 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00047 | 0.00160 | 0.00035 | <0.00090 ^{DLM} | 0.00044 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00232 | 0.000096 | 0.000109 | 0.00353 | 0.000883 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00161 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0028 | 0.0026 | 0.0011 | 0.121 | 0.0034 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00084 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1917913-6 | L1917913-7 | L1917913-8 | L1917913-9 |
|-------------------------|----------------------------------|--------------|--------------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER |
| | | 25-APR-17 | 15:20 | MC1 | 25-APR-17 | 25-APR-17 | 25-APR-17 | 25-APR-17 |
| | | | | | | 16:00 | 16:15 | |
| | | | | | | W3 | W17 | DUP |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000807 | 0.00416 | 0.00540 | 0.000861 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00080 | 0.00066 | 0.00074 | 0.00093 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.74 | 1.98 | 4.22 | 3.03 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000153 | 0.000266 | 0.000405 | 0.000151 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.15 | 5.58 | 4.99 | 5.48 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 7.52 | 15.5 | 18.0 | 8.19 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.263 | 0.690 | 0.749 | 0.257 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 4.41 | 18.2 | 19.8 | 5.03 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00011 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00037 | <0.00030 | <0.00030 | 0.00051 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000725 | 0.00263 | 0.00251 | 0.000789 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0024 | <0.0010 | <0.0010 | 0.0012 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1917913-1, -3, -5, -6, -7 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1917913-2 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1917913-2 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1917913-2 |
| Matrix Spike | Aluminum (Al)-Dissolved | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1917913-1, -2, -3, -4, -5, -6, -7, -8, -9 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-VA | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-04-26 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L1917913-COFC

| Report To | | | Report Form | | | Confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Company: Minto Explorations Ltd. | | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | EMERGENCY | | | | <input type="checkbox"/> 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | <input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 1 Business day [E1] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | | Email 1 or Fax minto_environment@mintomine.com | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Invoice Distribution | | | <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2"></th> <th>P</th> <th>F/P</th> <th>P</th> <th>F/P</th> <th>P</th> <th>F/P</th> <th colspan="4"></th> <th rowspan="2">Number of Containers</th> </tr> <tr> <th colspan="2"></th> <th>Total Suspended Solids (TSS)</th> <th>Total Dissolved Solids (TDS)</th> <th>Total Metals (TM), Hardness</th> <th>Dissolved Metals (DM) (Filtered and preserved)</th> <th>Total Mercury, Hardness</th> <th>Dissolved Mercury [1] (Filtered + preserved)</th> <th>Total Nutrients (Ammonia)</th> <th colspan="4">Dissolved Organic Carbon (DOC)</th> </tr> </thead> <tbody> <tr> <td rowspan="9" style="writing-mode: vertical-rl; transform: rotate(180deg);">ALS Lab Work Order # (lab use only)</td> <td>ALS Account # / Quote #:</td> <td>AFE/Cost Center:</td> <td>PO#</td> <td colspan="9"></td> <td rowspan="9"></td> </tr> <tr> <td>Job #:</td> <td>Major/Minor Code:</td> <td>Routing Code:</td> <td colspan="9"></td> </tr> <tr> <td>PO / AFE: 224162 (WUL)</td> <td>Requisitioner:</td> <td colspan="9"></td> </tr> <tr> <td>LSD:</td> <td>Location:</td> <td colspan="9"></td> </tr> <tr> <td colspan="2">ALS Lab Work Order # (lab use only)</td> <td>ALS Contact: Shane Stack</td> <td>Sampler: CH/CP</td> <td colspan="9"></td> </tr> <tr> <td>ALS Sample # (lab use only)</td> <td colspan="2">Sample Identification and/or Coordinates (This description will appear on the report)</td> <td>Date (dd-mmm-yy)</td> <td>Time (hh:mm)</td> <td>Sample Type</td> <td colspan="6"></td> <td></td> </tr> <tr> <td>1</td> <td colspan="2">W15</td> <td>25-Apr-17</td> <td>7:35</td> <td>Water</td> <td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td>2</td> <td colspan="2">W35</td> <td>25-Apr-17</td> <td>7:45</td> <td>Water</td> <td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td>3</td> <td colspan="2">W16</td> <td>25-Apr-17</td> <td>8:25</td> <td>Water</td> <td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td>4</td> <td colspan="2">W8A</td> <td>25-Apr-17</td> <td>11:45</td> <td>Water</td> <td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>6</td> </tr> <tr> <td>5</td> <td colspan="2">W2</td> <td>25-Apr-17</td> <td>14:30</td> <td>Water</td> <td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td>6</td> <td colspan="2">MC1</td> <td>25-Apr-17</td> <td>15:20</td> <td>Water</td> <td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td>7</td> <td colspan="2">W3</td> <td>25-Apr-17</td> <td>16:00</td> <td>Water</td> <td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td>8</td> <td colspan="2">W17</td> <td>25-Apr-17</td> <td>16:15</td> <td>Water</td> <td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td>9</td> <td colspan="2">DUP</td> <td>25-Apr-17</td> <td></td> <td>Water</td> <td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> </tbody> </table> | | | | | | | | | | | | | | P | F/P | P | F/P | P | F/P | | | | | Number of Containers | | | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | | ALS Lab Work Order # (lab use only) | ALS Account # / Quote #: | AFE/Cost Center: | PO# | | | | | | | | | | | Job #: | Major/Minor Code: | Routing Code: | | | | | | | | | | PO / AFE: 224162 (WUL) | Requisitioner: | | | | | | | | | | LSD: | Location: | | | | | | | | | | ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | Sampler: CH/CP | | | | | | | | | | ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | 1 | W15 | | 25-Apr-17 | 7:35 | Water | R | R | R | R | R | R | R | R | 7 | 2 | W35 | | 25-Apr-17 | 7:45 | Water | R | R | R | R | R | R | R | R | 7 | 3 | W16 | | 25-Apr-17 | 8:25 | Water | R | R | R | R | R | R | R | R | 7 | 4 | W8A | | 25-Apr-17 | 11:45 | Water | R | R | R | R | R | R | R | R | 6 | 5 | W2 | | 25-Apr-17 | 14:30 | Water | R | R | R | R | R | R | R | R | 7 | 6 | MC1 | | 25-Apr-17 | 15:20 | Water | R | R | R | R | R | R | R | R | 7 | 7 | W3 | | 25-Apr-17 | 16:00 | Water | R | R | R | R | R | R | R | R | 7 | 8 | W17 | | 25-Apr-17 | 16:15 | Water | R | R | R | R | R | R | R | R | 7 | 9 | DUP | | 25-Apr-17 | | Water | R | R | R | R | R | R | R | R | 7 |
| | | P | F/P | P | F/P | | | | | | | | | | | | | P | F/P | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | ALS Account # / Quote #: | AFE/Cost Center: | PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Job #: | Major/Minor Code: | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | PO / AFE: 224162 (WUL) | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | LSD: | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | Sampler: CH/CP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | W15 | | 25-Apr-17 | 7:35 | Water | R | R | R | R | R | R | | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | W35 | | 25-Apr-17 | 7:45 | Water | R | R | R | R | R | R | | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 | W16 | | 25-Apr-17 | 8:25 | Water | R | R | R | R | R | R | | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | W8A | | 25-Apr-17 | 11:45 | Water | R | R | R | R | R | R | R | R | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | W2 | | 25-Apr-17 | 14:30 | Water | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | MC1 | | 25-Apr-17 | 15:20 | Water | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | W3 | | 25-Apr-17 | 16:00 | Water | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | W17 | | 25-Apr-17 | 16:15 | Water | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | DUP | | 25-Apr-17 | | Water | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | Email 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 224162 (WUL) | | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | ALS Contact: Shane Stack | | | Sampler: CH/CP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input type="checkbox"/> INITIAL COOLER TEMPERATURES °C: 4°C FINAL COOLER TEMPERATURES °C: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: Chris Harry | | | Date: 2017-04-26 9:45 | | | Time: 9:45 | | | Received by: VD | | | Date: 2017-04-26 | | | Time: 10:30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

 Short Holding Time
Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 04-MAY-17
Report Date: 16-MAY-17 17:42 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1921497
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-05-03 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

16-MAY-17 17:42 (MT)

Version: FINAL

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1921497-1 | L1921497-2 | L1921497-3 | L1921497-4 | L1921497-5 |
|-----------------------------------|---|--------------|--------------|-----------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 02-MAY-17 | 07:45 | MC1 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 |
| | | | | | 08:30 | 08:00 | 08:10 | 08:20 | |
| | | | | | W2 | W3 | W50 | W16A | |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 167 | 161 | 375 | 334 | 319 | | | |
| | Hardness (as CaCO3) (mg/L) | 84.3 | 80.6 | 164 | 143 | 136 | | | |
| | pH (pH) | 7.84 | 7.87 | 8.04 | 8.03 | 7.87 | | | |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | 10.1 | <3.0 | <3.0 | | | |
| | Total Dissolved Solids (mg/L) | 146 | 143 | 225 | 204 | 185 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 74.9 | 73.6 | 138 | 117 | 111 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 74.9 | 73.6 | 138 | 117 | 111 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0099 | 0.0092 | 0.143 | 0.156 | 0.146 | | | |
| | Chloride (Cl) (mg/L) | 1.66 | 1.58 | 4.86 | 5.10 | 4.91 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | <0.0051 | <0.0051 | 1.63 | 2.15 | 2.11 | | | |
| | Nitrate (as N) (mg/L) | <0.0050 | <0.0050 | 1.58 | 2.08 | 2.04 | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | 0.0511 | 0.0717 | 0.0751 | | | |
| | Sulfate (SO4) (mg/L) | 8.89 | 7.89 | 43.7 | 43.1 | 41.4 | | | |
| | Anion Sum (meq/L) | 1.73 | 1.68 | 3.91 | 3.53 | 3.37 | | | |
| | Cation Sum (meq/L) | 1.95 | 1.86 | 3.94 | 3.47 | 3.34 | | | |
| | Cation - Anion Balance (%) | 6.0 | 5.0 | 0.3 | -0.9 | -0.5 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 34.0 | 32.7 | 11.4 | 8.48 | 8.39 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0435 | 0.0797 | 0.179 | 0.232 | 0.122 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | 0.00013 | 0.00020 | <0.00010 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00046 | 0.00052 | 0.00039 | 0.00033 | 0.00027 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0363 | 0.0385 | 0.0591 | 0.0567 | 0.0529 | | | |
| | Beryllium (Be)-Total (mg/L) | 0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | <0.010 | <0.010 | 0.035 | 0.046 | 0.047 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000150 | 0.0000164 | 0.0000242 | 0.0000443 | 0.0000254 | | | |
| | Calcium (Ca)-Total (mg/L) | 22.0 | 22.3 | 41.2 | 39.7 | 37.7 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00042 | 0.00046 | 0.00034 | 0.00018 | 0.00017 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00011 | 0.00019 | 0.00023 | 0.00019 | 0.00015 | | | |
| | Copper (Cu)-Total (mg/L) | 0.0104 | 0.0109 | 0.0304 | 0.112 | 0.0420 | | | |
| | Iron (Fe)-Total (mg/L) | 0.151 | 0.221 | 0.343 | 0.485 | 0.271 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | 0.000183 | 0.000535 | 0.000246 | | | |
| | Lithium (Li)-Total (mg/L) | <0.0010 | <0.0010 | 0.0016 | 0.0012 | 0.0010 | | | |
| | Magnesium (Mg)-Total (mg/L) | 7.26 | 7.25 | 16.1 | 12.0 | 11.2 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.00947 | 0.0326 | 0.413 | 0.322 | 0.262 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

16-MAY-17 17:42 (MT)

Version: FINAL

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1921497-6 | L1921497-7 | L1921497-8 | L1921497-9 | L1921497-10 |
|-----------------------------------|---|--------------|--------------|-----------|------------|------------|------------|------------|-------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 02-MAY-17 | 08:25 | | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 |
| | | | | | W17 | W35 | W15 | DUP1 | DUP2 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 508 | 129 | 478 | 166 | 162 | | | |
| | Hardness (as CaCO3) (mg/L) | 247 | 69.9 | 245 | 84.5 | 80.5 | | | |
| | pH (pH) | 8.19 | 7.56 | 7.94 | 7.85 | 7.86 | | | |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | 4.7 | <3.0 | <3.0 | | | |
| | Total Dissolved Solids (mg/L) | 303 | 152 | 381 | 164 | 158 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 216 | 50.7 | 113 | 74.4 | 73.4 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 216 | 50.7 | 113 | 74.4 | 73.4 | | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.0150 | 0.108 | 0.0099 | 0.0100 | | | |
| | Chloride (Cl) (mg/L) | 6.57 | 1.17 | 2.53 | 1.67 | 1.59 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.514 | 1.24 | 10.8 | <0.0051 | <0.0051 | | | |
| | Nitrate (as N) (mg/L) | 0.514 | 1.23 | 10.4 | <0.0050 | <0.0050 | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | 0.0050 | 0.390 | <0.0010 | <0.0010 | | | |
| | Sulfate (SO4) (mg/L) | 54.6 | 5.69 | 90.3 | 8.93 | 7.94 | | | |
| | Anion Sum (meq/L) | 5.68 | 1.25 | 4.97 | 1.72 | 1.68 | | | |
| | Cation Sum (meq/L) | 5.68 | 1.57 | 5.44 | 1.95 | 1.86 | | | |
| | Cation - Anion Balance (%) | 0.0 | 11.4 | 4.4 | 6.3 | 5.1 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 7.80 | 44.5 | 32.2 | 33.4 | 33.1 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0868 | 0.0518 | 0.167 | 0.0457 | 0.0757 | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00017 | <0.00010 | <0.00010 | <0.00010 | 0.00012 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00034 | 0.00037 | 0.00037 | 0.00047 | 0.00049 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0725 | 0.0453 | 0.0555 | 0.0374 | 0.0390 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | 0.030 | <0.010 | <0.010 | <0.010 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000105 | 0.0000102 | 0.0000255 | 0.0000127 | 0.0000164 | | | |
| | Calcium (Ca)-Total (mg/L) | 64.5 | 20.6 | 64.6 | 21.7 | 21.9 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00016 | 0.00037 | 0.00029 | 0.00046 | 0.00045 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00011 | 0.00011 | 0.00042 | 0.00012 | 0.00019 | | | |
| | Copper (Cu)-Total (mg/L) | 0.0520 | 0.0446 | 0.0435 | 0.0106 | 0.00992 | | | |
| | Iron (Fe)-Total (mg/L) | 0.167 | 0.149 | 0.335 | 0.158 | 0.219 | | | |
| | Lead (Pb)-Total (mg/L) | 0.000062 | <0.000050 | 0.000064 | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0017 | <0.0010 | 0.0014 | <0.0010 | <0.0010 | | | |
| | Magnesium (Mg)-Total (mg/L) | 21.5 | 5.18 | 18.1 | 7.74 | 7.15 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0669 | 0.0109 | 0.203 | 0.00984 | 0.0321 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1921497-11 | WATER | 03-MAY-17 | 08:15 | RO |
|-----------------------------------|--|-------------|------------|-----------|-------|----|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 216 | | | |
| | Hardness (as CaCO3) (mg/L) | | 4.84 | | | |
| | pH (pH) | | 7.97 | | | |
| | Total Suspended Solids (mg/L) | | <3.0 | | | |
| | Total Dissolved Solids (mg/L) | | 138 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 104 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 104 | | | |
| | Ammonia, Total (as N) (mg/L) | | 0.281 | | | |
| | Chloride (Cl) (mg/L) | | 1.10 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | | 2.51 | | | |
| | Nitrate (as N) (mg/L) | | 2.31 | | | |
| | Nitrite (as N) (mg/L) | | 0.199 | | | |
| | Sulfate (SO4) (mg/L) | | 4.81 | | | |
| | Anion Sum (meq/L) | | 2.39 | | | |
| | Cation Sum (meq/L) | | 2.12 | | | |
| | Cation - Anion Balance (%) | | -6.0 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 3.19 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0158 | | | |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | | | |
| | Arsenic (As)-Total (mg/L) | | <0.00010 | | | |
| | Barium (Ba)-Total (mg/L) | | 0.00133 | | | |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | | 0.111 | | | |
| | Cadmium (Cd)-Total (mg/L) | | <0.0000050 | | | |
| | Calcium (Ca)-Total (mg/L) | | 1.61 | | | |
| | Chromium (Cr)-Total (mg/L) | | <0.00010 | | | |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | | | |
| | Copper (Cu)-Total (mg/L) | | 0.00442 | | | |
| | Iron (Fe)-Total (mg/L) | | 0.022 | | | |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | | <0.0010 | | | |
| | Magnesium (Mg)-Total (mg/L) | | 0.23 | | | |
| | Manganese (Mn)-Total (mg/L) | | 0.00396 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1921497-1 WATER 02-MAY-17 07:45 MC1 | L1921497-2 WATER 02-MAY-17 08:30 W2 | L1921497-3 WATER 02-MAY-17 08:00 W3 | L1921497-4 WATER 02-MAY-17 08:10 W50 | L1921497-5 WATER 02-MAY-17 08:20 W16A | |
|---|--|---|---|--|---|------------------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | 0.0000064 | 0.0000070 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.000665 | 0.000591 | 0.00569 | 0.00352 | 0.00260 |
| | Nickel (Ni)-Total (mg/L) | 0.00148 | 0.00161 | 0.00146 | 0.00070 | 0.00056 |
| | Phosphorus (P)-Total (mg/L) | 0.066 | 0.059 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 1.70 | 1.91 | 2.57 | 2.70 | 2.53 |
| | Selenium (Se)-Total (mg/L) | 0.000100 | 0.000100 | 0.000461 | 0.000623 | 0.000584 |
| | Silicon (Si)-Total (mg/L) | 4.30 | 4.58 | 3.98 | 3.24 | 2.91 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000018 | 0.000039 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 4.64 | 4.44 | 13.2 | 12.8 | 12.5 |
| | Strontium (Sr)-Total (mg/L) | 0.183 | 0.175 | 0.486 | 0.422 | 0.404 |
| | Sulfur (S)-Total (mg/L) | 3.79 | 2.97 | 15.2 | 15.1 | 14.6 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.00117 | 0.00234 | 0.00894 | 0.0131 | <0.0045 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.000412 | 0.000369 | 0.00157 | 0.00107 | 0.000887 |
| | Vanadium (V)-Total (mg/L) | 0.00063 | 0.00066 | 0.00091 | 0.00100 | 0.00057 |
| | Zinc (Zn)-Total (mg/L) | 0.0034 | <0.0030 | <0.0030 | 0.0067 | 0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0412 | 0.0367 | 0.0081 | 0.0060 | 0.0118 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00044 | 0.00047 | 0.00031 | 0.00026 | 0.00024 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0394 | 0.0390 | 0.0613 | 0.0537 | 0.0526 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | 0.034 | 0.040 | 0.042 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000131 | 0.0000120 | 0.0000174 | 0.0000239 | 0.0000251 |
| | Calcium (Ca)-Dissolved (mg/L) | 21.6 | 21.3 | 40.4 | 39.1 | 36.8 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00038 | 0.00033 | <0.00010 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00010 | 0.00015 | 0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0102 | 0.00863 | 0.0139 | 0.0185 | 0.0249 |
| | Iron (Fe)-Dissolved (mg/L) | 0.136 | 0.137 | 0.045 | 0.054 | 0.078 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | 0.000052 | 0.000203 | 0.000110 |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | <0.0010 | 0.0014 | <0.0010 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | 7.35 | 6.66 | 15.3 | 10.9 | 10.6 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00770 | 0.0254 | 0.346 | 0.284 | 0.253 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1921497-6 | L1921497-7 | L1921497-8 | L1921497-9 | L1921497-10 |
|-------------------------|---------------------------------------|--------------|--------------|------------------------|------------|------------|------------|------------|-------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 |
| | | | | | 08:25 | 08:45 | 08:50 | | |
| | | | | | W17 | W35 | W15 | DUP1 | DUP2 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | 0.0000090 | 0.0000060 | 0.0000067 | 0.0000073 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00606 | 0.000495 | 0.00211 | 0.000648 | 0.000604 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00079 | 0.00157 | 0.00080 | 0.00148 | 0.00163 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.060 | 0.071 | 0.063 | <0.050 | | | |
| | Potassium (K)-Total (mg/L) | 3.79 | 1.72 | 3.97 | 1.77 | 1.88 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000392 | 0.000121 | 0.00373 | 0.000120 | 0.000107 | | | |
| | Silicon (Si)-Total (mg/L) | 5.50 | 3.93 | 4.03 | 4.57 | 4.47 | | | |
| | Silver (Ag)-Total (mg/L) | 0.000026 | 0.000012 | 0.000016 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 15.4 | 2.88 | 7.79 | 4.74 | 4.34 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.752 | 0.113 | 0.843 | 0.185 | 0.171 | | | |
| | Sulfur (S)-Total (mg/L) | 19.6 | 2.47 | 31.6 | 3.41 | 3.01 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.00502 | 0.00115 | <0.0060 ^{DLM} | 0.00107 | 0.00225 | | | |
| | Uranium (U)-Total (mg/L) | 0.00251 | 0.000054 | 0.00144 | 0.000406 | 0.000370 | | | |
| | Vanadium (V)-Total (mg/L) | 0.00066 | <0.000050 | 0.00074 | 0.00052 | 0.00073 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | 0.0050 | <0.0030 | <0.0030 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | 0.00032 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0111 | 0.0411 | 0.0601 | 0.0387 | 0.0343 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00034 | 0.00036 | 0.00036 | 0.00044 | 0.00050 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0741 | 0.0461 | 0.0630 | 0.0387 | 0.0391 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.026 | <0.010 | <0.010 | <0.010 | <0.010 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000069 | 0.0000282 | 0.0000140 | 0.0000127 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 65.6 | 20.0 | 65.3 | 21.6 | 21.3 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00011 | 0.00033 | 0.00022 | 0.00039 | 0.00037 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00010 | 0.00043 | 0.00012 | 0.00016 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00997 | 0.0431 | 0.0401 | 0.0103 | 0.00887 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.024 | 0.129 | 0.160 | 0.139 | 0.139 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0015 | <0.0010 | 0.0012 | <0.0010 | <0.0010 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 20.1 | 4.86 | 20.0 | 7.43 | 6.65 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0229 | 0.00634 | 0.231 | 0.00793 | 0.0258 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1921497-11 WATER 03-MAY-17 08:15 RO | | | |
|-------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.000419 | | | |
| | Nickel (Ni)-Total (mg/L) | <0.00050 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | | | |
| | Potassium (K)-Total (mg/L) | 1.40 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000209 | | | |
| | Silicon (Si)-Total (mg/L) | 0.12 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 47.8 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.0330 | | | |
| | Sulfur (S)-Total (mg/L) | 1.83 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | <0.00060 ^{DLM} | | | |
| | Uranium (U)-Total (mg/L) | 0.000037 | | | |
| | Vanadium (V)-Total (mg/L) | <0.00050 | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0050 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0013 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | <0.00010 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.00105 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.108 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 1.56 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00027 | | | |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 0.23 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00323 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1921497-1 | L1921497-2 | L1921497-3 | L1921497-4 | L1921497-5 |
|-------------------------|----------------------------------|--------------|--------------|------------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 02-MAY-17 | 07:45 | MC1 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 |
| | | | | | 08:30 | 08:30 | 08:00 | 08:10 | 08:20 |
| | | | | | W2 | W2 | W3 | W50 | W16A |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | 0.0000067 | 0.0000062 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000684 | 0.000530 | 0.00529 | 0.00336 | 0.00243 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00146 | 0.00147 | 0.00085 | 0.00061 | 0.00050 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | 0.053 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 1.81 | 1.90 | 2.62 | 2.57 | 2.54 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000139 | 0.000114 | 0.000561 | 0.000652 | 0.000568 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 4.39 | 4.24 | 3.57 | 2.71 | 2.59 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 4.69 | 4.25 | 13.0 | 12.2 | 12.3 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.182 | 0.169 | 0.475 | 0.419 | 0.391 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 3.08 | 2.77 | 14.9 | 14.5 | 13.7 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00077 | 0.00077 | 0.00033 | <0.00030 | 0.00050 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000358 | 0.000331 | 0.00141 | 0.000953 | 0.000812 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00050 | 0.00053 | <0.00050 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0032 | 0.0013 | 0.0012 | 0.0018 | 0.0018 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00038 | 0.00034 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1921497-6 | L1921497-7 | L1921497-8 | L1921497-9 | L1921497-10 |
|-------------------------|----------------------------------|-------------------------|-------------------------|------------|------------|------------|------------|------------|-------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 | 02-MAY-17 |
| | | | | | 08:25 | 08:45 | 08:50 | | |
| | | | | | W17 | W35 | W15 | DUP1 | DUP2 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | 0.0000083 | <0.0000050 | 0.0000069 | 0.0000073 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00545 | 0.000485 | 0.00203 | 0.000615 | 0.000551 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00062 | 0.00156 | 0.00082 | 0.00147 | 0.00164 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 3.64 | 1.74 | 4.52 | 1.82 | 1.90 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000402 | 0.000113 | 0.00394 | 0.000118 | 0.000093 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.03 | 3.78 | 3.69 | 4.37 | 4.34 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 15.1 | 2.75 | 8.91 | 4.73 | 4.25 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.736 | 0.113 | 0.832 | 0.181 | 0.169 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 17.9 | 2.20 | 30.2 | 3.20 | 2.82 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00090 ^{DLM} | <0.00090 ^{DLM} | 0.00144 | 0.00081 | 0.00082 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00228 | 0.000048 | 0.00132 | 0.000372 | 0.000332 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00050 | 0.00050 | 0.00052 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | 0.0012 | 0.0034 | 0.0018 | 0.0015 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | 0.00034 | <0.00030 | 0.00035 | 0.00037 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1921497-11 WATER 03-MAY-17 08:15 RO | | | | |
|---|----------------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.000050 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000373 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | | | | |
| | Potassium (K)-Dissolved (mg/L) | 1.45 | | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000237 | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 0.065 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 45.2 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.0316 | | | | |
| | Sulfur (S)-Dissolved (mg/L) | 1.68 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000028 | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0014 | | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|---------------------------|-----------|--|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1921497-11, -3, -4, -5, -6 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1921497-11, -3, -4, -5, -6 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1921497-1, -10, -2, -7, -8, -9 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1921497-1, -10, -2, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1921497-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1921497-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1921497-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L1921497-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1921497-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1921497-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1921497-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1921497-1 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1921497-10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1921497-1 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1921497-10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1921497-1 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1921497-10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1921497-1 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1921497-10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Molybdenum (Mo)-Total | MS-B | L1921497-1 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1921497-1 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1921497-1 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1921497-10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1921497-1 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1921497-10, -11, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1921497-1 |
| Matrix Spike | Uranium (U)-Total | MS-B | L1921497-1 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH ₃ -NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |

Reference Information

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-05-03 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L1921497-COFC

| | | | | | | | | | | | | | | | | | |
|--|---|-----------------------|--|---|--------------|---|---|--|------------------------------|-----------------------------|--|--|--|---------------------------|--------------------------------|----------------------|--|
| Report To Contact and company name below will appear on the final report | | | Report Format | | | All E&P TATs with your AM - surcharges will apply | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | | 1 Business day [E1] <input type="checkbox"/> | | | | | |
| Phone: 1-604-759-4659 | | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | |
| Company address below will appear on the final report | | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: (dd-mmm-yy) (hh:mm) | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | | Email 1 or Fax: minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | | Email 2 | | | Analysis Request | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | |
| Invoice To | | | Invoice Distribution | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | | Email 2 | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | |
| Project Information | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | AFE/Cost Center: | | | PO# | | | | | | | | | | | |
| Job #: | | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | |
| PO / AFE: 224162 (WUL) | | | Requisitioner: | | | | | | | | | | | | | | |
| LSD: | | | Location: | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | ALS Contact: Shane Stack | | Sampler: CH | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | |
| | MC1 | | | 2-May-17 | 7:45 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| | W2 | | | 2-May-17 | 8:30 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| | W3 | | | 2-May-17 | 8:00 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| | W50 | | | 2-May-17 | 8:10 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| | W16A | | | 2-May-17 | 8:20 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| | W17 | | | 2-May-17 | 8:25 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| | W35 | | | 2-May-17 | 8:45 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| | W15 | | | 2-May-17 | 8:50 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| | DUP1 | | | 2-May-17 | | Water | R | R | R | R | R | R | R | R | R | 7 | |
| | DUP2 | | | 2-May-17 | | Water | R | R | R | R | R | R | R | R | R | 7 | |
| | RO | | | 3-May-17 | 8:15 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| Drinking Water (DW) Samples (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> | | | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> | | | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | |
| | | | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | |
| | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | FINAL COOLER TEMPERATURES °C | | | | | |
| | | | | | | | | 5.0 | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-05-03 7:00 | | Time: | | Received by: <i>ENP</i> | | Date: <i>4 May 2017</i> | | Time: <i>09:15</i> | | Received by: | | Date: | | Time: | |

Short Holding Time

Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 10-MAY-17
Report Date: 19-MAY-17 17:45 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1924462
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-05-10A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1924462-1 WATER 09-MAY-17 07:30 W3 | L1924462-2 WATER 09-MAY-17 07:35 W50 | L1924462-3 WATER 09-MAY-17 07:45 W16A | L1924462-4 WATER 09-MAY-17 07:50 W17 | L1924462-5 WATER 09-MAY-17 08:20 W35 | |
|---|---|--|---|--|--|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 390 | 357 | 362 | 486 | 143 |
| | Hardness (as CaCO3) (mg/L) | 173 | 149 | 154 | 224 | 76.2 |
| | pH (pH) | 8.08 | 8.10 | 8.06 | 8.24 | 7.76 |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | <3.0 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | 221 | 204 | 203 | 276 | 77.5 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 145 | 126 | 121 | 201 | 61.7 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 145 | 126 | 121 | 201 | 61.7 |
| | Ammonia, Total (as N) (mg/L) | 0.0121 | 0.0598 | 0.0798 | 0.0237 | 0.0132 |
| | Chloride (Cl) (mg/L) | 5.03 | 5.30 | 5.28 | 6.12 | 0.77 |
| | Nitrate and Nitrite (as N) (mg/L) | 1.60 | 2.12 | 2.13 | 0.530 | 0.711 |
| | Nitrate (as N) (mg/L) | 1.58 | 2.07 | 2.07 | 0.530 | 0.709 |
| | Nitrite (as N) (mg/L) | 0.0184 | 0.0504 | 0.0560 | <0.0010 | 0.0021 |
| | Sulfate (SO4) (mg/L) | 46.8 | 46.4 | 46.2 | 51.4 | 5.43 |
| | Anion Sum (meq/L) | 4.14 | 3.78 | 3.68 | 5.31 | 1.42 |
| | Cation Sum (meq/L) | 4.12 | 3.62 | 3.74 | 5.21 | 1.70 |
| | Cation - Anion Balance (%) | -0.2 | -2.2 | 0.7 | -0.9 | 9.0 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 11.0 | 9.90 | 10.1 | 6.98 | 41.9 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0307 | 0.0736 | 0.121 | 0.0053 | 0.0568 |
| | Antimony (Sb)-Total (mg/L) | 0.00013 | <0.00010 | <0.00010 | 0.00011 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00037 | 0.00032 | 0.00035 | 0.00037 | 0.00044 |
| | Barium (Ba)-Total (mg/L) | 0.0595 | 0.0566 | 0.0623 | 0.0681 | 0.0466 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.035 | 0.041 | 0.042 | 0.030 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | 0.0000122 | 0.0000215 | 0.0000064 | 0.0000066 |
| | Calcium (Ca)-Total (mg/L) | 45.7 | 42.8 | 42.7 | 59.5 | 23.2 |
| | Chromium (Cr)-Total (mg/L) | 0.00017 | 0.00015 | 0.00020 | 0.00013 | 0.00043 |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | <0.00010 | 0.00016 | <0.00010 | 0.00013 |
| | Copper (Cu)-Total (mg/L) | 0.0133 | 0.0280 | 0.0357 | 0.00644 | 0.0476 |
| | Iron (Fe)-Total (mg/L) | 0.085 | 0.187 | 0.279 | <0.010 | 0.156 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.000169 | 0.00139 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0015 | <0.0010 | 0.0010 | 0.0014 | <0.0010 |
| | Magnesium (Mg)-Total (mg/L) | 17.0 | 13.0 | 13.0 | 19.7 | 5.96 |
| | Manganese (Mn)-Total (mg/L) | 0.0362 | 0.119 | 0.289 | 0.0388 | 0.00813 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1924462-6 | L1924462-7 | L1924462-8 | L1924462-9 | L1924462-10 |
|-----------------------------------|---|--------------|------------|------------|------------|------------|-------------|
| | | Description | WATER | WATER | WATER | WATER | WATER |
| | | Sampled Date | 09-MAY-17 | 09-MAY-17 | 09-MAY-17 | 09-MAY-17 | 09-MAY-17 |
| | | Sampled Time | 08:35 | 08:55 | | 13:50 | 08:20 |
| | | Client ID | W15 | RO | DUP | MC1 | W2 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 462 | 115 | 488 | 206 | 180 |
| | Hardness (as CaCO3) (mg/L) | | 218 | 10.8 | 226 | 98.1 | 90.0 |
| | pH (pH) | | 7.95 | 7.52 | 8.27 | 8.00 | 7.98 |
| | Total Suspended Solids (mg/L) | | 11.8 | <3.0 | <3.0 | 67.0 | 4.8 |
| | TDS (Calculated) (mg/L) | | 279 | 66.8 | 277 | 113 | 99.3 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 117 | 30.9 | 201 | 92.8 | 83.5 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 117 | 30.9 | 201 | 92.8 | 83.5 |
| | Ammonia, Total (as N) (mg/L) | | 0.120 | 0.322 | <0.0050 | 0.0108 | 0.0075 |
| | Chloride (Cl) (mg/L) | | 1.92 | 1.43 | 6.11 | 1.67 | 1.36 |
| | Nitrate and Nitrite (as N) (mg/L) | | 8.85 | 2.53 | 0.526 | 0.110 | 0.0265 |
| | Nitrate (as N) (mg/L) | | 8.53 | 2.30 | 0.526 | 0.109 | 0.0265 |
| | Nitrite (as N) (mg/L) | | 0.317 | 0.228 | <0.0010 | 0.0013 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 80.5 | 11.8 | 51.3 | 13.7 | 9.97 |
| | Anion Sum (meq/L) | | 4.69 | 1.08 | 5.30 | 2.20 | 1.92 |
| | Cation Sum (meq/L) | | 4.80 | 1.07 | 5.25 | 2.28 | 2.08 |
| | Cation - Anion Balance (%) | | 1.1 | -0.9 | -0.4 | 1.9 | 4.1 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 37.6 | 2.63 | 6.83 | 21.6 | 23.0 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.214 | 0.0046 | 0.0081 | 0.122 | 0.0633 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | <0.00010 | 0.00017 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00046 | <0.00010 | 0.00037 | 0.00060 | 0.00060 |
| | Barium (Ba)-Total (mg/L) | | 0.0676 | 0.00121 | 0.0707 | 0.0469 | 0.0422 |
| | Beryllium (Be)-Total (mg/L) | | 0.000021 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | <0.010 | 0.098 | 0.031 | <0.010 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000233 | <0.0000050 | 0.0000066 | 0.0000116 | 0.0000131 |
| | Calcium (Ca)-Total (mg/L) | | 62.5 | 3.53 | 63.3 | 26.5 | 24.0 |
| | Chromium (Cr)-Total (mg/L) | | 0.00037 | <0.00010 | 0.00018 | 0.00053 | 0.00042 |
| | Cobalt (Co)-Total (mg/L) | | 0.00052 | <0.00010 | <0.00010 | 0.00021 | 0.00018 |
| | Copper (Cu)-Total (mg/L) | | 0.0472 | 0.00101 | 0.00896 | 0.00715 | 0.00701 |
| | Iron (Fe)-Total (mg/L) | | 0.535 | <0.010 | 0.018 | 0.316 | 0.270 |
| | Lead (Pb)-Total (mg/L) | | 0.000062 | <0.000050 | <0.000050 | 0.000051 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | 0.0012 | <0.0010 | 0.0016 | <0.0010 | <0.0010 |
| | Magnesium (Mg)-Total (mg/L) | | 17.4 | 0.70 | 20.4 | 9.54 | 8.28 |
| | Manganese (Mn)-Total (mg/L) | | 0.276 | 0.00914 | 0.0493 | 0.0765 | 0.0310 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1924462-1 WATER 09-MAY-17 07:30 W3 | L1924462-2 WATER 09-MAY-17 07:35 W50 | L1924462-3 WATER 09-MAY-17 07:45 W16A | L1924462-4 WATER 09-MAY-17 07:50 W17 | L1924462-5 WATER 09-MAY-17 08:20 W35 | |
|---|---|--|---|--|--|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000065 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00342 | 0.00288 | 0.00283 | 0.00584 | 0.000649 |
| | Nickel (Ni)-Total (mg/L) | 0.00094 | 0.00063 | 0.00074 | 0.00063 | 0.00240 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.69 | 2.80 | 2.87 | 3.69 | 1.19 |
| | Selenium (Se)-Total (mg/L) | 0.000519 | 0.000616 | 0.000633 | 0.000342 | 0.000134 |
| | Silicon (Si)-Total (mg/L) | 3.96 | 3.32 | 3.42 | 4.95 | 3.89 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 14.5 | 13.2 | 13.4 | 15.0 | 3.26 |
| | Strontium (Sr)-Total (mg/L) | 0.491 | 0.463 | 0.457 | 0.692 | 0.124 |
| | Sulfur (S)-Total (mg/L) | 16.2 | 15.8 | 16.1 | 16.9 | 2.20 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.00131 | <0.0045 ^{DLM} | 0.00591 | <0.00030 | <0.0024 |
| | Uranium (U)-Total (mg/L) | 0.00151 | 0.00104 | 0.00104 | 0.00230 | 0.000063 |
| | Vanadium (V)-Total (mg/L) | 0.00083 | 0.00070 | 0.00085 | 0.00058 | 0.00071 |
| | Zinc (Zn)-Total (mg/L) | 0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0039 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | 0.00042 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0075 | 0.0125 | 0.0079 | 0.0017 | 0.0324 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00031 | 0.00025 | 0.00027 | 0.00031 | 0.00038 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0574 | 0.0536 | 0.0610 | 0.0670 | 0.0447 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.035 | 0.038 | 0.039 | 0.028 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000095 | 0.0000193 | <0.0000050 | 0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 42.0 | 39.1 | 40.3 | 57.3 | 20.8 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00061 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0112 | 0.0210 | 0.0256 | 0.00578 | 0.0415 |
| | Iron (Fe)-Dissolved (mg/L) | 0.047 | 0.062 | 0.073 | <0.010 | 0.150 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | 0.000074 | 0.000281 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0013 | <0.0010 | <0.0010 | 0.0013 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | 16.5 | 12.6 | 13.0 | 19.7 | 5.91 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0295 | 0.0984 | 0.259 | 0.0114 | 0.00320 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1924462-6 | L1924462-7 | L1924462-8 | L1924462-9 | L1924462-10 |
|-------------------------|---------------------------------------|--------------|--------------|------------|------------|------------|------------|------------|-------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 09-MAY-17 | 08:35 | | 09-MAY-17 | 08:55 | 09-MAY-17 | 09-MAY-17 | 09-MAY-17 |
| | | | | | W15 | RO | DUP | MC1 | W2 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | 0.0000061 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00212 | 0.00101 | 0.00604 | 0.00101 | 0.000794 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00108 | <0.00050 | 0.00068 | 0.00171 | 0.00171 | | | |
| | Phosphorus (P)-Total (mg/L) | 0.083 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Total (mg/L) | 3.56 | 1.95 | 3.86 | 1.61 | 1.55 | | | |
| | Selenium (Se)-Total (mg/L) | 0.00322 | 0.000258 | 0.000378 | 0.000179 | 0.000125 | | | |
| | Silicon (Si)-Total (mg/L) | 4.18 | 0.12 | 4.98 | 4.87 | 4.49 | | | |
| | Silver (Ag)-Total (mg/L) | 0.000018 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 7.58 | 18.1 | 15.3 | 6.50 | 5.52 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.725 | 0.0797 | 0.699 | 0.233 | 0.204 | | | |
| | Sulfur (S)-Total (mg/L) | 27.9 | 3.91 | 17.6 | 4.93 | 3.37 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.00827 | <0.00030 | 0.00035 | 0.00453 | 0.00213 | | | |
| | Uranium (U)-Total (mg/L) | 0.00144 | 0.000076 | 0.00239 | 0.000681 | 0.000500 | | | |
| | Vanadium (V)-Total (mg/L) | 0.00128 | <0.00050 | 0.00061 | 0.00125 | 0.00100 | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0032 | 0.0038 | <0.0030 | <0.0030 | 0.0031 | | | |
| | Zirconium (Zr)-Total (mg/L) | 0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0712 | 0.0023 | 0.0032 | 0.0174 | 0.0216 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00039 | <0.00010 | 0.00031 | 0.00049 | 0.00052 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0628 | 0.00108 | 0.0675 | 0.0444 | 0.0406 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.095 | 0.032 | <0.010 | <0.010 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000149 | <0.0000050 | <0.0000050 | 0.0000090 | 0.0000103 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 58.6 | 3.20 | 58.3 | 24.2 | 22.4 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00021 | <0.00010 | <0.00010 | 0.00030 | 0.00051 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00045 | <0.00010 | <0.00010 | 0.00014 | 0.00014 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0331 | 0.00061 | 0.00637 | 0.00609 | 0.00615 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.233 | <0.010 | <0.010 | 0.151 | 0.164 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0010 | <0.0010 | 0.0015 | <0.0010 | <0.0010 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 17.3 | 0.67 | 19.6 | 9.18 | 8.25 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.250 | 0.00813 | 0.0117 | 0.0568 | 0.0197 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1924462-1 WATER 09-MAY-17 07:30 W3 | L1924462-2 WATER 09-MAY-17 07:35 W50 | L1924462-3 WATER 09-MAY-17 07:45 W16A | L1924462-4 WATER 09-MAY-17 07:50 W17 | L1924462-5 WATER 09-MAY-17 08:20 W35 | |
|---|---|--|---|--|--|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000053 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00347 | 0.00279 | 0.00277 | 0.00597 | 0.000601 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00074 | 0.00054 | 0.00061 | 0.00053 | 0.00173 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 2.54 | 2.68 | 2.84 | 3.48 | 1.12 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000481 | 0.000567 | 0.000634 | 0.000356 | 0.000132 |
| | Silicon (Si)-Dissolved (mg/L) | 3.99 | 3.14 | 3.20 | 5.24 | 3.93 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 13.7 | 12.7 | 13.1 | 14.7 | 3.10 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.512 | 0.463 | 0.455 | 0.712 | 0.120 |
| | Sulfur (S)-Dissolved (mg/L) | 17.0 | 15.7 | 16.2 | 18.8 | 2.10 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | 0.00089 |
| | Uranium (U)-Dissolved (mg/L) | 0.00132 | 0.000918 | 0.000899 | 0.00220 | 0.000057 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | 0.0010 | 0.0014 | <0.0010 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | 0.00045 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1924462-6 WATER 09-MAY-17 08:35 W15 | L1924462-7 WATER 09-MAY-17 08:55 RO | L1924462-8 WATER 09-MAY-17 DUP | L1924462-9 WATER 09-MAY-17 13:50 MC1 | L1924462-10 WATER 09-MAY-17 08:20 W2 |
|-------------------------|---|--|---|---|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | 0.0000063 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00209 | 0.00100 | 0.00575 | 0.000981 | 0.000761 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00088 | <0.00050 | 0.00054 | 0.00132 | 0.00153 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 3.42 | 1.91 | 3.68 | 1.50 | 1.49 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00313 | 0.000306 | 0.000362 | 0.000155 | 0.000127 |
| | Silicon (Si)-Dissolved (mg/L) | 4.06 | 0.099 | 5.19 | 4.58 | 4.31 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 7.45 | 17.9 | 14.8 | 6.20 | 5.32 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.743 | 0.0768 | 0.713 | 0.233 | 0.199 |
| | Sulfur (S)-Dissolved (mg/L) | 29.4 | 4.04 | 18.5 | 5.00 | 3.49 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00143 | <0.00030 | <0.00030 | <0.00060 ^{DLM} | 0.00071 |
| | Uranium (U)-Dissolved (mg/L) | 0.00132 | 0.000071 | 0.00220 | 0.000642 | 0.000470 |
| | Vanadium (V)-Dissolved (mg/L) | 0.00063 | <0.00050 | <0.00050 | 0.00069 | 0.00064 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0038 | 0.0024 | 0.0014 | 0.0017 | 0.0012 |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00038 | <0.00030 | <0.00030 | 0.00030 | 0.00034 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|---|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1924462-1, -10, -2, -3, -4, -7, -8, -9 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1924462-1, -10, -2, -3, -4, -7, -8, -9 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1924462-1, -10, -2, -3, -4, -7, -8, -9 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1924462-5, -6 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1924462-5, -6 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1924462-5, -6 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1924462-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 17-MAY-17
Report Date: 30-MAY-17 16:45 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1928294
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-05-17 C
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1928294-1 | L1928294-2 | L1928294-3 | L1928294-4 | L1928294-5 |
|---|---|---------------------------------|------------|------------|------------|------------|
| | | WATER | WATER | WATER | WATER | WATER |
| | | 16-MAY-17 | 16-MAY-17 | 16-MAY-17 | 16-MAY-17 | 16-MAY-17 |
| | | 09:10 | 10:00 | 08:50 | 09:15 | 10:40 |
| | | W16A | W3 | W7 | W50 | W2 |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 323 | 367 | 149 | 324 | 207 |
| | Hardness (as CaCO3) (mg/L) | 145 | 170 | 78.4 | 154 | 107 |
| | pH (pH) | 8.24 | 8.32 | 8.00 | 8.24 | 8.13 |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | <3.0 | <3.0 | 6.7 |
| | TDS (Calculated) (mg/L) | 196 | 219 | 83.5 | 200 | 120 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 115 | 140 | 76.3 | 115 | 98.6 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | 2.8 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 115 | 143 | 76.3 | 115 | 98.6 |
| | Ammonia, Total (as N) (mg/L) | 0.0445 | 0.0069 | 0.0070 | 0.0349 | 0.0062 |
| | Chloride (Cl) (mg/L) | 4.94 | 4.88 | 0.56 | 4.96 | 1.69 |
| | Nitrate and Nitrite (as N) (mg/L) | 2.17 | 1.58 | <0.0051 | 2.16 | 0.0935 |
| | Nitrate (as N) (mg/L) | 2.09 | 1.56 | 0.0050 | 2.09 | 0.0935 |
| | Nitrite (as N) (mg/L) | 0.0764 | 0.0137 | <0.0010 | 0.0628 | <0.0010 |
| | Sulfate (SO4) (mg/L) | 44.8 | 46.3 | 4.32 | 44.9 | 13.6 |
| | Anion Sum (meq/L) | 3.53 | 4.07 | 1.63 | 3.53 | 2.31 |
| | Cation Sum (meq/L) | 3.56 | 4.08 | 1.81 | 3.76 | 2.46 |
| | Cation - Anion Balance (%) | 0.4 | 0.2 | 5.3 | 3.1 | 3.2 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 12.1 | 30.0 | 25.6 | 12.1 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0794 | 0.0210 | 0.0412 | 0.0553 | 0.157 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00010 | <0.00010 | 0.00011 | 0.00012 |
| | Arsenic (As)-Total (mg/L) | 0.00027 | 0.00030 | 0.00049 | 0.00032 | 0.00068 |
| | Barium (Ba)-Total (mg/L) | 0.0544 | 0.0586 | 0.0411 | 0.0532 | 0.0494 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.043 | 0.038 | <0.010 | 0.045 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000175 | <0.0000050 | 0.0000082 | 0.0000113 | 0.0000158 |
| | Calcium (Ca)-Total (mg/L) | 35.4 | 42.0 | 19.1 | 36.9 | 26.7 |
| | Chromium (Cr)-Total (mg/L) | 0.00033 | 0.00016 | 0.00054 | 0.00023 | 0.00065 |
| | Cobalt (Co)-Total (mg/L) | 0.00013 | <0.00010 | 0.00021 | <0.00010 | 0.00024 |
| | Copper (Cu)-Total (mg/L) | 0.0291 | 0.0138 | 0.00620 | 0.0252 | 0.00705 |
| | Iron (Fe)-Total (mg/L) | 0.197 | 0.069 | 0.233 | 0.142 | 0.438 |
| | Lead (Pb)-Total (mg/L) | 0.000191 | <0.000050 | <0.000050 | 0.000118 | 0.000083 |
| | Lithium (Li)-Total (mg/L) | <0.0010 | 0.0016 | <0.0010 | 0.0012 | 0.0013 |
| | Magnesium (Mg)-Total (mg/L) | 11.2 | 16.1 | 7.42 | 11.5 | 9.40 |
| | Manganese (Mn)-Total (mg/L) | 0.196 | 0.0279 | 0.0331 | 0.111 | 0.0350 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1928294-6 | WATER | 16-MAY-17 | DUP |
|-----------------------------------|--|------------|-------|-----------|-----|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 208 | | | |
| | Hardness (as CaCO3) (mg/L) | 108 | | | |
| | pH (pH) | 8.18 | | | |
| | Total Suspended Solids (mg/L) | 7.3 | | | |
| | TDS (Calculated) (mg/L) | 119 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 97.1 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 97.1 | | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | | | |
| | Chloride (Cl) (mg/L) | 1.68 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.0933 | | | |
| | Nitrate (as N) (mg/L) | 0.0933 | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | | | |
| | Sulfate (SO4) (mg/L) | 13.6 | | | |
| | Anion Sum (meq/L) | 2.28 | | | |
| | Cation Sum (meq/L) | 2.48 | | | |
| | Cation - Anion Balance (%) | 4.4 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 20.4 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.144 | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00011 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00066 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0490 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000113 | | | |
| | Calcium (Ca)-Total (mg/L) | 25.1 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00060 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00023 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00593 | | | |
| | Iron (Fe)-Total (mg/L) | 0.432 | | | |
| | Lead (Pb)-Total (mg/L) | 0.000070 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0011 | | | |
| | Magnesium (Mg)-Total (mg/L) | 9.64 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0379 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1928294-1 WATER 16-MAY-17 09:10 W16A | L1928294-2 WATER 16-MAY-17 10:00 W3 | L1928294-3 WATER 16-MAY-17 08:50 W7 | L1928294-4 WATER 16-MAY-17 09:15 W50 | L1928294-5 WATER 16-MAY-17 10:40 W2 |
|---|---------------------------------------|---|---|---|--|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00255 | 0.00342 | 0.000812 | 0.00285 | 0.00108 |
| | Nickel (Ni)-Total (mg/L) | 0.00074 | 0.00090 | 0.00177 | 0.00064 | 0.00178 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.64 | 2.52 | 0.82 | 2.64 | 1.35 |
| | Selenium (Se)-Total (mg/L) | 0.000609 | 0.000537 | 0.000131 | 0.000627 | 0.000178 |
| | Silicon (Si)-Total (mg/L) | 2.89 | 3.77 | 4.82 | 2.84 | 4.77 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 13.7 | 14.7 | 4.77 | 13.6 | 6.48 |
| | Strontium (Sr)-Total (mg/L) | 0.379 | 0.486 | 0.166 | 0.431 | 0.243 |
| | Sulfur (S)-Total (mg/L) | 15.1 | 16.8 | 1.76 | 15.8 | 4.78 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.00348 | 0.00162 | 0.00113 | 0.00187 | 0.00583 |
| | Uranium (U)-Total (mg/L) | 0.000781 | 0.00130 | 0.000400 | 0.000851 | 0.000667 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00057 | 0.00085 | 0.00053 | 0.00131 |
| | Zinc (Zn)-Total (mg/L) | 0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0056 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | 0.00035 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0093 | 0.0080 | 0.0279 | 0.0081 | 0.0173 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00030 | 0.00030 | 0.00049 | 0.00030 | 0.00053 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0555 | 0.0620 | 0.0413 | 0.0539 | 0.0463 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.048 | 0.039 | <0.010 | 0.050 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000273 | 0.0000051 | 0.0000084 | 0.0000115 | 0.0000104 |
| | Calcium (Ca)-Dissolved (mg/L) | 41.0 | 44.5 | 19.8 | 43.8 | 28.4 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00011 | 0.00038 | <0.00010 | 0.00033 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00019 | <0.00010 | 0.00012 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0237 | 0.0124 | 0.00568 | 0.0227 | 0.00499 |
| | Iron (Fe)-Dissolved (mg/L) | 0.068 | 0.039 | 0.170 | 0.064 | 0.159 |
| | Lead (Pb)-Dissolved (mg/L) | 0.000095 | <0.000050 | <0.000050 | 0.000072 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | 10.5 | 14.4 | 7.00 | 10.8 | 8.85 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.154 | 0.0165 | 0.0314 | 0.0820 | 0.0126 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1928294-6 WATER 16-MAY-17 DUP | | | |
|-------------------------|--|---|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00103 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00181 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | | | |
| | Potassium (K)-Total (mg/L) | 1.36 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000165 | | | |
| | Silicon (Si)-Total (mg/L) | 4.92 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 6.61 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.235 | | | |
| | Sulfur (S)-Total (mg/L) | 4.93 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.00514 | | | |
| | Uranium (U)-Total (mg/L) | 0.000638 | | | |
| | Vanadium (V)-Total (mg/L) | 0.00127 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0204 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00057 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0471 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000069 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 28.0 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00033 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00014 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00563 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.157 | | | |
| | Lead (Pb)-Dissolved (mg/L) | 0.000088 | | | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 9.16 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0128 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1928294-1 | L1928294-2 | L1928294-3 | L1928294-4 | L1928294-5 |
|-------------------------|----------------------------------|--------------|--------------|------------|------------|-------------------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 16-MAY-17 | 16-MAY-17 | 16-MAY-17 | 16-MAY-17 | 16-MAY-17 |
| | | | | | 09:10 | 10:00 | 08:50 | 09:15 | 10:40 |
| | | | | | W16A | W3 | W7 | W50 | W2 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00275 | 0.00331 | 0.000846 | 0.00295 | 0.00106 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00059 | 0.00081 | 0.00175 | 0.00065 | 0.00156 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.62 | 2.53 | 0.87 | 2.73 | 1.34 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000608 | 0.000472 | 0.000141 | 0.000587 | 0.000155 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 2.63 | 3.47 | 4.75 | 2.73 | 4.56 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 13.1 | 14.1 | 4.88 | 13.8 | 6.26 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.436 | 0.481 | 0.169 | 0.466 | 0.240 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 14.4 | 14.1 | 1.54 | 14.3 | 4.40 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00038 | <0.00030 | 0.00060 | 0.00038 | <0.00060 ^{DLM} | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000823 | 0.00124 | 0.000410 | 0.000856 | 0.000635 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00068 | <0.00050 | 0.00068 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0021 | 0.0019 | <0.0010 | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00043 | <0.00030 | 0.00031 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1928294-6 | WATER | 16-MAY-17 | DUP |
|-------------------------|--|------------|-------|-----------|-----|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00107 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00156 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 1.35 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000135 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 4.50 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 6.62 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.238 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 4.43 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00063 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000669 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00067 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00031 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--------------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1928294-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1928294-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1928294-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1928294-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L1928294-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1928294-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1928294-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1928294-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1928294-1 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1928294-2 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1928294-3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1928294-1 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1928294-2 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1928294-3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1928294-1 |
| Matrix Spike | Copper (Cu)-Total | MS-B | L1928294-1 |
| Matrix Spike | Iron (Fe)-Total | MS-B | L1928294-1 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1928294-2 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1928294-3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1928294-1 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1928294-3, -4, -5, -6 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1928294-1 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1928294-2 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1928294-3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1928294-2 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1928294-3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1928294-1 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1928294-2 |
| Matrix Spike | Titanium (Ti)-Total | MS-B | L1928294-1 |
| Matrix Spike | Nitrite (as N) | MS-B | L1928294-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Nitrate (as N) | MS-B | L1928294-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1928294-1, -2, -3, -4, -5, -6 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--------------------------------------|------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |

Reference Information

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

CARBONS-DOC-VA Water Dissolved organic carbon by combustion APHA 5310B TOTAL ORGANIC CARBON (TOC)
 This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CL-IC-N-WR Water Chloride in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.
 This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510
 Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B
 Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)
 Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)
 Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E
 Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)
 Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)
 Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)
 This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
 This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"
 This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

Reference Information

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
 This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
 This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
 The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D
 This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-05-17 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 24-MAY-17
Report Date: 01-JUN-17 18:26 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1930879
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-05-24 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1930879-1 WATER 22-MAY-17 17:00 W55 | L1930879-2 WATER 23-MAY-17 07:25 W3 | L1930879-3 WATER 23-MAY-17 08:00 W50 | L1930879-4 WATER 23-MAY-17 08:40 W16A | L1930879-5 WATER 23-MAY-17 11:05 MC1 | |
|---|--|---|--|---|--|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 140 | 380 | 336 | 336 | 253 |
| | Hardness (as CaCO3) (mg/L) | 87.9 | 180 | 150 | 149 | 127 |
| | pH (pH) | 7.84 | 8.13 | 8.18 | 8.25 | 8.11 |
| | Total Suspended Solids (mg/L) | 4.4 | 9.4 | 4.4 | <3.0 | 31.6 |
| | TDS (Calculated) (mg/L) | 79.9 | 225 | 197 | 199 | 146 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 70.1 | 146 | 116 | 118 | 116 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 70.1 | 146 | 116 | 118 | 116 |
| | Ammonia, Total (as N) (mg/L) | 0.0134 | 0.0218 | 0.0164 | 0.0123 | 0.0071 |
| | Chloride (Cl) (mg/L) | <2.5 ^{DLDS} | 4.98 | 5.00 | 5.00 | 2.01 |
| | Nitrate and Nitrite (as N) (mg/L) | <0.025 | 1.43 | 1.95 | 1.93 | 0.248 |
| | Nitrate (as N) (mg/L) | <0.025 ^{DLDS} | 1.42 | 1.90 | 1.92 | 0.247 |
| | Nitrite (as N) (mg/L) | <0.0050 ^{DLDS} | 0.0100 | 0.0487 | 0.0111 | 0.0012 |
| | Sulfate (SO4) (mg/L) | 2.4 | 47.3 | 45.6 | 45.7 | 19.3 |
| | Anion Sum (meq/L) | 1.45 | 4.14 | 3.55 | 3.59 | 2.79 |
| | Cation Sum (meq/L) | 1.92 | 4.33 | 3.64 | 3.64 | 2.95 |
| | Cation - Anion Balance (%) | 13.9 | 2.2 | 1.4 | 0.7 | 2.7 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 12.2 | 13.3 | 13.5 | 15.9 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.180 | 0.189 | 0.0427 | 0.0486 | 0.674 |
| | Antimony (Sb)-Total (mg/L) | 0.00012 | <0.00010 | <0.00010 | <0.00010 | 0.00011 |
| | Arsenic (As)-Total (mg/L) | 0.00075 | 0.00038 | 0.00032 | 0.00032 | 0.00093 |
| | Barium (Ba)-Total (mg/L) | 0.0558 | 0.0604 | 0.0542 | 0.0547 | 0.0661 |
| | Beryllium (Be)-Total (mg/L) | 0.000048 | <0.000020 | <0.000020 | <0.000020 | 0.000034 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | <0.010 | 0.037 | 0.043 | 0.044 | 0.010 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000207 | 0.0000122 | 0.0000109 | 0.0000153 | 0.0000170 |
| | Calcium (Ca)-Total (mg/L) | 26.0 | 42.8 | 40.5 | 39.7 | 32.3 |
| | Chromium (Cr)-Total (mg/L) | 0.00167 | 0.00041 | 0.00016 | 0.00016 | 0.00160 |
| | Cobalt (Co)-Total (mg/L) | 0.00015 | 0.00018 | 0.00012 | 0.00014 | 0.00076 |
| | Copper (Cu)-Total (mg/L) | 0.108 | 0.0159 | 0.0252 | 0.0277 | 0.00729 |
| | Iron (Fe)-Total (mg/L) | 0.347 | 0.306 | 0.140 | 0.181 | 1.31 |
| | Lead (Pb)-Total (mg/L) | 0.000117 | 0.000106 | 0.000091 | 0.000079 | 0.000299 |
| | Lithium (Li)-Total (mg/L) | 0.0011 | 0.0018 | <0.0010 | <0.0010 | 0.0011 |
| | Magnesium (Mg)-Total (mg/L) | 5.52 | 14.4 | 10.7 | 11.1 | 11.0 |
| | Manganese (Mn)-Total (mg/L) | 0.0123 | 0.256 | 0.109 | 0.143 | 0.124 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1930879-6 | L1930879-7 | | | |
|-----------------------------|---|---------------------------------|------------|------------|------|--|--|
| | | Description | WATER | WATER | | | |
| | | Sampled Date | 23-MAY-17 | 24-MAY-17 | | | |
| | | Sampled Time | | 10:05 | | | |
| | | Client ID | DUP | W2 | | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 379 | 338 | | | |
| | Hardness (as CaCO3) (mg/L) | | 177 | 171 | | | |
| | pH (pH) | | 8.13 | 8.25 | | | |
| | Total Suspended Solids (mg/L) | | 10.6 | 10.0 | | | |
| | TDS (Calculated) (mg/L) | | 224 | 197 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 146 | 162 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 146 | 162 | | | |
| | Ammonia, Total (as N) (mg/L) | | 0.0207 | 0.0336 | | | |
| | Chloride (Cl) (mg/L) | | 4.98 | 2.92 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | | 1.44 | 0.137 | | | |
| | Nitrate (as N) (mg/L) | | 1.43 | 0.136 | | | |
| | Nitrite (as N) (mg/L) | | 0.0102 | 0.0013 | | | |
| | Sulfate (SO4) (mg/L) | | 47.4 | 24.4 | | | |
| | Anion Sum (meq/L) | | 4.14 | 3.84 | | | |
| | Cation Sum (meq/L) | | 4.25 | 3.96 | | | |
| | Cation - Anion Balance (%) | | 1.2 | 1.5 | | | |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 12.1 | 13.7 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.189 | 0.142 | | | |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Total (mg/L) | | 0.00037 | 0.00094 | | | |
| | Barium (Ba)-Total (mg/L) | | 0.0623 | 0.0681 | | | |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | | 0.037 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000118 | 0.0000136 | | | |
| | Calcium (Ca)-Total (mg/L) | | 43.3 | 41.3 | | | |
| | Chromium (Cr)-Total (mg/L) | | 0.00036 | 0.00057 | | | |
| | Cobalt (Co)-Total (mg/L) | | 0.00021 | 0.00026 | | | |
| | Copper (Cu)-Total (mg/L) | | 0.0162 | 0.00393 | | | |
| | Iron (Fe)-Total (mg/L) | | 0.322 | 0.696 | | | |
| | Lead (Pb)-Total (mg/L) | | 0.000105 | 0.000115 | | | |
| | Lithium (Li)-Total (mg/L) | | 0.0013 | <0.0010 | | | |
| | Magnesium (Mg)-Total (mg/L) | | 14.8 | 14.3 | | | |
| | Manganese (Mn)-Total (mg/L) | | 0.256 | 0.0552 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1930879-1 WATER 22-MAY-17 17:00 W55 | L1930879-2 WATER 23-MAY-17 07:25 W3 | L1930879-3 WATER 23-MAY-17 08:00 W50 | L1930879-4 WATER 23-MAY-17 08:40 W16A | L1930879-5 WATER 23-MAY-17 11:05 MC1 | |
|---|--|---|--|---|--|------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | 0.0000107 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00143 | 0.00391 | 0.00292 | 0.00291 | 0.00152 |
| | Nickel (Ni)-Total (mg/L) | 0.00228 | 0.00125 | 0.00075 | 0.00079 | 0.00287 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | 0.072 |
| | Potassium (K)-Total (mg/L) | 1.10 | 2.45 | 2.46 | 2.50 | 1.44 |
| | Selenium (Se)-Total (mg/L) | 0.000260 | 0.000436 | 0.000540 | 0.000568 | 0.000220 |
| | Silicon (Si)-Total (mg/L) | 4.48 | 3.69 | 2.56 | 2.57 | 5.96 |
| | Silver (Ag)-Total (mg/L) | 0.000013 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 2.84 | 14.2 | 13.6 | 13.6 | 8.70 |
| | Strontium (Sr)-Total (mg/L) | 0.191 | 0.504 | 0.439 | 0.446 | 0.312 |
| | Sulfur (S)-Total (mg/L) | 1.21 | 15.4 | 15.7 | 15.6 | 6.80 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.00730 | 0.00825 | 0.00150 | 0.00223 | 0.0346 |
| | Uranium (U)-Total (mg/L) | 0.000336 | 0.00149 | 0.000776 | 0.000763 | 0.00106 |
| | Vanadium (V)-Total (mg/L) | 0.00132 | 0.00092 | <0.00050 | <0.00050 | 0.00320 |
| | Zinc (Zn)-Total (mg/L) | 0.0033 | <0.0030 | <0.0030 | <0.0030 | 0.0044 |
| | Zirconium (Zr)-Total (mg/L) | 0.00063 | <0.00030 | <0.00030 | <0.00030 | 0.00036 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0678 | 0.0050 | 0.0062 | 0.0068 | 0.0100 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00068 | 0.00031 | 0.00028 | 0.00027 | 0.00057 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0565 | 0.0621 | 0.0549 | 0.0557 | 0.0549 |
| | Beryllium (Be)-Dissolved (mg/L) | 0.000042 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.036 | 0.042 | 0.041 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000165 | <0.0000050 | 0.0000076 | 0.0000092 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 25.6 | 45.6 | 41.4 | 41.1 | 32.3 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00039 | 0.00025 | 0.00011 | 0.00011 | 0.00027 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00015 |
| | Copper (Cu)-Dissolved (mg/L) | 0.101 | 0.0130 | 0.0221 | 0.0242 | 0.00384 |
| | Iron (Fe)-Dissolved (mg/L) | 0.144 | 0.048 | 0.062 | 0.073 | 0.145 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | 0.000158 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | 0.0013 | <0.0010 | <0.0010 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | 5.82 | 16.1 | 11.3 | 11.3 | 11.3 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00584 | 0.204 | 0.0262 | 0.0353 | 0.0434 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1930879-6 WATER 23-MAY-17 DUP | L1930879-7 WATER 24-MAY-17 10:05 W2 | | | |
|---|---------------------------------------|---|---|--|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00386 | 0.00167 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00129 | 0.00155 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.052 | | | |
| | Potassium (K)-Total (mg/L) | 2.41 | 1.64 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000477 | 0.000182 | | | |
| | Silicon (Si)-Total (mg/L) | 3.79 | 5.97 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 14.7 | 11.0 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.520 | 0.401 | | | |
| | Sulfur (S)-Total (mg/L) | 16.2 | 8.88 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.00838 | 0.00634 | | | |
| | Uranium (U)-Total (mg/L) | 0.00128 | 0.00133 | | | |
| | Vanadium (V)-Total (mg/L) | 0.00100 | 0.00153 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0052 | 0.0097 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00029 | 0.00072 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0620 | 0.0687 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.035 | <0.010 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000052 | 0.0000073 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 45.3 | 43.4 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00011 | 0.00025 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00014 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0128 | 0.00305 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.048 | 0.338 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0012 | <0.0010 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 15.5 | 15.2 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.205 | 0.0336 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1930879-1 | L1930879-2 | L1930879-3 | L1930879-4 | L1930879-5 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | WATER | WATER | WATER | WATER | WATER |
| | | Sampled Date | 22-MAY-17 | 23-MAY-17 | 23-MAY-17 | 23-MAY-17 | 23-MAY-17 |
| | | Sampled Time | 17:00 | 07:25 | 08:00 | 08:40 | 11:05 |
| | | Client ID | W55 | W3 | W50 | W16A | MC1 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | 0.0000100 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00125 | 0.00353 | 0.00271 | 0.00266 | 0.00147 | 0.00147 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00219 | 0.00094 | 0.00070 | 0.00070 | 0.00136 | 0.00136 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 1.10 | 2.64 | 2.62 | 2.66 | 1.42 | 1.42 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000318 | 0.000493 | 0.000618 | 0.000633 | 0.000210 | 0.000210 |
| | Silicon (Si)-Dissolved (mg/L) | 4.69 | 3.69 | 2.53 | 2.52 | 5.05 | 5.05 |
| | Silver (Ag)-Dissolved (mg/L) | 0.000011 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 2.60 | 14.9 | 13.2 | 13.5 | 8.41 | 8.41 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.181 | 0.517 | 0.447 | 0.442 | 0.307 | 0.307 |
| | Sulfur (S)-Dissolved (mg/L) | 1.16 | 16.2 | 15.1 | 15.3 | 6.53 | 6.53 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00198 | <0.00030 | 0.00032 | <0.00030 | 0.00047 | 0.00047 |
| | Uranium (U)-Dissolved (mg/L) | 0.000311 | 0.00128 | 0.000798 | 0.000797 | 0.00104 | 0.00104 |
| | Vanadium (V)-Dissolved (mg/L) | 0.00092 | <0.00050 | <0.00050 | <0.00050 | 0.00080 | 0.00080 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0013 | <0.0010 | 0.0011 | <0.0010 | <0.0010 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00053 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1930879-6 | L1930879-7 | | |
|-------------------------|----------------------------------|------------|------------|--|--|
| | Description | WATER | WATER | | |
| | Sampled Date | 23-MAY-17 | 24-MAY-17 | | |
| | Sampled Time | | 10:05 | | |
| | Client ID | DUP | W2 | | |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00361 | 0.00157 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00096 | 0.00130 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 2.59 | 1.74 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000494 | 0.000161 | | |
| | Silicon (Si)-Dissolved (mg/L) | 3.54 | 6.03 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 14.4 | 10.8 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.518 | 0.417 | | |
| | Sulfur (S)-Dissolved (mg/L) | 15.7 | 8.60 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00062 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00133 | 0.00135 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00096 | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|------------------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1930879-2, -3, -4, -5, -6, -7 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1930879-2, -3, -4, -5, -6, -7 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1930879-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1930879-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1930879-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1930879-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1930879-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1930879-1, -2, -3, -4, -5, -6, -7 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |

Reference Information

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-05-24 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|------------------------|--|------------------|--|---|------------------------------|-----------------------------|--|-------------------------|--|---------------------------|--------------------------------|--|----------------------|--|--|--|--|--|--|--|--|---|---|
| Report To Contact and company name below will appear on the final report | | | Report For as confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-804-759-4659 | | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | | Email 1 or Fax minto_environment@mintomine.com | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | | Email 2 | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | | Email 3 | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Invoice Distribution | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | Email 2 | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | | | | | |
| Job #: | | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 224162 (WUL) | | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | | Location: | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | ALS Contact: Shane Stack | Sampler: CH/CP | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Description (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Analysis Request | | | | | | | | | | Number of Containers | | | | | | | | | | |
| | | | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | |
| | | | | | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | | | | | | | | | | |
| 1 | W55 | 22-May-17 | 17:00 | Water | R | R | R | R | R | R | R | R | | | | | | | | | | | | 6 | |
| 2 | W3 | 23-May-17 | 7:25 | Water | R | R | R | R | R | R | R | R | | | | | | | | | | | | | 7 |
| 3 | W50 | 23-May-17 | 8:00 | Water | R | R | R | R | R | R | R | R | | | | | | | | | | | | | 7 |
| 4 | W16A | 23-May-17 | 8:40 | Water | R | R | R | R | R | R | R | R | | | | | | | | | | | | | 7 |
| 5 | MC1 | 23-May-17 | 11:05 | Water | R | R | R | R | R | R | R | R | | | | | | | | | | | | | 7 |
| 6 | DUP | 23-May-17 | | Water | R | R | R | R | R | R | R | R | | | | | | | | | | | | 7 | |
| 7 | W2 | 24-May-17 | 10:05 | Water | R | R | R | R | R | R | R | R | | | | | | | | | | | | 7 | |
| Drinking Water (DW) Samples¹ (client use) | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-05-24 10:00 | Time: | Received by: EHP | | Date: 24 May 2017 | Time: 15:00 | Received by: | | Date: | Time: | | | | | | | | | | | | | | |

Short Holding Time
Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 01-JUN-17
Report Date: 13-JUN-17 17:50 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1935320
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-05-31 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1935320-1 Water 30-MAY-17 08:30 W3 | L1935320-2 Water 30-MAY-17 10:55 MC1 | L1935320-3 Water 30-MAY-17 15:45 W50 | L1935320-4 Water 30-MAY-17 16:25 W16A | L1935320-5 Water 30-MAY-17 DUP | |
|---|---|--|--|---|---|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 408 | 284 | 342 | 342 | 421 |
| | Hardness (as CaCO3) (mg/L) | 180 | 128 | 146 | 145 | 186 |
| | pH (pH) | 8.18 | 8.22 | 8.29 | 8.33 | 8.29 |
| | Total Suspended Solids (mg/L) | 3.4 | 6.6 | <3.0 | 5.4 | <3.0 |
| | TDS (Calculated) (mg/L) | 231 | 155 | 194 | 195 | 237 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 164 | 121 | 120 | 119 | 170 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | 2.4 | 1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 164 | 121 | 120 | 122 | 171 |
| | Ammonia, Total (as N) (mg/L) | 0.0133 | 0.0349 | 0.0182 | 0.0081 | 0.0116 |
| | Chloride (Cl) (mg/L) | 4.63 | 2.46 | 4.83 | 4.81 | 4.62 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.917 | 0.446 | 1.80 | 1.79 | 0.905 |
| | Nitrate (as N) (mg/L) | 0.912 | 0.444 | 1.77 | 1.75 | 0.901 |
| | Nitrite (as N) (mg/L) | 0.0048 | 0.0027 | 0.0356 | 0.0391 | 0.0040 |
| | Sulfate (SO4) (mg/L) | 46.5 | 23.1 | 43.7 | 43.6 | 46.5 |
| | Anion Sum (meq/L) | 4.44 | 3.00 | 3.57 | 3.60 | 4.57 |
| | Cation Sum (meq/L) | 4.26 | 3.00 | 3.53 | 3.52 | 4.40 |
| | Cation - Anion Balance (%) | -2.1 | 0.1 | -0.6 | -1.1 | -1.9 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 12.3 | 15.5 | 14.7 | 14.5 | 12.2 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.201 | 2.29 | 0.124 | 0.0948 | 0.293 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00020 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00038 | 0.00199 | 0.00038 | 0.00036 | 0.00049 |
| | Barium (Ba)-Total (mg/L) | 0.0640 | 0.0985 | 0.0551 | 0.0582 | 0.0726 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | 0.000076 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.029 | 0.013 | 0.033 | 0.034 | 0.029 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000098 | 0.0000419 | 0.0000142 | 0.0000123 | 0.0000182 |
| | Calcium (Ca)-Total (mg/L) | 42.0 | 31.1 | 35.1 | 34.7 | 41.4 |
| | Chromium (Cr)-Total (mg/L) | 0.00041 | 0.00456 | 0.00025 | 0.00025 | 0.00051 |
| | Cobalt (Co)-Total (mg/L) | 0.00019 | 0.00167 | 0.00014 | 0.00013 | 0.00061 |
| | Copper (Cu)-Total (mg/L) | 0.0153 | 0.0114 | 0.0333 | 0.0325 | 0.0238 |
| | Iron (Fe)-Total (mg/L) | 0.328 | 3.74 | 0.263 | 0.242 | 0.582 |
| | Lead (Pb)-Total (mg/L) | 0.000121 | 0.00115 | 0.000530 | 0.000297 | 0.000233 |
| | Lithium (Li)-Total (mg/L) | 0.0014 | 0.0022 | <0.0010 | <0.0010 | 0.0014 |
| | Magnesium (Mg)-Total (mg/L) | 16.4 | 11.6 | 10.9 | 11.1 | 16.8 |
| | Manganese (Mn)-Total (mg/L) | 0.136 | 0.283 | 0.148 | 0.101 | 0.280 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1935320-6 | | | |
|-----------------------------|--|---------------------------------|------|--|--|
| | | Water | | | |
| | | 31-MAY-17 | | | |
| | | 07:35 | | | |
| | | W2 | | | |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 269 | | | |
| | Hardness (as CaCO3) (mg/L) | 123 | | | |
| | pH (pH) | 8.23 | | | |
| | Total Suspended Solids (mg/L) | 3.4 | | | |
| | TDS (Calculated) (mg/L) | 147 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 119 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 119 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0052 | | | |
| | Chloride (Cl) (mg/L) | 2.08 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.257 | | | |
| | Nitrate (as N) (mg/L) | 0.255 | | | |
| | Nitrite (as N) (mg/L) | 0.0016 | | | |
| | Sulfate (SO4) (mg/L) | 19.8 | | | |
| | Anion Sum (meq/L) | 2.88 | | | |
| | Cation Sum (meq/L) | 2.88 | | | |
| | Cation - Anion Balance (%) | 0.0 | | | |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 14.8 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.710 | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00015 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00106 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0636 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000181 | | | |
| | Calcium (Ca)-Total (mg/L) | 27.7 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00156 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00056 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00592 | | | |
| | Iron (Fe)-Total (mg/L) | 1.30 | | | |
| | Lead (Pb)-Total (mg/L) | 0.000405 | | | |
| | Lithium (Li)-Total (mg/L) | <0.0010 | | | |
| | Magnesium (Mg)-Total (mg/L) | 10.7 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0888 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1935320-1 Water 30-MAY-17 08:30 W3 | L1935320-2 Water 30-MAY-17 10:55 MC1 | L1935320-3 Water 30-MAY-17 15:45 W50 | L1935320-4 Water 30-MAY-17 16:25 W16A | L1935320-5 Water 30-MAY-17 DUP | |
|---|---|--|--|---|---|------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.000025 ^{DLM} | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00356 | 0.00196 | 0.00254 | 0.00252 | 0.00353 |
| | Nickel (Ni)-Total (mg/L) | 0.00132 | 0.00572 | 0.00090 | 0.00098 | 0.00163 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.105 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.34 | 1.66 | 2.44 | 2.49 | 2.38 |
| | Selenium (Se)-Total (mg/L) | 0.000370 | 0.000278 | 0.000594 | 0.000535 | 0.000373 |
| | Silicon (Si)-Total (mg/L) | 4.33 | 8.73 | 2.53 | 2.54 | 4.37 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000023 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 13.4 | 8.54 | 11.9 | 12.5 | 14.4 |
| | Strontium (Sr)-Total (mg/L) | 0.480 | 0.297 | 0.370 | 0.367 | 0.491 |
| | Sulfur (S)-Total (mg/L) | 15.7 | 7.49 | 14.0 | 14.5 | 15.1 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | 0.000021 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.00869 | 0.0936 | 0.00573 | 0.00496 | 0.00977 |
| | Uranium (U)-Total (mg/L) | 0.00155 | 0.00132 | 0.000811 | 0.000815 | 0.00156 |
| | Vanadium (V)-Total (mg/L) | 0.00098 | 0.00842 | 0.00073 | 0.00068 | 0.00129 |
| | Zinc (Zn)-Total (mg/L) | 0.0050 | 0.0095 | <0.0030 | 0.0040 | 0.0039 |
| | Zirconium (Zr)-Total (mg/L) | 0.00039 | 0.00055 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0062 | 0.0126 | 0.0049 | 0.0062 | 0.0102 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00032 | 0.00071 | 0.00031 | 0.00033 | 0.00031 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0601 | 0.0585 | 0.0540 | 0.0553 | 0.0604 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.030 | 0.014 | 0.034 | 0.035 | 0.030 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000056 | 0.0000056 | 0.0000082 | 0.0000093 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 44.1 | 31.6 | 39.1 | 38.1 | 45.5 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00013 | 0.00024 | 0.00012 | 0.00013 | 0.00014 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00021 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0129 | 0.00471 | 0.0257 | 0.0271 | 0.0131 |
| | Iron (Fe)-Dissolved (mg/L) | 0.039 | 0.240 | 0.053 | 0.065 | 0.046 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | 0.000095 | 0.000076 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0020 | 0.0015 | 0.0013 | 0.0012 | 0.0019 |
| | Magnesium (Mg)-Dissolved (mg/L) | 16.9 | 11.8 | 11.7 | 12.1 | 17.6 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0487 | 0.192 | 0.0159 | 0.0207 | 0.0542 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1935320-6 Water 31-MAY-17 07:35 W2 | | | |
|-------------------------|--|---|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00163 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00259 | | | |
| | Phosphorus (P)-Total (mg/L) | 0.051 | | | |
| | Potassium (K)-Total (mg/L) | 1.39 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000183 | | | |
| | Silicon (Si)-Total (mg/L) | 5.75 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 7.68 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.278 | | | |
| | Sulfur (S)-Total (mg/L) | 6.60 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.000010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.0305 | | | |
| | Uranium (U)-Total (mg/L) | 0.00117 | | | |
| | Vanadium (V)-Total (mg/L) | 0.00341 | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0059 | | | |
| | Zirconium (Zr)-Total (mg/L) | 0.00046 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0133 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00011 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00061 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0534 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.011 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000056 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 30.6 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00024 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00014 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00386 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.168 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0013 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 11.5 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0492 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

13-JUN-17 17:50 (MT)

Version: FINAL

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1935320-1 | L1935320-2 | L1935320-3 | L1935320-4 | L1935320-5 |
|-------------------------|----------------------------------|--------------|-------------------------|------------|-------------------------|-------------------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 30-MAY-17 | 08:30 | W3 | 30-MAY-17 | 10:55 | 30-MAY-17 | 16:25 | 30-MAY-17 |
| | | | | | W3 | MC1 | W50 | W16A | DUP |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00368 | 0.00198 | 0.00274 | 0.00269 | 0.00370 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00094 | 0.00144 | 0.00078 | 0.00084 | 0.00097 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.35 | 1.45 | 2.44 | 2.52 | 2.41 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000360 | 0.000246 | 0.000628 | 0.000619 | 0.000363 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 3.71 | 4.36 | 2.33 | 2.33 | 3.84 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 13.8 | 9.08 | 12.5 | 12.7 | 14.1 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.525 | 0.313 | 0.429 | 0.417 | 0.523 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 15.7 | 7.91 | 15.2 | 15.1 | 16.0 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00090 ^{DLM} | 0.00035 | <0.00090 ^{DLM} | <0.00060 ^{DLM} | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00137 | 0.00118 | 0.000807 | 0.000810 | 0.00146 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00136 | <0.00050 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | 0.0011 | <0.0010 | <0.0010 | 0.0011 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1935320-6 | Water | 31-MAY-17 | 07:35 | W2 |
|-------------------------|--|------------|-------|-----------|-------|----|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00174 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00129 | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | | | | |
| | Potassium (K)-Dissolved (mg/L) | 1.35 | | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000183 | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 4.48 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 8.35 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.309 | | | | |
| | Sulfur (S)-Dissolved (mg/L) | 6.89 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00083 | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00112 | | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00107 | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--------------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1935320-1, -2, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1935320-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1935320-1, -2, -3, -4, -5, -6 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

| | |
|----|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |
|----|---|

Reference Information

Chain of Custody Numbers:

2017-05-31 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

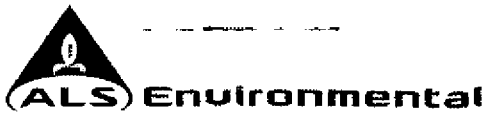
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



L1935320-COFC

COC Number: 2017-05-31 A

Page 1 of 1

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

| | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|---|--------------------|---|--|--|------------------------------|--|-------------------------|--|---------------------------|--------------------------------|----------------------|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | | 1 Business day [E1] <input type="checkbox"/> | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 224162 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (1) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | |
| W3 | | | | 30-May-17 | 8:30 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| MC1 | | | | 30-May-17 | 10:55 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| W50 | | | | 30-May-17 | 15:45 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| W16A | | | | 30-May-17 | 16:25 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| DUP | | | | 30-May-17 | | Water | R | R | R | R | R | R | R | R | R | 7 | |
| W2 | | | | 31-May-17 | 7:35 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | 6.0 | | | | | 7.2 14.5 | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-05-31 8:00 | | Time: | | Received by: EHT | | Date: 01 June 2017 | | Time: 16:45 | | Received by: | | Date: | | Time: | |

Short Holding Time
Rush Processing

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

CCT001 R 2016 F-ROW1

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

MS 02 June 2017 14:30



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 07-JUN-17
Report Date: 29-JUN-17 16:09 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1938367
Project P.O. #: 224162 (WUL)
Job Reference:
C of C Numbers: 2017-06-07 A
Legal Site Desc:

Comments: Please note, the ALS Fort Collins Ra226 detailed analysis report can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1938367-1 | L1938367-2 | L1938367-3 | L1938367-4 | L1938367-5 |
|-----------------------------------|---|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 05-JUN-17 | 05-JUN-17 | 05-JUN-17 | 05-JUN-17 | 05-JUN-17 |
| | | Sampled Time | 08:10 | 07:45 | 08:05 | 14:40 | 15:35 |
| | | Client ID | W17 | W35 | W15 | W16 | W6 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 439 | 168 | 371 | 324 | 122 |
| | Hardness (as CaCO3) (mg/L) | | 213 | 84.7 | 181 | 146 | 62.2 |
| | pH (pH) | | 8.33 | 7.94 | 8.06 | 8.30 | 7.82 |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | 3.5 | 7.5 | 294 |
| | TDS (Calculated) (mg/L) | | 263 | 93.1 | 228 | 192 | 66.7 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 187 | 74.3 | 117 | 118 | 63.7 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | 3.2 | <1.0 | <1.0 | 1.6 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 190 | 74.3 | 117 | 119 | 63.7 |
| | Ammonia, Total (as N) (mg/L) | | <0.0050 | 0.0105 | 0.0310 | 0.0125 | 0.0311 |
| | Chloride (Cl) (mg/L) | | 5.81 | <0.50 | 1.68 | 4.62 | 1.24 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.459 | 1.48 | 4.27 | 1.80 | 0.0077 |
| | Nitrate (as N) (mg/L) | | 0.459 | 1.48 | 4.24 | 1.77 | 0.0077 |
| | Nitrite (as N) (mg/L) | | <0.0010 | 0.0017 | 0.0337 | 0.0341 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 49.6 | 7.52 | 63.9 | 43.5 | 1.36 |
| | Anion Sum (meq/L) | | 5.03 | 1.75 | 4.02 | 3.54 | 1.34 |
| | Cation Sum (meq/L) | | 4.97 | 1.89 | 4.02 | 3.48 | 1.41 |
| | Cation - Anion Balance (%) | | -0.6 | 3.9 | 0.0 | -0.9 | 2.5 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 7.51 | 29.5 | 30.6 | 16.3 | 24.3 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | <0.0030 | 0.0495 | 0.257 | 0.232 | 4.72 |
| | Antimony (Sb)-Total (mg/L) | | 0.00011 | <0.00010 | <0.00010 | <0.00010 | 0.00026 |
| | Arsenic (As)-Total (mg/L) | | 0.00034 | 0.00038 | 0.00058 | 0.00044 | 0.00294 |
| | Barium (Ba)-Total (mg/L) | | 0.0629 | 0.0489 | 0.0654 | 0.0598 | 0.137 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | 0.000023 | 0.000023 | 0.000022 | 0.000204 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.031 | <0.010 | <0.010 | 0.032 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | | <0.0000050 | <0.0000050 | 0.0000144 | 0.0000098 | 0.0000842 |
| | Calcium (Ca)-Total (mg/L) | | 56.7 | 24.9 | 52.1 | 41.1 | 22.4 |
| | Chromium (Cr)-Total (mg/L) | | 0.00012 | 0.00051 | 0.00052 | 0.00035 | 0.00943 |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | <0.00010 | 0.00038 | 0.00020 | 0.00360 |
| | Copper (Cu)-Total (mg/L) | | 0.00797 | 0.0295 | 0.0417 | 0.0431 | 0.0124 |
| | Iron (Fe)-Total (mg/L) | | <0.010 | 0.125 | 0.480 | 0.407 | 7.64 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | <0.000050 | 0.000110 | 0.000183 | 0.00238 |
| | Lithium (Li)-Total (mg/L) | | 0.0016 | <0.0010 | 0.0011 | 0.0012 | 0.0037 |
| | Magnesium (Mg)-Total (mg/L) | | 17.0 | 6.72 | 14.4 | 11.4 | 6.64 |
| | Manganese (Mn)-Total (mg/L) | | 0.00274 | 0.00656 | 0.117 | 0.0679 | 0.273 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1938367-6 | L1938367-7 | L1938367-8 | L1938367-9 | L1938367-10 |
|---|---|------------|------------|------------|------------|-------------|
| | | Water | Water | Water | Water | Water |
| | | 05-JUN-17 | 06-JUN-17 | 06-JUN-17 | 06-JUN-17 | 05-JUN-17 |
| | | 16:30 | 08:00 | 08:50 | 07:30 | |
| | | W30 | W3 | W16A | W2 | DUP |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 366 | 338 | 323 | 242 | 326 |
| | Hardness (as CaCO3) (mg/L) | 165 | 152 | 150 | 115 | 146 |
| | pH (pH) | 8.32 | 8.21 | 8.26 | 8.12 | 8.29 |
| | Total Suspended Solids (mg/L) | <3.0 | 5.7 | 3.5 | 144 | 35.7 |
| | TDS (Calculated) (mg/L) | 225 | 199 | 194 | 139 | 193 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 103 | 130 | 118 | 111 | 120 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 2.2 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 105 | 130 | 118 | 111 | 120 |
| | Ammonia, Total (as N) (mg/L) | 0.0346 | 0.0120 | 0.0129 | 0.0348 | 0.0167 |
| | Chloride (Cl) (mg/L) | 2.20 | 4.48 | 4.37 | 2.16 | 4.63 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.750 | 1.57 | 1.94 | 0.367 | 1.80 |
| | Nitrate (as N) (mg/L) | 0.740 | 1.55 | 1.91 | 0.363 | 1.77 |
| | Nitrite (as N) (mg/L) | 0.0093 | 0.0147 | 0.0316 | 0.0042 | 0.0337 |
| | Sulfate (SO4) (mg/L) | 88.6 | 43.5 | 43.8 | 19.8 | 43.5 |
| | Anion Sum (meq/L) | 4.06 | 3.74 | 3.54 | 2.72 | 3.57 |
| | Cation Sum (meq/L) | 3.81 | 3.60 | 3.55 | 2.69 | 3.48 |
| | Cation - Anion Balance (%) | -3.1 | -2.0 | 0.1 | -0.5 | -1.3 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 16.9 | 20.1 | 19.7 | 17.9 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0603 | 0.104 | 0.182 | 3.12 | 0.272 |
| | Antimony (Sb)-Total (mg/L) | 0.00012 | <0.00010 | <0.00010 | 0.00022 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00052 | 0.00039 | 0.00043 | 0.00259 | 0.00041 |
| | Barium (Ba)-Total (mg/L) | 0.0616 | 0.0563 | 0.0589 | 0.116 | 0.0591 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | 0.000123 | 0.000022 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | <0.010 | 0.030 | 0.030 | 0.011 | 0.032 |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | 0.0000078 | 0.0000103 | 0.0000605 | 0.0000121 |
| | Calcium (Ca)-Total (mg/L) | 41.5 | 42.2 | 41.2 | 31.7 | 40.8 |
| | Chromium (Cr)-Total (mg/L) | <0.00010 | 0.00032 | 0.00033 | 0.00620 | 0.00035 |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00011 | 0.00018 | 0.00225 | 0.00023 |
| | Copper (Cu)-Total (mg/L) | 0.0250 | 0.0274 | 0.0396 | 0.0156 | 0.0464 |
| | Iron (Fe)-Total (mg/L) | 0.115 | 0.179 | 0.332 | 5.40 | 0.473 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.000078 | 0.000120 | 0.00148 | 0.000125 |
| | Lithium (Li)-Total (mg/L) | 0.0014 | 0.0014 | 0.0012 | 0.0031 | 0.0011 |
| | Magnesium (Mg)-Total (mg/L) | 16.2 | 12.9 | 11.4 | 11.3 | 11.3 |
| | Manganese (Mn)-Total (mg/L) | 0.0226 | 0.0607 | 0.0609 | 0.377 | 0.0656 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1938367-1 Water 05-JUN-17 08:10 W17 | L1938367-2 Water 05-JUN-17 07:45 W35 | L1938367-3 Water 05-JUN-17 08:05 W15 | L1938367-4 Water 05-JUN-17 14:40 W16 | L1938367-5 Water 05-JUN-17 15:35 W6 |
|---|---------------------------------------|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000131 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00558 | 0.000807 | 0.00234 | 0.00263 | 0.000429 |
| | Nickel (Ni)-Total (mg/L) | 0.00060 | 0.00148 | 0.00127 | 0.00101 | 0.0113 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | 0.272 |
| | Potassium (K)-Total (mg/L) | 3.27 | 0.57 | 2.41 | 2.34 | 0.94 |
| | Selenium (Se)-Total (mg/L) | 0.000330 | 0.000156 | 0.00150 | 0.000597 | 0.000226 |
| | Silicon (Si)-Total (mg/L) | 4.76 | 4.64 | 4.77 | 2.72 | 14.1 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000039 |
| | Sodium (Na)-Total (mg/L) | 14.0 | 4.23 | 8.02 | 11.5 | 3.53 |
| | Strontium (Sr)-Total (mg/L) | 0.638 | 0.147 | 0.476 | 0.426 | 0.109 |
| | Sulfur (S)-Total (mg/L) | 17.0 | 2.92 | 22.3 | 14.7 | 0.90 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000042 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.00030 | 0.00228 | 0.0112 | 0.0120 | 0.141 |
| | Uranium (U)-Total (mg/L) | 0.00204 | 0.000063 | 0.000933 | 0.000856 | 0.000522 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00056 | 0.00149 | 0.00127 | 0.0157 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0208 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | 0.00046 | 0.00044 | <0.00030 | 0.00077 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0016 | 0.0293 | 0.0516 | 0.0053 | 0.0194 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00031 | 0.00032 | 0.00043 | 0.00032 | 0.00051 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0650 | 0.0461 | 0.0608 | 0.0564 | 0.0335 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.027 | <0.010 | <0.010 | 0.029 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000097 | <0.0000050 | 0.0000083 | 0.0000057 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 55.9 | 23.2 | 49.0 | 39.8 | 17.4 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00010 | 0.00039 | 0.00032 | 0.00014 | 0.00028 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00028 | <0.00010 | 0.00015 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00811 | 0.0257 | 0.0280 | 0.0300 | 0.00230 |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | 0.075 | 0.175 | 0.041 | 0.162 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0015 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | 17.9 | 6.47 | 14.2 | 11.4 | 4.55 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00077 | 0.00514 | 0.0974 | 0.0153 | 0.0257 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1938367-6 Water 05-JUN-17 16:30 W30 | L1938367-7 Water 06-JUN-17 08:00 W3 | L1938367-8 Water 06-JUN-17 08:50 W16A | L1938367-9 Water 06-JUN-17 07:30 W2 | L1938367-10 Water 05-JUN-17 DUP |
|---|---------------------------------------|--|---|---|---|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000091 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00399 | 0.00296 | 0.00257 | 0.00178 | 0.00270 |
| | Nickel (Ni)-Total (mg/L) | 0.00051 | 0.00119 | 0.00113 | 0.00755 | 0.00106 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | 0.186 | <0.050 |
| | Potassium (K)-Total (mg/L) | 3.13 | 2.26 | 2.27 | 1.55 | 2.29 |
| | Selenium (Se)-Total (mg/L) | 0.00281 | 0.000549 | 0.000599 | 0.000349 | 0.000594 |
| | Silicon (Si)-Total (mg/L) | 0.68 | 3.06 | 2.77 | 10.8 | 2.84 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | 0.000029 | 0.000010 |
| | Sodium (Na)-Total (mg/L) | 9.77 | 11.9 | 10.9 | 7.93 | 11.2 |
| | Strontium (Sr)-Total (mg/L) | 0.459 | 0.452 | 0.424 | 0.315 | 0.427 |
| | Sulfur (S)-Total (mg/L) | 31.0 | 15.1 | 15.1 | 7.27 | 15.0 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | 0.000029 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.00384 | 0.00547 | 0.00967 | 0.112 | 0.0161 |
| | Uranium (U)-Total (mg/L) | 0.00127 | 0.000988 | 0.000842 | 0.00128 | 0.000858 |
| | Vanadium (V)-Total (mg/L) | 0.00054 | 0.00075 | 0.00103 | 0.0112 | 0.00129 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | 0.0129 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | 0.00038 | 0.00056 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0040 | 0.0068 | 0.0045 | 0.0166 | 0.0056 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00011 | <0.00010 | <0.00010 | <0.00010 | 0.00012 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00051 | 0.00030 | 0.00036 | 0.00070 | 0.00035 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0605 | 0.0549 | 0.0578 | 0.0537 | 0.0569 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.027 | 0.027 | <0.010 | 0.030 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000051 | 0.0000054 | 0.0000088 | <0.0000050 | 0.0000062 |
| | Calcium (Ca)-Dissolved (mg/L) | 39.0 | 39.6 | 40.4 | 29.2 | 39.3 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00016 | 0.00016 | 0.00030 | 0.00012 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00018 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0213 | 0.0215 | 0.0280 | 0.00463 | 0.0286 |
| | Iron (Fe)-Dissolved (mg/L) | 0.022 | 0.041 | 0.053 | 0.272 | 0.045 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0013 | 0.0011 | 0.0010 | <0.0010 | 0.0014 |
| | Magnesium (Mg)-Dissolved (mg/L) | 16.5 | 12.8 | 11.9 | 10.2 | 11.5 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0135 | 0.0143 | 0.0122 | 0.138 | 0.0126 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1938367-1 | L1938367-2 | L1938367-3 | L1938367-4 | L1938367-5 |
|--------------------------------|----------------------------------|--------------|--------------|------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 05-JUN-17 | 08:10 | | 05-JUN-17 | 07:45 | 05-JUN-17 | 08:05 | 05-JUN-17 |
| | | | | | W17 | W35 | W15 | W16 | W6 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00479 | 0.000684 | 0.00200 | 0.00249 | 0.000364 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00052 | 0.00136 | 0.00108 | 0.00082 | 0.00184 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 3.37 | 0.55 | 2.26 | 2.33 | 0.42 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000380 | 0.000105 | 0.00144 | 0.000625 | 0.000103 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 4.52 | 4.04 | 3.99 | 2.04 | 4.98 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 14.4 | 4.02 | 7.67 | 11.4 | 3.17 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.616 | 0.135 | 0.434 | 0.397 | 0.0751 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 14.5 | 2.44 | 19.1 | 13.2 | 0.67 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00089 | 0.00170 | 0.00062 | 0.00088 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00167 | 0.000058 | 0.000796 | 0.000769 | 0.000075 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00070 | <0.00050 | 0.00098 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | 0.00038 | 0.00044 | <0.00030 | 0.00033 | | | |
| Radiological Parameters | Ra-226 (Bq/L) | | | | | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1938367-6 Water 05-JUN-17 16:30 W30 | L1938367-7 Water 06-JUN-17 08:00 W3 | L1938367-8 Water 06-JUN-17 08:50 W16A | L1938367-9 Water 06-JUN-17 07:30 W2 | L1938367-10 Water 05-JUN-17 DUP |
|---|--|---|---|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00352 | 0.00265 | 0.00221 | 0.00166 |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | 0.00103 | 0.00094 | 0.00155 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 3.09 | 2.23 | 2.29 | 1.19 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00256 | 0.000465 | 0.000669 | 0.000178 |
| | Silicon (Si)-Dissolved (mg/L) | 0.471 | 2.54 | 2.26 | 4.38 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 9.77 | 11.6 | 11.2 | 7.83 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.419 | 0.414 | 0.397 | 0.275 |
| | Sulfur (S)-Dissolved (mg/L) | 26.9 | 13.3 | 13.5 | 6.49 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00060 ^{DLM} | 0.00062 | 0.00114 |
| | Uranium (U)-Dissolved (mg/L) | 0.00108 | 0.000867 | 0.000689 | 0.000929 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00128 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Radiological Parameters | Ra-226 (Bq/L) | | 0.0082 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|---|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1938367-10, -8, -9 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1938367-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1938367-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1938367-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1938367-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1938367-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Reference Information

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

RA226-MMER-FC Water Ra226 by Alpha Scint, MDC=0.01 Bq/L EPA 903.1

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| FC | ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-06-07 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Wednesday, June 28, 2017

Shane Stack
ALS Environmental
8081 Lougheed Hwy, Suite 100
Burnaby, BC V5A 1W9

Re: ALS Workorder: 1706292
Project Name:
Project Number: L1938367

Dear Mr. Stack:

One water sample was received from ALS Environmental, on 6/13/2017. The sample was scheduled for the following analysis:

Radium-226

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Shiloh J. Summy
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

| ALS Environmental – Fort Collins | |
|----------------------------------|---------------------------------|
| Accreditation Body | License or Certification Number |
| AIHA | 214884 |
| Alaska (AK) | UST-086 |
| Alaska (AK) | CO01099 |
| Arizona (AZ) | AZ0742 |
| California (CA) | 06251CA |
| Colorado (CO) | CO01099 |
| Connecticut (CT) | PH-0232 |
| Florida (FL) | E87914 |
| Idaho (ID) | CO01099 |
| Kansas (KS) | E-10381 |
| Kentucky (KY) | 90137 |
| L-A-B (DoD ELAP/ISO 170250) | L2257 |
| Louisiana (LA) | 05057 |
| Maryland (MD) | 285 |
| Missouri (MO) | 175 |
| Nebraska(NE) | NE-OS-24-13 |
| Nevada (NV) | CO000782008A |
| New York (NY) | 12036 |
| North Dakota (ND) | R-057 |
| Oklahoma (OK) | 1301 |
| Pennsylvania (PA) | 68-03116 |
| Tennessee (TN) | 2976 |
| Texas (TX) | T104704241 |
| Utah (UT) | CO01099 |
| Washington (WA) | C1280 |



1706292

Radium-226:

The sample was prepared and analyzed according to the current revision of SOP 783.

All acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1706292

Client Name: ALS Environmental

Client Project Name:

Client Project Number: L1938367

Client PO Number: L1938367

| Client Sample Number | Lab Sample Number | COC Number | Matrix | Date Collected | Time Collected |
|----------------------|-------------------|------------|--------|----------------|----------------|
| L1938367-7 | 1706292-1 | | WATER | 06-Jun-17 | |



L1938367

VANCOUVER

Subcontract Request Form

1706297

Subcontract To:

ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
225 COMMERCE DRIVE
FORT COLLINS, CO 80524

NOTES: Please reference on final report and invoice: PO# L1938367
ALS requires QC data to be provided with your final results.

Please see enclosed 1 sample(s) in 1 Container(s)

| SAMPLE NUMBER | ANALYTICAL REQUIRED | DATE SAMPLED | Priority Flag |
|-----------------|---|--------------|---------------|
| | | DUE DATE | |
| ① L1938367-7 W3 | Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1) | 6/6/2017 | |
| | | 6/21/2017 | |

Subcontract Info Contact: Walter Lin (604) 253-4188
Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9
Phone: (604) 253-4188 Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to: **Shane.Stack@alsglobal.com**

Shipped By: _____ Date Shipped: _____

Received By: [Signature] Date Received: 6/13/17

Verified By: _____ Date Verified: _____

Temperature: _____

Sample Integrity Issues: _____



ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: ALS CA
Project Manager: SS

Workorder No: 1706292
Initials: JNS Date: 6/13/17

| | | | |
|---|---|--------------------------------------|-------------------------------------|
| 1. Does this project require any special handling in addition to standard ALS procedures? | | YES | <input checked="" type="radio"/> NO |
| 2. Are custody seals on shipping containers intact? | <input checked="" type="radio"/> NONE | YES | NO |
| 3. Are Custody seals on sample containers intact? | <input checked="" type="radio"/> NONE | YES | NO |
| 4. Is there a COC (Chain-of-Custody) present or other representative documents? | | <input checked="" type="radio"/> YES | NO |
| 5. Are the COC and bottle labels complete and legible? | | <input checked="" type="radio"/> YES | NO |
| 6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.) | | <input checked="" type="radio"/> YES | NO |
| 7. Were airbills / shipping documents present and/or removable? | DROP OFF | <input checked="" type="radio"/> YES | NO |
| 8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles) | N/A | <input checked="" type="radio"/> YES | NO |
| 9. Are all aqueous non-preserved samples pH 4-9? | <input checked="" type="radio"/> N/A | YES | NO |
| 10. Is there sufficient sample for the requested analyses? | | <input checked="" type="radio"/> YES | NO |
| 11. Were all samples placed in the proper containers for the requested analyses? | | <input checked="" type="radio"/> YES | NO |
| 12. Are all samples within holding times for the requested analyses? | | <input checked="" type="radio"/> YES | NO |
| 13. Were all sample containers received intact? (not broken or leaking, etc.) | | <input checked="" type="radio"/> YES | NO |
| 14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ___ < green pea ___ > green pea | <input checked="" type="radio"/> N/A | YES | NO |
| 15. Do any water samples contain sediment? Amount of sediment: ___ dusting ___ moderate ___ heavy | Amount N/A | <input checked="" type="radio"/> YES | NO |
| 16. Were the samples shipped on ice? | | YES | <input checked="" type="radio"/> NO |
| 17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4 | <input checked="" type="radio"/> RAD ONLY | YES | <input checked="" type="radio"/> NO |
| Cooler #: <u>1</u> | | | |
| Temperature (°C): <u>amb</u> | | | |
| No. of custody seals on cooler: <u>0</u> | | | |
| External µR/hr reading: <u>10</u> | | | |
| Background µR/hr reading: <u>10</u> | | | |
| Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? <input checked="" type="radio"/> YES / NO / NA (If no, see Form 008.) | | | |

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? YES / NO / NA Contact: _____ Date/Time: _____

Project Manager Signature / Date: Philob Jimmy

DEFINITIONS: On the Air Waybill "We", "Our", "us" and "FedEx" refer to Federal Express Corporation, its subsidiaries and branches and their respective employees, agents and independent contractors. "You" and "your" refer to the shipper, its employees, principals and agents. If your shipment originates outside the United States, your contract of carriage is with the Federal Express subsidiary, branch or independent contractor who originally accepts the shipment from you. "Package" means any container or envelope that is accepted by us for delivery, including any such items tendered by you utilizing our automated systems, meters, manifests or waybills. "Shipment" means all packages, which are tendered to and accepted by us on a single Air Waybill.

AGREEMENT TO TERMS: By giving us your shipment, you agree, regardless of whether you sign the front of this Air Waybill, for yourself and as agent for and on behalf of any other person having an interest in this shipment, to all terms on this NON-NEGOTIABLE Air Waybill, in any applicable tariff, and in our current Service Guide or Standard Conditions of Carriage, copies of which are available upon request. If there is a conflict between this Air Waybill and either the tariff, Service Guide or Standard Conditions then in effect, the tariff and the terms of any customer automation agreement between the shipper and Federal Express will control (the Service Guide or Standard Conditions have secondary priority). No one is authorized to alter or modify the terms of our agreement. This Air Waybill shall be binding on us when the shipment is accepted.

YOUR OBLIGATIONS: You warrant that each article in the shipment is properly described on this Air Waybill and is acceptable for transport by us, and that the shipment is properly marked, addressed (including postal codes) and packaged to ensure safe transportation with ordinary care in handling.

NOTE CONCERNING LIMITATIONS OF LIABILITY: Air Carriage Notice. If the carriage of your shipment by air involves an ultimate destination or stop in a country other than the country of departure, the Warsaw Convention, an international treaty relating to international carriage by air, may be applicable, which treaty would then govern and in most cases limit our liability for loss or delay of or damage to your shipment. In the U.S. the Warsaw Convention limits our liability to U.S. \$9.07 per pound (U.S. \$20.39 per kilogram). Unless you declare a higher value for carriage as described below. The interpretation of the Warsaw Convention liability limits may vary in other countries. There are no stopping places which are agreed at the time of tender of the shipment and we reserve the right to route shipments in any way we deem appropriate.

Road Transport Notice: Shipments transported partly or solely by road be it explicit agreement to do so or not, to, from a country which is party to the Convention on the Contract for the International Carriage of Goods by Road (the "CMR") are subject to the terms and conditions of the CMR, notwithstanding any other provisions of this Agreement to the contrary. For these shipments transported solely by road, if a conflict arises between the provisions of the CMR and this Air Waybill the terms of the CMR shall prevail.

Limitation of Liability: If not governed by the Warsaw Convention or the CMR as described above, our maximum liability for loss, damage or delay is limited by this Air Waybill to U.S. \$100 per shipment or U.S. \$9.07 per pound (U.S. \$20.39 per kilo) (or equivalent local currency), whichever is greater, unless you declare a higher value for carriage as described below. FedEx does not provide cargo liability or all-risk insurance, but you may pay an additional charge to each additional U.S. \$100 (or equivalent local currency) of declared value for carriage. If a higher value for carriage is declared and the additional charge is paid, FedEx maximum liability will be the lesser of the declared value for carriage or your actual damages.

LIABILITIES NOT ASSUMED: IN ANY EVENT, WE WON'T BE LIABLE FOR ANY DAMAGES WHETHER DIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL, IN EXCESS OF THE DECLARED VALUE FOR CARRIAGE (INCLUDING BUT NOT LIMITED TO LOSS OF INCOME OR PROFITS) WHETHER OR NOT WE HAD ANY KNOWLEDGE THAT SUCH DAMAGES MIGHT BE INCURRED, UNLESS SUCH DAMAGES WERE CAUSED BY OUR OWN WILLFUL MISCONDUCT OR GROSS NEGLIGENCE.

We won't be liable for your actions or omissions, including but not limited to incorrect declaration of cargo, improper or insufficient packing, securing, marking or addressing of the shipment, or for the acts or omissions of the recipient or anyone else with an interest in the shipment. Also we won't be liable if you (or the recipient) violate any of the terms of our agreement. We won't be liable for loss of or damage to shipments of cash, currency or other prohibited items. We won't be liable for loss, damage or delay caused by events we cannot control, including but not limited to acts of God, perils of the air, weather conditions, mechanical delays, acts of public enemies, war, strikes, civil commotions, or acts or omissions of public authorities (including customs and health officials) with actual or apparent authority.

NO WARRANTIES: We make no warranties, express or implied.

CLAIM FOR LOSS, DAMAGE FOR DELAY: ALL CLAIMS MUST BE NOTIFIED TO US WITHIN 15 DAYS AFTER DELIVERY OF THE SHIPMENT FAILING WHICH NO ACTION FOR DAMAGES MAY BE BROUGHT. All claims for loss, non-delivery or mis-delivery must be received by us within 90 days after the shipment is accepted by us. The right to damages against us shall be extinguished unless an action is brought within two years from the date of delivery of the shipment or from date on which the shipment should have been delivered. Within 30 days after notification to us (of the claim, it must be documented by sending us all relevant information about it. We are not obligated to act on any claim until all transportation charges have been paid; the claim amount may not be deducted from those charges. If the recipient accepts the shipment without noting any damage on the delivery record, we will assume the shipment was delivered in good condition. In order for us to consider a claim for damages, the contents, original shipping cartons, and packing must be available to us for inspection.

RIGHT TO INSPECT: Your shipment may, at our option or at the request of governmental authorities, be opened and inspected by us or such authorities at any time.

CUSTOMS CLEARANCE: It is your responsibility to provide proper customs documentation and confirmations, where required.

EXPORT CONTROL: You authorize Federal Express to act as forwarding agent for you for export control and customs purposes. You hereby certify that all statements and information contained in this air waybill relating to exportation are true and correct. Furthermore, you understand that civil and criminal penalties, including forfeiture and sale, may be imposed for making false or fraudulent statements or for the violation of any United States laws on exportation, including but not limited to, 13 USC Sec. 305; 22 USC Sec. 401; 18 USC Sec. 1001; 50 USC app. 2410.

MANDATORY LAW: Insofar as any provision contained or referred to in this air waybill may be contrary to any applicable international treaty, law government regulations, orders or requirements such provision shall remain in effect as a part of our agreement to the extent that it is not overridden. The liability or unenforceability of any provision shall not affect any other part of this Air Waybill. Unless otherwise indicated the Sender's address indicated on the face of this Waybill is the place of execution and the place of departure, and Recipient's address listed on the face of this Waybill is the place of destination. Unless otherwise indicated Federal Express Corporation, P.O. Box 727, Memphis, TN 38184 USA is the first carrier of this shipment.

- After printing this label:
CONSIGNEE COPY - PLEASE PLACE IN FRONT OF POUCH
 1. Fold the printed page along the horizontal line.
 2. Place label in shipping pouch and affix it to your shipment.

TRK# 7012 5069 3374
 0A30

XH FTCA

CO-US DEN 80524

INTL PRIORITY 10:30A



FedEx Express

J161216191002UW

TO SAMPLE RECEIVING
 ALS ENVIRONMENTAL
 225 COMMERCE DRIVE

FORT COLLINS CO 80524
 (970) 490-1511

DEPT: SUBLET REF: SUBLETS

ORIGIN ID: BYVA (604) 253-4188
 HARJIT GILL
 ALS ENVIRONMENTAL LAB GROUP
 LOUGHNEED HIGHWAY
 BURNABY, BC V5A1W9
 CANADA CA

SHIP DATE: 12JUN17
 ACTWGT: 25.00 LB MAN
 CAD: 03471419/CANFE30114

BILL SENDER

1786202

(US) 540C1A502727F

Client: ALS Environmental

Date: 28-Jun-17

Project: L1938367

Work Order: 1706292

Sample ID: L1938367-7

Lab ID: 1706292-1

Legal Location:

Matrix: WATER

Collection Date: 6/6/2017

Percent Moisture:

| Analyses | Result | Qual | Report Limit | Units | Dilution Factor | Date Analyzed |
|---|---------------------|------|----------------|-------|-----------------------------|--------------------|
| Radium-226 by Radon Emanation - Method 903.1 | | | PAI 783 | | Prep Date: 6/14/2017 | PrepBy: HCJ |
| Ra-226 | 0.0082 (+/- 0.0060) | LT | 0.0079 | BQ/l | NA | 6/27/2017 12:50 |
| Carr: <i>BARIUM</i> | 90.3 | | 40-110 | %REC | DL = NA | 6/27/2017 12:50 |

Client: ALS Environmental

Date: 28-Jun-17

Project: L1938367

Work Order: 1706292

Sample ID: L1938367-7

Lab ID: 1706292-1

Legal Location:

Matrix: WATER

Collection Date: 6/6/2017

Percent Moisture:

| Analyses | Result | Qual | Report Limit | Units | Dilution Factor | Date Analyzed |
|----------|--------|------|--------------|-------|-----------------|---------------|
|----------|--------|------|--------------|-------|-----------------|---------------|

Explanation of Qualifiers

Radiochemistry:

- U or ND - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- Y2 - Chemical Yield outside default limits.
- W - DER is greater than Warning Limit of 1.42
- * - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
- # - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.
- G - Sample density differs by more than 15% of LCS density.
- D - DER is greater than Control Limit
- M - Requested MDC not met.
- LT - Result is less than requested MDC but greater than achieved MDC.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS, Matrix Spike Recovery within control limits.
- N - Matrix Spike Recovery outside control limits
- NC - Not Calculated for duplicate results less than 5 times MDC
- B - Analyte concentration greater than MDC.
- B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

- B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).
- U or ND - Indicates that the compound was analyzed for but not detected.
- E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.
- M - Duplicate injection precision was not met.
- N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.
- Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.
- * - Duplicate analysis (relative percent difference) not within control limits.
- S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

- U or ND - Indicates that the compound was analyzed for but not detected.
- B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.
- E - Analyte concentration exceeds the upper level of the calibration range.
- J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).
- A - A tentatively identified compound is a suspected aldol-condensation product.
- X - The analyte was diluted below an accurate quantitation level.
- * - The spike recovery is equal to or outside the control criteria used.
- + - The relative percent difference (RPD) equals or exceeds the control criteria.
- G - A pattern resembling gasoline was detected in this sample.
- D - A pattern resembling diesel was detected in this sample.
- M - A pattern resembling motor oil was detected in this sample.
- C - A pattern resembling crude oil was detected in this sample.
- 4 - A pattern resembling JP-4 was detected in this sample.
- 5 - A pattern resembling JP-5 was detected in this sample.
- H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.
- L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.
- Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
 - gasoline
 - JP-8
 - diesel
 - mineral spirits
 - motor oil
 - Stoddard solvent
 - bunker C

ALS -- Fort Collins

Date: 6/28/2017 3:29:

Client: ALS Environmental
 Work Order: 1706292
 Project: L1938367

QC BATCH REPORT

Batch ID: **RE170614-1-1** Instrument ID **Alpha Scin** Method: **Radium-226 by Radon Emanation**

| LCS | | Sample ID: RE170614-1 | | | Units: BQ/I | | Analysis Date: 6/27/2017 13:33 | | | | |
|--------------|------------------|------------------------------|---------|---------------|-----------------------------|---------------|---------------------------------------|---------|-----|-----------|------|
| Client ID: | | Run ID: RE170614-1A | | | Prep Date: 6/14/2017 | | DF: NA | | | | |
| Analyte | Result | ReportLimit | SPK Val | SPK Ref Value | %REC | Control Limit | Decision Level | DER Ref | DER | DER Limit | Qual |
| Ra-226 | 1.93 (+/- 0.479) | 0.00595 | 1.703 | | 114 | 67-120 | | | | | P |
| Carr: BARIUM | 15500 | | 16190 | | 95.6 | 40-110 | | | | | |

| LCSD | | Sample ID: RE170614-1 | | | Units: BQ/I | | Analysis Date: 6/27/2017 13:33 | | | | |
|--------------|------------------|------------------------------|---------|---------------|-----------------------------|---------------|---------------------------------------|---------|-----|-----------|------|
| Client ID: | | Run ID: RE170614-1A | | | Prep Date: 6/14/2017 | | DF: NA | | | | |
| Analyte | Result | ReportLimit | SPK Val | SPK Ref Value | %REC | Control Limit | Decision Level | DER Ref | DER | DER Limit | Qual |
| Ra-226 | 1.87 (+/- 0.462) | 0.00456 | 1.703 | | 110 | 67-120 | | 1.93 | 0.1 | 2.1 | P |
| Carr: BARIUM | 15500 | | 16190 | | 95.9 | 40-110 | | 15500 | | | |

| MB | | Sample ID: RE170614-1 | | | Units: BQ/I | | Analysis Date: 6/27/2017 13:33 | | | | |
|--------------|---------------------|------------------------------|---------|---------------|-----------------------------|---------------|---------------------------------------|---------|-----|-----------|------|
| Client ID: | | Run ID: RE170614-1A | | | Prep Date: 6/14/2017 | | DF: NA | | | | |
| Analyte | Result | ReportLimit | SPK Val | SPK Ref Value | %REC | Control Limit | Decision Level | DER Ref | DER | DER Limit | Qual |
| Ra-226 | 0.0028 (+/- 0.0030) | 0.0043 | | | | | | | | | U |
| Carr: BARIUM | 15700 | | 16190 | | 97.1 | 40-110 | | | | | |

The following samples were analyzed in this batch:



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L1938367-COFC

COC Number: 2017-06-07 A

Page of

| | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|--|-------------------|-------------------------------------|--|--|-------------|--|--------------|--|-------|-------------------------------------|-------|---|--|--|--|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format | | | Analysis Request | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT If received by 3 pm - business days - no surcharges apply | | | | | | EMERGENCY | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | 4 day [P4] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | Date and Time Required for all E&P TATs: | | | | | | do not apply, forward | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 1 or Fax: minto_environment@mintomine.com | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 2: | | | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2: | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | | | | | | |
| PO / AFE: 224162 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | | Sampler: SR/SB/EB | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | | Time (hh:mm) | | Sample Type | | Number of Containers | | | | | | | | | | | |
| ✓ W17 | | | | | 5-Jun-17 | | 8:10 | | Water | | R R R R R R R R R R | | | | | | 7 | | | | | |
| ✓ W35 | | | | | 5-Jun-17 | | 7:45 | | Water | | R R R R R R R R R R | | | | | | 7 | | | | | |
| ✓ W15 | | | | | 5-Jun-17 | | 8:05 | | Water | | R R R R R R R R R R | | | | | | 7 | | | | | |
| ✓ W16 | | | | | 5-Jun-17 | | 14:40 | | Water | | R R R R R R R R R R | | | | | | 7 | | | | | |
| ✓ W6 | | | | | 5-Jun-17 | | 15:35 | | Water | | R R R R R R R R R R | | | | | | 7 | | | | | |
| ✓ W30 | | | | | 5-Jun-17 | | 16:30 | | Water | | R R R R R R R R R R | | | | | | 6 | | | | | |
| ✓ W3 | | | | | 6-Jun-17 | | 8:00 | | Water | | R R R R R R R R R R | | | | | | 8 | | | | | |
| ✓ W16A | | | | | 6-Jun-17 | | 8:50 | | Water | | R R R R R R R R R R | | | | | | 7 | | | | | |
| ✓ W2 | | | | | 6-Jun-17 | | 7:30 | | Water | | R R R R R R R R R R | | | | | | 7 | | | | | |
| ✓ DUP | | | | | 5-Jun-17 | | | | Water | | R R R R R R R R R R | | | | | | 7 | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | INITIAL COOLER TEMPERATURES °C: 13.0 | | | | | | | | | | | |
| | | | | | | | | | | | FINAL COOLER TEMPERATURES °C: | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-06-07 | | Time: 11:30 | | Received by: RIFE | | Date: 7 June 2017 | | Time: 17:00 | | Received by: | | Date: | | Time: | | | | | | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 14-JUN-17
Report Date: 26-JUN-17 17:28 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1942313
Project P.O. #: 226337 (WUL)
Job Reference:
C of C Numbers: 2017-06-14 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1942313-1 WATER 13-JUN-17 08:00 W3 | L1942313-2 WATER 13-JUN-17 08:30 W50 | L1942313-3 WATER 13-JUN-17 09:20 W16A | L1942313-4 WATER 13-JUN-17 11:15 MC1 | L1942313-5 WATER 13-JUN-17 13:30 W4 |
|-----------------------------------|---|---|--|---|--|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 346 | 340 | 340 | 224 | 110 |
| | Hardness (as CaCO3) (mg/L) | 163 | 160 | 161 | 108 | 54.6 |
| | pH (pH) | 8.03 | 8.07 | 8.08 | 7.84 | 7.52 |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | <3.0 | 793 | 211 |
| | TDS (Calculated) (mg/L) | 207 | 205 | 206 | 132 | 61.5 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 129 | 122 | 122 | 105 | 53.3 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 129 | 122 | 122 | 105 | 53.3 |
| | Ammonia, Total (as N) (mg/L) | 0.0167 | 0.0251 | 0.0291 | 0.0838 | 0.0148 |
| | Chloride (Cl) (mg/L) | 4.25 | 4.39 | 4.38 | 1.96 | <0.50 |
| | Nitrate (as N) (mg/L) | 1.91 | 2.23 | 2.24 | 0.398 | 0.0257 |
| | Nitrite (as N) (mg/L) | 0.0133 | 0.0264 | 0.0304 | 0.0036 | <0.0010 |
| | Sulfate (SO4) (mg/L) | 46.7 | 48.2 | 48.4 | 19.1 | 6.36 |
| | Anion Sum (meq/L) | 3.81 | 3.73 | 3.73 | 2.58 | 1.20 |
| | Cation Sum (meq/L) | 3.83 | 3.76 | 3.77 | 2.53 | 1.27 |
| | Cation - Anion Balance (%) | 0.3 | 0.4 | 0.5 | -1.0 | 2.8 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 20.5 | 20.0 | 19.5 | 22.9 | 17.7 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0669 | 0.0869 | 0.0966 | 13.5 | 4.94 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00044 | 0.00032 |
| | Arsenic (As)-Total (mg/L) | 0.00043 | 0.00043 | 0.00042 | 0.00684 | 0.00517 |
| | Barium (Ba)-Total (mg/L) | 0.0604 | 0.0626 | 0.0630 | 0.359 | 0.129 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | 0.000557 | 0.000243 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | 0.000108 | 0.000132 |
| | Boron (B)-Total (mg/L) | 0.027 | 0.028 | 0.027 | 0.012 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000084 | 0.0000121 | 0.0000097 | 0.000247 | 0.000109 |
| | Calcium (Ca)-Total (mg/L) | 45.2 | 45.4 | 45.1 | 41.4 | 17.2 |
| | Chromium (Cr)-Total (mg/L) | 0.00031 | 0.00026 | 0.00026 | 0.0262 | 0.0100 |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00012 | 0.00012 | 0.00969 | 0.00350 |
| | Copper (Cu)-Total (mg/L) | 0.0258 | 0.0323 | 0.0325 | 0.0461 | 0.0159 |
| | Iron (Fe)-Total (mg/L) | 0.137 | 0.169 | 0.178 | 20.1 | 6.52 |
| | Lead (Pb)-Total (mg/L) | 0.000074 | 0.000160 | 0.000092 | 0.00583 | 0.00313 |
| | Lithium (Li)-Total (mg/L) | 0.0011 | <0.0010 | <0.0010 | 0.0094 | 0.0035 |
| | Magnesium (Mg)-Total (mg/L) | 13.7 | 13.0 | 12.9 | 15.9 | 7.49 |
| | Manganese (Mn)-Total (mg/L) | 0.0432 | 0.0369 | 0.0300 | 0.756 | 0.216 |
| | Mercury (Hg)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 ^{DLM} | <0.000050 ^{DLM} |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1942313-6 | L1942313-7 | L1942313-8 | | |
|-----------------------------------|---|--------------------------|--------------------------|--------------------------|------------|------------|------------|--|--|
| | | | | | WATER | WATER | WATER | | |
| | | 13-JUN-17 | 13:55 | | 13-JUN-17 | 15:00 | 13-JUN-17 | | |
| | | | | | W2 | W5 | DUP | | |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 224 | 144 | 222 | | | | | |
| | Hardness (as CaCO3) (mg/L) | 106 | 67.3 | 109 | | | | | |
| | pH (pH) | 7.90 | 7.69 | 7.91 | | | | | |
| | Total Suspended Solids (mg/L) | 527 | 153 | 529 | | | | | |
| | TDS (Calculated) (mg/L) | 130 | 79.6 | 131 | | | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 106 | 67.8 | 105 | | | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | | | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | | | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 106 | 67.8 | 105 | | | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0726 | 0.0229 | 0.0719 | | | | | |
| | Chloride (Cl) (mg/L) | 1.87 | 0.57 | 1.87 | | | | | |
| | Nitrate (as N) (mg/L) | 0.365 | 0.0921 | 0.362 | | | | | |
| | Nitrite (as N) (mg/L) | 0.0036 | <0.0010 | 0.0039 | | | | | |
| | Sulfate (SO4) (mg/L) | 18.3 | 9.91 | 18.3 | | | | | |
| | Anion Sum (meq/L) | 2.57 | 1.58 | 2.56 | | | | | |
| | Cation Sum (meq/L) | 2.48 | 1.54 | 2.54 | | | | | |
| | Cation - Anion Balance (%) | -1.8 | -1.5 | -0.4 | | | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 23.3 | 16.3 | 21.3 | | | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 11.3 | 4.02 | 11.1 | | | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00044 | 0.00030 | 0.00044 | | | | | |
| | Arsenic (As)-Total (mg/L) | 0.00622 | 0.00356 | 0.00614 | | | | | |
| | Barium (Ba)-Total (mg/L) | 0.302 | 0.117 | 0.296 | | | | | |
| | Beryllium (Be)-Total (mg/L) | 0.000446 | 0.000172 | 0.000450 | | | | | |
| | Bismuth (Bi)-Total (mg/L) | 0.000098 | 0.000082 | 0.000099 | | | | | |
| | Boron (B)-Total (mg/L) | 0.011 | <0.010 | 0.010 | | | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.000208 | 0.0000859 | 0.000214 | | | | | |
| | Calcium (Ca)-Total (mg/L) | 39.6 | 21.2 | 39.2 | | | | | |
| | Chromium (Cr)-Total (mg/L) | 0.0228 | 0.00800 | 0.0223 | | | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00785 | 0.00280 | 0.00775 | | | | | |
| | Copper (Cu)-Total (mg/L) | 0.0413 | 0.0124 | 0.0404 | | | | | |
| | Iron (Fe)-Total (mg/L) | 17.3 | 5.68 | 17.0 | | | | | |
| | Lead (Pb)-Total (mg/L) | 0.00505 | 0.00235 | 0.00509 | | | | | |
| | Lithium (Li)-Total (mg/L) | 0.0078 | 0.0032 | 0.0079 | | | | | |
| | Magnesium (Mg)-Total (mg/L) | 14.9 | 7.77 | 14.4 | | | | | |
| | Manganese (Mn)-Total (mg/L) | 0.634 | 0.190 | 0.599 | | | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000050 ^{DLM} | <0.000050 ^{DLM} | <0.000050 ^{DLM} | | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1942313-1 | L1942313-2 | L1942313-3 | L1942313-4 | L1942313-5 |
|-------------------------|---------------------------------------|--------------|--------------|------------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 13-JUN-17 | 13-JUN-17 | 13-JUN-17 | 13-JUN-17 | 13-JUN-17 |
| | | | | | 08:00 | 08:30 | 09:20 | 11:15 | 13:30 |
| | | | | | W3 | W50 | W16A | MC1 | W4 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Molybdenum (Mo)-Total (mg/L) | 0.00305 | 0.00271 | 0.00263 | 0.00161 | 0.000911 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00138 | 0.00113 | 0.00117 | 0.0279 | 0.0129 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | 0.666 | 0.251 | | | |
| | Potassium (K)-Total (mg/L) | 2.19 | 2.36 | 2.33 | 2.21 | 1.45 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000702 | 0.000717 | 0.000683 | 0.000656 | 0.000156 | | | |
| | Silicon (Si)-Total (mg/L) | 3.20 | 2.69 | 2.74 | 28.5 | 13.7 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | 0.000096 | 0.000046 | | | |
| | Sodium (Na)-Total (mg/L) | 11.2 | 11.2 | 11.1 | 8.36 | 3.68 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.462 | 0.440 | 0.437 | 0.396 | 0.146 | | | |
| | Sulfur (S)-Total (mg/L) | 17.3 | 17.5 | 17.5 | 7.44 | 2.49 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | 0.000090 | 0.000052 | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00014 | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.00330 | 0.00533 | 0.00533 | 0.380 | 0.144 | | | |
| | Uranium (U)-Total (mg/L) | 0.000905 | 0.000807 | 0.000825 | 0.00202 | 0.00139 | | | |
| | Vanadium (V)-Total (mg/L) | 0.00068 | 0.00077 | 0.00078 | 0.0425 | 0.0154 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | 0.0512 | 0.0198 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00144 | 0.00070 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0098 | 0.0061 | 0.0056 | 0.0254 | 0.0880 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00013 | 0.00012 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00035 | 0.00039 | 0.00038 | 0.00076 | 0.00086 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0618 | 0.0644 | 0.0645 | 0.0564 | 0.0375 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | 0.000026 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.023 | 0.024 | 0.024 | <0.010 | <0.010 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000052 | 0.0000076 | 0.0000065 | <0.0000050 | 0.0000133 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 43.0 | 43.2 | 43.3 | 28.2 | 14.1 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00019 | 0.00016 | 0.00017 | 0.00036 | 0.00034 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00022 | 0.00015 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0220 | 0.0271 | 0.0279 | 0.00492 | 0.00300 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.055 | 0.062 | 0.067 | 0.322 | 0.219 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.000081 | | | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 13.6 | 12.7 | 12.8 | 9.15 | 4.72 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00897 | 0.0122 | 0.0170 | 0.0847 | 0.0213 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1942313-6 WATER 13-JUN-17 13:55 W2 | L1942313-7 WATER 13-JUN-17 15:00 W5 | L1942313-8 WATER 13-JUN-17 DUP | |
|-------------------------|---|---|---|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Molybdenum (Mo)-Total (mg/L) | 0.00170 | 0.00106 | 0.00171 | |
| | Nickel (Ni)-Total (mg/L) | 0.0231 | 0.00964 | 0.0230 | |
| | Phosphorus (P)-Total (mg/L) | 0.552 | 0.182 | 0.534 | |
| | Potassium (K)-Total (mg/L) | 2.07 | 1.33 | 2.02 | |
| | Selenium (Se)-Total (mg/L) | 0.000590 | 0.000240 | 0.000620 | |
| | Silicon (Si)-Total (mg/L) | 25.1 | 12.0 | 25.2 | |
| | Silver (Ag)-Total (mg/L) | 0.000088 | 0.000038 | 0.000087 | |
| | Sodium (Na)-Total (mg/L) | 8.30 | 4.15 | 8.03 | |
| | Strontium (Sr)-Total (mg/L) | 0.370 | 0.172 | 0.367 | |
| | Sulfur (S)-Total (mg/L) | 7.24 | 3.49 | 7.08 | |
| | Thallium (Tl)-Total (mg/L) | 0.000078 | 0.000046 | 0.000081 | |
| | Tin (Sn)-Total (mg/L) | 0.00013 | <0.00010 | 0.00013 | |
| | Titanium (Ti)-Total (mg/L) | 0.335 | 0.129 | 0.325 | |
| | Uranium (U)-Total (mg/L) | 0.00200 | 0.00119 | 0.00204 | |
| | Vanadium (V)-Total (mg/L) | 0.0376 | 0.0131 | 0.0368 | |
| | Zinc (Zn)-Total (mg/L) | 0.0424 | 0.0158 | 0.0410 | |
| | Zirconium (Zr)-Total (mg/L) | 0.00138 | 0.00054 | 0.00142 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0274 | 0.0637 | 0.0267 | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00013 | 0.00013 | 0.00013 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00077 | 0.00072 | 0.00077 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0526 | 0.0386 | 0.0543 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000133 | <0.0000050 | |
| | Calcium (Ca)-Dissolved (mg/L) | 27.8 | 17.9 | 28.2 | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00035 | 0.00031 | 0.00033 | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00017 | 0.00013 | 0.00017 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00445 | 0.00426 | 0.00426 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.302 | 0.203 | 0.298 | |
| | Lead (Pb)-Dissolved (mg/L) | 0.000055 | 0.000083 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 8.91 | 5.49 | 9.33 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0408 | 0.0237 | 0.0419 | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1942313-1 | L1942313-2 | L1942313-3 | L1942313-4 | L1942313-5 |
|-------------------------|----------------------------------|--------------|--------------|-----------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 13-JUN-17 | 13-JUN-17 | 13-JUN-17 | 13-JUN-17 | 13-JUN-17 |
| | | | | | 08:00 | 08:30 | 09:20 | 11:15 | 13:30 |
| | | | | | W3 | W50 | W16A | MC1 | W4 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Molybdenum (Mo)-Dissolved (mg/L) | 0.00257 | 0.00235 | 0.00241 | 0.00151 | 0.000684 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00119 | 0.00097 | 0.00102 | 0.00173 | 0.00173 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.39 | 2.50 | 2.51 | 0.95 | 0.70 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000679 | 0.000724 | 0.000664 | 0.000215 | 0.000113 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 2.82 | 2.35 | 2.37 | 4.68 | 4.94 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 11.5 | 11.1 | 11.2 | 7.18 | 3.17 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.421 | 0.411 | 0.411 | 0.254 | 0.111 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 14.8 | 15.4 | 15.3 | 6.30 | 2.63 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00057 | 0.00067 | 0.00064 | 0.00130 | 0.00307 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000832 | 0.000759 | 0.000785 | 0.000854 | 0.000670 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00167 | 0.00143 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00038 | 0.00051 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1942313-6 WATER 13-JUN-17 13:55 W2 | L1942313-7 WATER 13-JUN-17 15:00 W5 | L1942313-8 WATER 13-JUN-17 DUP | | |
|---|---|---|---|-----------|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Molybdenum (Mo)-Dissolved (mg/L) | 0.00140 | 0.000868 | 0.00137 | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00170 | 0.00174 | 0.00167 | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | |
| | Potassium (K)-Dissolved (mg/L) | 0.95 | 0.74 | 0.99 | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000239 | 0.000132 | 0.000196 | |
| | Silicon (Si)-Dissolved (mg/L) | 4.61 | 3.98 | 4.61 | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Sodium (Na)-Dissolved (mg/L) | 7.02 | 3.54 | 7.27 | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.245 | 0.134 | 0.249 | |
| | Sulfur (S)-Dissolved (mg/L) | 6.11 | 3.14 | 5.80 | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00140 | 0.00287 | 0.00118 | |
| | Uranium (U)-Dissolved (mg/L) | 0.000861 | 0.000739 | 0.000847 | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00181 | 0.00136 | 0.00175 | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | 0.0017 | <0.0010 | |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00037 | 0.00039 | 0.00039 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--|
| Method Blank | Manganese (Mn)-Total | MB-LOR | L1942313-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1942313-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1942313-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1942313-8 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1942313-8 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1942313-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1942313-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1942313-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1942313-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1942313-1, -2, -3, -4, -5, -6, -7, -8 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) | | | |

Reference Information

should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-06-14 B

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1942313-COFC

COC Number: 2017-06-14 B

Page of

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all E&P TATs with your AM - surcharges will apply

| | | | | | | |
|--|---|--|------------------|-------------------|---|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Dis Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax minto_environment@mintomine.com | | | PRIORITY (Business Days) 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> | EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> |
| Contact: | Minto Environment - Coordinator | Email 2 | | | | |
| Phone: | 1-804-759-4659 | Email 3 | | | | |
| Company address below will appear on the final report | | Invoice Distribution Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax ap@mintomine.com Email 2 | | | Date and Time Required for all E&P TATs: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax ap@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | |
| Postal Code: | V6B 0M3 | Email 3 | | | Number of Containers | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | pH / Conductivity / Alkalinity / Anions | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Email 1 or Fax ap@mintomine.com | | | Total Suspended Solids (TSS) | |
| Company: | Minto Explorations Ltd. | Email 2 | | | Total Dissolved Solids (TDS) | |
| Contact: | Ruth Cayetano | Oil and Gas Required Fields (client use) AFE/Cost Center: PO# Major/Minor Code: Routing Code: Requisitioner: Location: | | | Total Metals (TM), Hardness | |
| Project Information | | ALS Contact: Shane Stack | | | Total Dissolved Metals (DM) (Filtered and preserved) | |
| ALS Account # / Quote #: | | Sampler: SR/SB | | | Total Mercury, Hardness | |
| Job #: | | ALS Lab Work Order # (lab use only) | | | Dissolved Mercury [1] (Filtered + preserved) | |
| PO / AFE: | 226337 (WUL) | ALS Sample # (lab use only) | | | Total Nutrients (Ammonia) | |
| LSD: | | Sample Identification and/or Coordinates (This description will appear on the report) | | | Dissolved Organic Carbon (DOC) | |
| ALS Sample # (lab use only) | | Date (dd-mmm-yy) | | | Total Suspended Solids (TSS) | |
| Sample Identification and/or Coordinates (This description will appear on the report) | | Time (hh:mm) | | | Total Dissolved Solids (TDS) | |
| Sample Type | | Date | | | Total Metals (TM), Hardness | |
| W3 | | 13-Jun-17 | | | Dissolved Metals (DM) (Filtered and preserved) | |
| W50 | | 13-Jun-17 | | | Total Mercury, Hardness | |
| W16A | | 13-Jun-17 | | | Dissolved Mercury [1] (Filtered + preserved) | |
| MC1 | | 13-Jun-17 | | | Total Nutrients (Ammonia) | |
| W4 | | 13-Jun-17 | | | Dissolved Organic Carbon (DOC) | |
| W2 | | 13-Jun-17 | | | Total Suspended Solids (TSS) | |
| W5 | | 13-Jun-17 | | | Total Dissolved Solids (TDS) | |
| DUP | | 13-Jun-17 | | | Total Metals (TM), Hardness | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | |
| | | | | | INITIAL COOLER TEMPERATURES °C: 5.0 | |
| | | | | | FINAL COOLER TEMPERATURES °C: | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | |
| Released by: Shaun Roberts | Date: 2017-06-14 | Time: 12:00 | Received by: EHF | Date: 14 Jun 2017 | Time: 15:45 | Received by: |
| | | | | | | Date: |
| | | | | | | Time: |

Short Holding Time
Rush Processing

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 22-JUN-17
Report Date: 04-JUL-17 13:47 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1947077
Project P.O. #: 226337 (WUL)
Job Reference:
C of C Numbers: 2017-06-21 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1947077-1 | L1947077-2 | L1947077-3 | L1947077-4 | L1947077-5 |
|-----------------------------------|---|--------------|------------|------------|------------|------------|------------|
| | | Description | WATER | WATER | WATER | WATER | WATER |
| | | Sampled Date | 20-JUN-17 | 20-JUN-17 | 20-JUN-17 | 20-JUN-17 | 20-JUN-17 |
| | | Sampled Time | 07:45 | 08:20 | 08:55 | 14:10 | 14:35 |
| | | Client ID | W3 | W50 | W16A | W2 | MC1 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 391 | 343 | 335 | 288 | 282 |
| | Hardness (as CaCO3) (mg/L) | | 187 | 161 | 159 | 139 | 140 |
| | pH (pH) | | 8.19 | 8.13 | 8.14 | 8.22 | 8.20 |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | <3.0 | 21.7 | 55.1 |
| | TDS (Calculated) (mg/L) | | 230 | 203 | 202 | 163 | 160 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 151 | 120 | 118 | 132 | 128 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 151 | 120 | 118 | 132 | 128 |
| | Ammonia, Total (as N) (mg/L) | | 0.0127 | 0.0457 | 0.0586 | 0.0100 | 0.0206 |
| | Chloride (Cl) (mg/L) | | 4.21 | 3.97 | 3.94 | 1.89 | 1.81 |
| | Nitrate and Nitrite (as N) (mg/L) | | 1.58 | 2.41 | 2.45 | 0.311 | 0.317 |
| | Nitrate (as N) (mg/L) | | 1.57 | 2.35 | 2.37 | 0.310 | 0.316 |
| | Nitrite (as N) (mg/L) | | 0.0075 | 0.0601 | 0.0808 | 0.0011 | 0.0011 |
| | Sulfate (SO4) (mg/L) | | 48.1 | 46.4 | 46.5 | 21.6 | 20.9 |
| | Anion Sum (meq/L) | | 4.25 | 3.65 | 3.61 | 3.17 | 3.07 |
| | Cation Sum (meq/L) | | 4.38 | 3.79 | 3.75 | 3.21 | 3.24 |
| | Cation - Anion Balance (%) | | 1.5 | 1.9 | 2.0 | 0.6 | 2.7 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 14.6 | 18.5 | 18.8 | 14.9 | 15.5 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0143 | 0.0316 | 0.0509 | 0.496 | 1.05 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.00014 |
| | Arsenic (As)-Total (mg/L) | | 0.00040 | 0.00045 | 0.00045 | 0.00090 | 0.00118 |
| | Barium (Ba)-Total (mg/L) | | 0.0624 | 0.0601 | 0.0621 | 0.0705 | 0.0836 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | <0.000020 | <0.000020 | 0.000036 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.028 | 0.029 | 0.029 | <0.010 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | | <0.0000050 | <0.0000050 | 0.0000076 | 0.0000084 | 0.0000164 |
| | Calcium (Ca)-Total (mg/L) | | 47.8 | 43.6 | 43.3 | 37.2 | 36.9 |
| | Chromium (Cr)-Total (mg/L) | | 0.00020 | 0.00024 | 0.00024 | 0.00119 | 0.00223 |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | <0.00010 | 0.00011 | 0.00038 | 0.00075 |
| | Copper (Cu)-Total (mg/L) | | 0.0163 | 0.0302 | 0.0331 | 0.00513 | 0.00688 |
| | Iron (Fe)-Total (mg/L) | | 0.047 | 0.111 | 0.151 | 0.890 | 1.72 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | 0.000133 | 0.000132 | 0.000245 | 0.000480 |
| | Lithium (Li)-Total (mg/L) | | 0.0014 | <0.0010 | <0.0010 | 0.0012 | 0.0015 |
| | Magnesium (Mg)-Total (mg/L) | | 16.6 | 12.4 | 12.6 | 12.3 | 12.4 |
| | Manganese (Mn)-Total (mg/L) | | 0.0160 | 0.0320 | 0.0396 | 0.0442 | 0.0834 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1947077-6 | WATER | 20-JUN-17 | DUP |
|-----------------------------------|--|------------|-------|-----------|-----|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 394 | | | |
| | Hardness (as CaCO3) (mg/L) | 181 | | | |
| | pH (pH) | 8.20 | | | |
| | Total Suspended Solids (mg/L) | <3.0 | | | |
| | TDS (Calculated) (mg/L) | 228 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 152 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 152 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0134 | | | |
| | Chloride (Cl) (mg/L) | 4.20 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 1.57 | | | |
| | Nitrate (as N) (mg/L) | 1.56 | | | |
| | Nitrite (as N) (mg/L) | 0.0079 | | | |
| | Sulfate (SO4) (mg/L) | 48.0 | | | |
| | Anion Sum (meq/L) | 4.26 | | | |
| | Cation Sum (meq/L) | 4.25 | | | |
| | Cation - Anion Balance (%) | -0.1 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 14.7 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0132 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00036 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0648 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | 0.028 | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | | | |
| | Calcium (Ca)-Total (mg/L) | 47.3 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00020 | | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | | | |
| | Copper (Cu)-Total (mg/L) | 0.0165 | | | |
| | Iron (Fe)-Total (mg/L) | 0.047 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0013 | | | |
| | Magnesium (Mg)-Total (mg/L) | 16.9 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0159 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1947077-1 WATER 20-JUN-17 07:45 W3 | L1947077-2 WATER 20-JUN-17 08:20 W50 | L1947077-3 WATER 20-JUN-17 08:55 W16A | L1947077-4 WATER 20-JUN-17 14:10 W2 | L1947077-5 WATER 20-JUN-17 14:35 MC1 |
|-------------------------|---|---|--|---|---|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000056 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00334 | 0.00251 | 0.00245 | 0.00171 | 0.00186 |
| | Nickel (Ni)-Total (mg/L) | 0.00117 | 0.00106 | 0.00109 | 0.00230 | 0.00338 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | 0.075 |
| | Potassium (K)-Total (mg/L) | 2.20 | 2.25 | 2.30 | 1.28 | 1.28 |
| | Selenium (Se)-Total (mg/L) | 0.000511 | 0.000602 | 0.000687 | 0.000213 | 0.000239 |
| | Silicon (Si)-Total (mg/L) | 3.55 | 2.59 | 2.62 | 5.93 | 6.96 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000011 |
| | Sodium (Na)-Total (mg/L) | 12.9 | 10.9 | 11.1 | 8.68 | 8.66 |
| | Strontium (Sr)-Total (mg/L) | 0.522 | 0.425 | 0.419 | 0.369 | 0.370 |
| | Sulfur (S)-Total (mg/L) | 15.5 | 14.9 | 15.2 | 7.05 | 6.98 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000012 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.00090 ^{DLM} | <0.0018 ^{DLM} | 0.00302 | 0.0204 | 0.0439 |
| | Uranium (U)-Total (mg/L) | 0.00126 | 0.000780 | 0.000808 | 0.00126 | 0.00131 |
| | Vanadium (V)-Total (mg/L) | 0.00061 | 0.00070 | 0.00081 | 0.00282 | 0.00442 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | 0.0033 | <0.0030 | 0.0066 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00035 | 0.00047 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0062 | 0.0111 | 0.0127 | 0.0178 | 0.0189 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00033 | 0.00039 | 0.00040 | 0.00058 | 0.00061 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0651 | 0.0617 | 0.0634 | 0.0621 | 0.0658 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.026 | 0.028 | 0.028 | <0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | 0.0000079 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 48.1 | 44.1 | 44.1 | 36.3 | 36.3 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00017 | 0.00018 | 0.00020 | 0.00027 | 0.00031 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0157 | 0.0263 | 0.0277 | 0.00347 | 0.00356 |
| | Iron (Fe)-Dissolved (mg/L) | 0.037 | 0.079 | 0.094 | 0.097 | 0.135 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | 0.000077 | 0.000092 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0014 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | 16.2 | 12.3 | 12.0 | 11.8 | 12.0 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0112 | 0.0224 | 0.0343 | 0.00536 | 0.0174 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | L1947077-6 | | | | |
|-------------------------|---------------------------------------|------------|--|--|--|
| Description | WATER | | | | |
| Sampled Date | 20-JUN-17 | | | | |
| Sampled Time | | | | | |
| Client ID | DUP | | | | |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00332 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00120 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | | | |
| | Potassium (K)-Total (mg/L) | 2.23 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000499 | | | |
| | Silicon (Si)-Total (mg/L) | 3.58 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 13.2 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.520 | | | |
| | Sulfur (S)-Total (mg/L) | 15.3 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.00071 | | | |
| | Uranium (U)-Total (mg/L) | 0.00125 | | | |
| | Vanadium (V)-Total (mg/L) | 0.00057 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0062 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00034 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0631 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.027 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 46.7 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00015 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0157 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.034 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0012 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 15.7 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0107 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1947077-1 WATER 20-JUN-17 07:45 W3 | L1947077-2 WATER 20-JUN-17 08:20 W50 | L1947077-3 WATER 20-JUN-17 08:55 W16A | L1947077-4 WATER 20-JUN-17 14:10 W2 | L1947077-5 WATER 20-JUN-17 14:35 MC1 | |
|---|---|--|---|---|--|------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00298 | 0.00220 | 0.00221 | 0.00160 | 0.00161 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00126 | 0.00110 | 0.00111 | 0.00137 | 0.00154 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 2.34 | 2.43 | 2.39 | 1.28 | 1.25 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000572 | 0.000703 | 0.000728 | 0.000177 | 0.000180 |
| | Silicon (Si)-Dissolved (mg/L) | 3.87 | 2.81 | 2.70 | 5.40 | 5.42 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 13.4 | 11.5 | 11.3 | 8.88 | 9.06 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.501 | 0.409 | 0.407 | 0.341 | 0.343 |
| | Sulfur (S)-Dissolved (mg/L) | 14.9 | 14.7 | 14.4 | 6.90 | 6.59 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00035 | 0.00075 | 0.00082 | 0.00094 | 0.00074 |
| | Uranium (U)-Dissolved (mg/L) | 0.00108 | 0.000689 | 0.000709 | 0.00113 | 0.00108 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00115 | 0.00108 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | 0.0010 | <0.0010 | 0.0013 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | Sample ID | Description | Sampled Date | Sampled Time | Client ID |
|-------------------------|----------------------------------|------------|-------------|--------------|--------------|------------|
| | | L1947077-6 | WATER | 20-JUN-17 | | DUP |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | | | | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | | | | 0.00302 |
| | Nickel (Ni)-Dissolved (mg/L) | | | | | 0.00110 |
| | Phosphorus (P)-Dissolved (mg/L) | | | | | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | | | | 2.24 |
| | Selenium (Se)-Dissolved (mg/L) | | | | | 0.000594 |
| | Silicon (Si)-Dissolved (mg/L) | | | | | 3.78 |
| | Silver (Ag)-Dissolved (mg/L) | | | | | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | | | | 13.1 |
| | Strontium (Sr)-Dissolved (mg/L) | | | | | 0.486 |
| | Sulfur (S)-Dissolved (mg/L) | | | | | 15.3 |
| | Thallium (Tl)-Dissolved (mg/L) | | | | | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | | | | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | | | | 0.00037 |
| | Uranium (U)-Dissolved (mg/L) | | | | | 0.00117 |
| | Vanadium (V)-Dissolved (mg/L) | | | | | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | | | | 0.0022 |
| | Zirconium (Zr)-Dissolved (mg/L) | | | | | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Samples Listed:

| Sample Number | Client Sample ID | Qualifier | Description |
|---------------|------------------|-----------|---|
| L1947077-3 | W16A | WSMT | Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low. |

QC Samples with Qualifiers & Comments:

| QC Type | Description | Parameter | Qualifier | Applies to Sample Number(s) |
|--------------|-------------|--------------------------|-----------|--------------------------------|
| Matrix Spike | | Barium (Ba)-Dissolved | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Calcium (Ca)-Dissolved | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Magnesium (Mg)-Dissolved | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Manganese (Mn)-Dissolved | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Potassium (K)-Dissolved | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Sodium (Na)-Dissolved | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Strontium (Sr)-Dissolved | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Barium (Ba)-Total | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Calcium (Ca)-Total | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Magnesium (Mg)-Total | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Manganese (Mn)-Total | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Potassium (K)-Total | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Sodium (Na)-Total | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Strontium (Sr)-Total | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Sulfur (S)-Total | MS-B | L1947077-1, -2, -3, -4, -5, -6 |
| Matrix Spike | | Uranium (U)-Total | MS-B | L1947077-1, -2, -3, -4, -5, -6 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |

Reference Information

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

Reference Information

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-06-21 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L1947077-COFC

COC Number: 2017-06-21 A

| Report To Contact and company name below will appear on the final report Company: Minto Explorations Ltd. Contact: Minto Environment - Coordinator Phone: 1-804-759-4659 Company address below will appear on the final report Street: 2100-510 West Georgia St. City/Province: Vancouver, British Columbia Postal Code: V6B 0M3 | | Report Format Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: minto_environment@mintomine.com Email 2 Email 3 | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|--|---|-----|---|-----|---|-----|---|-----|--|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|--|--|--|------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|-----------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|---------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|----------------------|--|--|--|--|--|--|--|--|--|--|--|--|
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Company: Minto Explorations Ltd. Contact: Ruth Cayetano | | Invoice Distribution Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: ap@mintomine.com Email 2 | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>P</th> <th>F/P</th> <th>P</th> <th>F/P</th> <th>P</th> <th>F/P</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> </tr> </thead> <tbody> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">pH / Conductivity / Alkalinity / Anions</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Suspended Solids (TSS)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Dissolved Solids (TDS)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Metals (TW), Hardness</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Dissolved Metals (DM) (Filtered and preserved)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Mercury, Hardness</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Dissolved Mercury [1] (Filtered + preserved)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Nutrients (Ammonia)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Dissolved Organic Carbon (DOC)</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Number of Containers</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </tbody> </table> | | | P | F/P | P | F/P | P | F/P | | | | | | | pH / Conductivity / Alkalinity / Anions | | | | | | | | | | | | | Total Suspended Solids (TSS) | | | | | | | | | | | | | Total Dissolved Solids (TDS) | | | | | | | | | | | | | Total Metals (TW), Hardness | | | | | | | | | | | | | Dissolved Metals (DM) (Filtered and preserved) | | | | | | | | | | | | | Total Mercury, Hardness | | | | | | | | | | | | | Dissolved Mercury [1] (Filtered + preserved) | | | | | | | | | | | | | Total Nutrients (Ammonia) | | | | | | | | | | | | | Dissolved Organic Carbon (DOC) | | | | | | | | | | | | | Number of Containers | | | | | | | | | | | | |
| | P | F/P | P | F/P | P | F/P | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| pH / Conductivity / Alkalinity / Anions | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Suspended Solids (TSS) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Dissolved Solids (TDS) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Metals (TW), Hardness | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dissolved Metals (DM) (Filtered and preserved) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Mercury, Hardness | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dissolved Mercury [1] (Filtered + preserved) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Nutrients (Ammonia) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dissolved Organic Carbon (DOC) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information ALS Account # / Quote #: AFE/Cost Center: PO# Job #: Major/Minor Code: Routing Code: PO / AFE: 226337 (WUL) Requisitioner: LSD: Location: | | Oil and Gas Required Fields (client use) ALS Contact: Shane Stack Sampler: CH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on report) Date (dd-mmm-yy) Time (hh:mm) Sample Type | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | W3 20-Jun-17 7:45 Water W50 20-Jun-17 8:20 Water W16A 20-Jun-17 8:55 Water W2 20-Jun-17 14:10 Water MC1 20-Jun-17 14:35 Water DUP 20-Jun-17 Water | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples (lab use) Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) SAMPLE CONDITION AS RECEIVED (lab use only) Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input type="checkbox"/> INITIAL COOLER TEMPERATURES °C: 2.6 FINAL COOLER TEMPERATURES °C: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) Released by: Chris Harry Date: 2017-06-21 7:15 Time: | | INITIAL SHIPMENT RECEPTION (lab use only) Received by: <i>JD</i> Date: <i>June 22/17</i> Time: <i>8:40</i> | | FINAL SHIPMENT RECEPTION (lab use only) Received by: Date: Time: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Short Holding Time
Rush Processing



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 28-JUN-17
Report Date: 10-JUL-17 17:56 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1950514
Project P.O. #: 226337 (WUL)
Job Reference:
C of C Numbers: 2017-06-28 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

10-JUL-17 17:56 (MT)

Version: FINAL

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1950514-1 | L1950514-2 | L1950514-3 | L1950514-4 | L1950514-5 |
|-----------------------------------|---|--------------|--------------|------------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 27-JUN-17 | 07:45 | W2 | 27-JUN-17 | 27-JUN-17 | 27-JUN-17 | 27-JUN-17 | 27-JUN-17 |
| | | | | | 07:45 | 09:30 | 10:00 | 11:30 | 07:45 |
| | | | | | W2 | W7 | W3 | MC1 | DUP |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 319 | 228 | 490 | 310 | 319 | | | |
| | Hardness (as CaCO3) (mg/L) | 156 | 111 | 234 | 151 | 154 | | | |
| | pH (pH) | 8.15 | 8.05 | 8.19 | 8.21 | 8.14 | | | |
| | Total Suspended Solids (mg/L) | 7.4 | 22.0 | 3.4 | 17.8 | 5.8 | | | |
| | TDS (Calculated) (mg/L) | 183 | 126 | 286 | 178 | 181 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 150 | 118 | 214 | 150 | 147 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 150 | 118 | 214 | 150 | 147 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0133 | 0.0114 | 0.0078 | 0.0183 | 0.0134 | | | |
| | Chloride (Cl) (mg/L) | 2.10 | <0.50 | 4.70 | 1.82 | 2.10 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.308 | 0.144 | 0.232 | 0.248 | 0.309 | | | |
| | Nitrate (as N) (mg/L) | 0.307 | 0.144 | 0.232 | 0.247 | 0.308 | | | |
| | Nitrite (as N) (mg/L) | 0.0012 | <0.0010 | <0.0010 | 0.0015 | 0.0014 | | | |
| | Sulfate (SO4) (mg/L) | 24.8 | 8.70 | 54.2 | 21.8 | 24.8 | | | |
| | Anion Sum (meq/L) | 3.59 | 2.54 | 5.56 | 3.53 | 3.54 | | | |
| | Cation Sum (meq/L) | 3.57 | 2.55 | 5.46 | 3.48 | 3.53 | | | |
| | Cation - Anion Balance (%) | -0.3 | 0.1 | -0.8 | -0.6 | -0.2 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 12.4 | 13.1 | 8.26 | 12.6 | 12.2 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.135 | 0.368 | 0.0109 | 0.376 | 0.124 | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00010 | 0.00011 | <0.00010 | 0.00014 | 0.00012 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00061 | 0.00059 | 0.00027 | 0.00069 | 0.00056 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0702 | 0.0732 | 0.0601 | 0.0612 | 0.0589 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | 0.000020 | <0.000020 | 0.000021 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | <0.010 | <0.010 | 0.024 | <0.010 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | 0.0000104 | <0.0000050 | 0.0000115 | 0.0000061 | | | |
| | Calcium (Ca)-Total (mg/L) | 42.6 | 29.8 | 57.8 | 40.6 | 42.1 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00045 | 0.00098 | 0.00011 | 0.00094 | 0.00043 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00013 | 0.00037 | <0.00010 | 0.00033 | 0.00013 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00322 | 0.00288 | 0.00533 | 0.00372 | 0.00317 | | | |
| | Iron (Fe)-Total (mg/L) | 0.279 | 0.659 | 0.026 | 0.672 | 0.238 | | | |
| | Lead (Pb)-Total (mg/L) | 0.000077 | 0.000192 | <0.000050 | 0.000186 | 0.000089 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0015 | <0.0010 | 0.0025 | 0.0015 | 0.0014 | | | |
| | Magnesium (Mg)-Total (mg/L) | 13.6 | 10.6 | 24.8 | 14.1 | 13.8 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0225 | 0.0464 | 0.0414 | 0.0416 | 0.0213 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1950514-1 WATER 27-JUN-17 07:45 W2 | L1950514-2 WATER 27-JUN-17 09:30 W7 | L1950514-3 WATER 27-JUN-17 10:00 W3 | L1950514-4 WATER 27-JUN-17 11:30 MC1 | L1950514-5 WATER 27-JUN-17 07:45 DUP |
|---|---------------------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00186 | 0.00155 | 0.00468 | 0.00196 | 0.00183 |
| | Nickel (Ni)-Total (mg/L) | 0.00138 | 0.00196 | 0.00107 | 0.00186 | 0.00128 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 1.27 | 0.75 | 1.99 | 1.21 | 1.24 |
| | Selenium (Se)-Total (mg/L) | 0.000169 | 0.000164 | 0.000283 | 0.000168 | 0.000173 |
| | Silicon (Si)-Total (mg/L) | 5.81 | 6.20 | 5.30 | 6.05 | 5.38 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 8.92 | 6.49 | 16.2 | 9.06 | 8.98 |
| | Strontium (Sr)-Total (mg/L) | 0.473 | 0.338 | 0.754 | 0.455 | 0.458 |
| | Sulfur (S)-Total (mg/L) | 8.74 | 2.79 | 18.2 | 7.13 | 7.91 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.00534 | 0.0160 | 0.00040 | 0.0148 | 0.00578 |
| | Uranium (U)-Total (mg/L) | 0.00164 | 0.00110 | 0.00261 | 0.00168 | 0.00162 |
| | Vanadium (V)-Total (mg/L) | 0.00131 | 0.00216 | <0.00050 | 0.00224 | 0.00131 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | 0.00031 | 0.00035 | <0.00030 | 0.00033 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0079 | 0.0101 | 0.0045 | 0.0325 | 0.0088 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00049 | 0.00039 | 0.00025 | 0.00058 | 0.00048 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0662 | 0.0599 | 0.0642 | 0.0632 | 0.0648 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | 0.022 | <0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000051 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 40.8 | 27.9 | 54.8 | 38.9 | 40.3 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00017 | 0.00029 | 0.00010 | 0.00027 | 0.00017 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00276 | 0.00147 | 0.00501 | 0.00271 | 0.00275 |
| | Iron (Fe)-Dissolved (mg/L) | 0.055 | 0.084 | 0.013 | 0.143 | 0.052 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0014 | <0.0010 | 0.0024 | 0.0013 | 0.0014 |
| | Magnesium (Mg)-Dissolved (mg/L) | 13.1 | 10.1 | 23.5 | 13.1 | 13.0 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00924 | 0.0203 | 0.0346 | 0.0158 | 0.00915 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1950514-1 | L1950514-2 | L1950514-3 | L1950514-4 | L1950514-5 |
|-------------------------|----------------------------------|--------------|--------------------------|------------|-------------------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 27-JUN-17 | 27-JUN-17 | 27-JUN-17 | 27-JUN-17 | 27-JUN-17 |
| | | | | | 07:45 | 09:30 | 10:00 | 11:30 | 07:45 |
| | | | | | W2 | W7 | W3 | MC1 | DUP |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00163 | 0.00140 | 0.00401 | 0.00175 | 0.00160 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00107 | 0.00125 | 0.00099 | 0.00124 | 0.00111 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 1.43 | 0.84 | 2.27 | 1.35 | 1.43 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000205 | 0.000174 | 0.000360 | 0.000175 | 0.000199 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.63 | 5.86 | 5.60 | 5.81 | 5.74 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 9.38 | 6.84 | 16.9 | 9.58 | 9.36 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.380 | 0.279 | 0.628 | 0.373 | 0.380 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 8.67 | 3.00 | 18.7 | 7.58 | 8.48 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00035 | <0.000060 ^{DLM} | 0.00044 | <0.00020 ^{DLM} | 0.00048 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00142 | 0.000948 | 0.00230 | 0.00146 | 0.00140 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00087 | 0.00088 | <0.00050 | 0.00110 | 0.00083 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1950514-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1950514-1, -2, -3, -4, -5 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". | | | |
| The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

Reference Information

2017-06-28 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



L1950514-COFC

COC Number: 2017-06-28 A

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

| | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|---|--|-------------------------------------|---|--|--|-----------------------------|--|---|--|---------------------------|--------------------------------|------------------------------|--|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | EMERGENCY | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | 1 Business day [E1] <input type="checkbox"/> | | | EMERGENCY | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Analysis Request | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 2 | | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | | | | | | | | | | | | | | | | | | |
| Project Information | | | | Oil and Gas Required Fields (client use) | | | | | | | | Number of Containers | | | | | | | |
| ALS Account # / Quote #: | | | | AFE/Cost Center: | | | | PO# | | | | | | | | | | | |
| Job #: | | | | Major/Minor Code: | | | | Routing Code: | | | | | | | | | | | |
| PO / AFE: 226337 (WUL) | | | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | ALS Contact: Shane Stack | | Sampler: CH/EB | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | | |
| | W2 | | | 27-Jun-17 | 7:45 | Water | R | R | R | R | R | R | R | R | R | | | | |
| | W7 | | | 27-Jun-17 | 9:30 | Water | R | R | R | R | R | R | R | R | R | | | | |
| | W3 | | | 27-Jun-17 | 10:00 | Water | R | R | R | R | R | R | R | R | R | | | | |
| | MC1 | | | 27-Jun-17 | 11:30 | Water | R | R | R | R | R | R | R | R | R | | | | |
| | DUP | | | 27-Jun-17 | | Water | R | R | R | R | R | R | R | R | R | | | | |
| Drinking Water (DW) Samples¹ (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | |
| | | | | | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | FINAL COOLER TEMPERATURES °C | | | |
| | | | | | | | | | | | | 2.0 | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-06-28 8:00 | | Time: | | Received by: PH | | Date: June 26/17 | | Time: 17:45 | | Received by: PAUL | | Date: JUN 29 | | Time: 16:00 | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 05-JUL-17
Report Date: 18-JUL-17 18:08 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1953755
Project P.O. #: 226337 (WUL)
Job Reference:
C of C Numbers: 2017-07-05-B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

18-JUL-17 18:08 (MT)

Version: FINAL

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1953755-1 | L1953755-2 | L1953755-3 | L1953755-4 | L1953755-5 |
|-----------------------------------|---|--------------|--------------------------|-----------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 03-JUL-17 | 13:45 | W10 | 03-JUL-17 | 03-JUL-17 | 03-JUL-17 | 04-JUL-17 | 04-JUL-17 |
| | | | | | 13:45 | 14:25 | 14:25 | 07:40 | 08:40 |
| | | | | | W10 | W12 | W14 | W2 | MC1 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 248 | 2560 | 3420 | 345 | 336 | | | |
| | Hardness (as CaCO3) (mg/L) | 130 | 1240 | 1700 | 164 | 161 | | | |
| | pH (pH) | 7.76 | 7.99 | 8.05 | 8.25 | 8.29 | | | |
| | Total Suspended Solids (mg/L) | <3.0 | 9.1 | 58.1 | 4.1 | 10.9 | | | |
| | TDS (Calculated) (mg/L) | 145 | 2300 | 3290 | 193 | 189 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 125 | 157 | 76.2 | 163 | 163 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | 1.8 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 125 | 157 | 76.2 | 163 | 165 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0288 | 3.68 | 3.76 | 0.0141 | <0.0050 | | | |
| | Chloride (Cl) (mg/L) | <0.50 | 36 | 39 | 2.13 | 1.66 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 2.65 | 20.8 | 27.2 | 0.185 | 0.151 | | | |
| | Nitrate (as N) (mg/L) | 2.62 | 15.1 | 21.4 | 0.184 | 0.150 | | | |
| | Nitrite (as N) (mg/L) | 0.0246 | 5.77 | 5.77 | 0.0013 | 0.0011 | | | |
| | Sulfate (SO4) (mg/L) | 3.45 | 1430 | 2150 | 24.1 | 20.8 | | | |
| | Anion Sum (meq/L) | 2.76 | 35.5 | 49.4 | 3.84 | 3.78 | | | |
| | Cation Sum (meq/L) | 2.98 | 32.5 | 45.7 | 3.75 | 3.70 | | | |
| | Cation - Anion Balance (%) | 3.8 | -4.5 | -3.9 | -1.2 | -1.1 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | | | 9.51 | 9.79 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0775 | 0.0654 | 1.31 | 0.0680 | 0.247 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00022 | 0.00029 | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00053 | 0.00040 | 0.00077 | 0.00053 | 0.00068 | | | |
| | Barium (Ba)-Total (mg/L) | 0.169 | 0.110 | 0.180 | 0.0718 | 0.0690 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000040 ^{DLA} | 0.000042 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.00010 ^{DLA} | 0.00098 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | <0.010 | 0.203 | 0.247 | <0.010 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000058 | 0.000148 | 0.000648 | <0.0000050 | 0.0000071 | | | |
| | Calcium (Ca)-Total (mg/L) | 38.3 | 373 | 502 | 42.8 | 41.5 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00035 | <0.00020 ^{DLA} | 0.00454 | 0.00029 | 0.00065 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00044 | 0.00174 | 0.00282 | 0.00010 | 0.00022 | | | |
| | Copper (Cu)-Total (mg/L) | 0.0272 | 0.0498 | 9.72 | 0.00237 | 0.00299 | | | |
| | Iron (Fe)-Total (mg/L) | 1.68 | 0.137 | 6.11 | 0.128 | 0.468 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.00019 | 0.00286 | <0.000050 | 0.000126 | | | |
| | Lithium (Li)-Total (mg/L) | <0.0010 | 0.0173 | 0.0314 | 0.0015 | 0.0013 | | | |
| | Magnesium (Mg)-Total (mg/L) | 8.31 | 50.3 | 73.3 | 13.7 | 14.6 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.264 | 1.43 | 1.60 | 0.0237 | 0.0264 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1953755-6 | L1953755-7 | L1953755-8 | L1953755-9 |
|-----------------------------------|---|--------------|--------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water |
| | | 04-JUL-17 | 09:30 | W3 | 04-JUL-17 | 04-JUL-17 | 04-JUL-17 | 04-JUL-17 |
| | | | | | W3 | W33 | F-BL | DUP |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 520 | 190 | <2.0 | 321 | | | |
| | Hardness (as CaCO3) (mg/L) | 249 | 100 | <0.50 | 162 | | | |
| | pH (pH) | 8.31 | 7.79 | 5.26 | 8.10 | | | |
| | Total Suspended Solids (mg/L) | <3.0 | 3.5 | <3.0 | 8.7 | | | |
| | TDS (Calculated) (mg/L) | 301 | 104 | <1.0 | 187 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 227 | 100 | <1.0 | 161 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 3.6 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 231 | 100 | <1.0 | 161 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0087 | 0.0103 | <0.0050 | 0.0146 | | | |
| | Chloride (Cl) (mg/L) | 4.60 | <0.50 | <0.50 | 1.65 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.197 | 0.442 | <0.0051 | 0.151 | | | |
| | Nitrate (as N) (mg/L) | 0.197 | 0.442 | <0.0050 | 0.150 | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | <0.0010 | 0.0012 | | | |
| | Sulfate (SO4) (mg/L) | 54.9 | 1.71 | <0.30 | 20.8 | | | |
| | Anion Sum (meq/L) | 5.90 | 2.07 | <0.10 | 3.71 | | | |
| | Cation Sum (meq/L) | 5.82 | 2.21 | <0.10 | 3.72 | | | |
| | Cation - Anion Balance (%) | -0.6 | 3.5 | 0.0 | 0.2 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 5.90 | | <0.50 | 9.69 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0061 | 0.0423 | <0.0030 | 0.226 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00012 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00025 | 0.00044 | <0.00010 | 0.00074 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0668 | 0.0529 | <0.000050 | 0.0689 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | 0.026 | <0.010 | <0.010 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000126 | | | |
| | Calcium (Ca)-Total (mg/L) | 59.0 | 28.2 | <0.050 | 41.6 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00012 | 0.00059 | <0.00010 | 0.00063 | | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00016 | <0.00010 | 0.00020 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00353 | 0.0140 | <0.00050 | 0.00268 | | | |
| | Iron (Fe)-Total (mg/L) | 0.014 | 0.246 | <0.010 | 0.448 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | 0.000116 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0030 | <0.0010 | <0.0010 | 0.0013 | | | |
| | Magnesium (Mg)-Total (mg/L) | 27.1 | 7.66 | <0.10 | 14.6 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0384 | 0.0289 | <0.00010 | 0.0262 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1953755-1 Water 03-JUL-17 13:45 W10 | L1953755-2 Water 03-JUL-17 14:25 W12 | L1953755-3 Water 03-JUL-17 14:25 W14 | L1953755-4 Water 04-JUL-17 07:40 W2 | L1953755-5 Water 04-JUL-17 08:40 MC1 |
|---|---------------------------------------|--|--|--|---|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.000025 ^{DLM} | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.000463 | 0.0741 | 0.147 | 0.00146 | 0.00183 |
| | Nickel (Ni)-Total (mg/L) | 0.00126 | 0.0043 | 0.0045 | 0.00110 | 0.00154 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.10 ^{DLA} | 0.13 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 0.70 | 47.0 | 96.2 | 1.50 | 1.35 |
| | Selenium (Se)-Total (mg/L) | 0.000114 | 0.0110 | 0.0170 | 0.000148 | 0.000157 |
| | Silicon (Si)-Total (mg/L) | 1.79 | 3.32 | 4.93 | 5.85 | 6.31 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000020 ^{DLA} | 0.00233 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 5.66 | 122 | 180 | 9.43 | 9.84 |
| | Strontium (Sr)-Total (mg/L) | 0.253 | 6.85 | 7.16 | 0.431 | 0.428 |
| | Sulfur (S)-Total (mg/L) | 1.70 | 427 | 659 | 8.50 | 7.49 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000020 ^{DLA} | 0.000031 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.00183 | <0.0033 ^{DLM} | 0.0769 | 0.00274 | 0.00914 |
| | Uranium (U)-Total (mg/L) | 0.000071 | 0.00617 | 0.0149 | 0.00179 | 0.00189 |
| | Vanadium (V)-Total (mg/L) | 0.00066 | <0.0010 ^{DLA} | 0.0066 | 0.00089 | 0.00166 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0076 | 0.0228 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | 0.00039 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0536 | 0.0036 | 0.0356 | 0.0065 | 0.0068 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00028 | 0.00033 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00051 | 0.00041 | 0.00031 | 0.00046 | 0.00053 |
| | Barium (Ba)-Dissolved (mg/L) | 0.178 | 0.122 | 0.211 | 0.0709 | 0.0642 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000040 ^{DLA} | <0.000040 ^{DLA} | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.231 | 0.286 | 0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000061 | <0.00018 ^{DLM} | <0.00015 ^{DLM} | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 37.0 | 406 | 547 | 42.4 | 40.2 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00032 | <0.00020 ^{DLA} | <0.00020 ^{DLA} | 0.00012 | 0.00016 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00043 | 0.00193 | 0.00133 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0259 | 0.0397 | 0.0140 | 0.00212 | 0.00171 |
| | Iron (Fe)-Dissolved (mg/L) | 1.07 | <0.020 ^{DLA} | <0.020 ^{DLA} | 0.031 | 0.081 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | 0.0185 | 0.0328 | 0.0010 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | 9.26 | 56.4 | 81.9 | 14.1 | 14.7 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.282 | 1.62 | 1.60 | 0.0170 | 0.00921 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1953755-6 Water 04-JUL-17 09:30 W3 | L1953755-7 Water 04-JUL-17 10:20 W33 | L1953755-8 Water 04-JUL-17 F-BL | L1953755-9 Water 04-JUL-17 DUP |
|---|---------------------------------------|---|--|--|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00489 | 0.000737 | <0.000050 | 0.00188 |
| | Nickel (Ni)-Total (mg/L) | 0.00093 | 0.00161 | <0.00050 | 0.00152 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.19 | <0.10 | <0.10 | 1.37 |
| | Selenium (Se)-Total (mg/L) | 0.000312 | 0.000149 | <0.000050 | 0.000137 |
| | Silicon (Si)-Total (mg/L) | 5.80 | 5.29 | <0.10 | 6.21 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 18.0 | 4.26 | <0.050 | 9.90 |
| | Strontium (Sr)-Total (mg/L) | 0.761 | 0.162 | <0.00020 | 0.424 |
| | Sulfur (S)-Total (mg/L) | 19.1 | 0.77 | <0.50 | 7.02 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.00030 | 0.00119 | <0.00030 | 0.00820 |
| | Uranium (U)-Total (mg/L) | 0.00286 | 0.000030 | <0.000010 | 0.00191 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00053 | <0.00050 | 0.00161 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | 0.00049 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0022 | 0.0337 | <0.0010 | 0.0072 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00024 | 0.00041 | <0.00010 | 0.00056 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0663 | 0.0537 | <0.000050 | 0.0645 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.024 | <0.010 | <0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 54.7 | 27.3 | <0.050 | 41.1 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00042 | <0.00010 | 0.00017 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00016 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00340 | 0.0129 | <0.00020 | 0.00191 |
| | Iron (Fe)-Dissolved (mg/L) | 0.011 | 0.205 | <0.010 | 0.085 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0025 | <0.0010 | <0.0010 | 0.0011 |
| | Magnesium (Mg)-Dissolved (mg/L) | 27.4 | 7.85 | <0.10 | 14.5 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0372 | 0.0261 | <0.00010 | 0.00922 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

18-JUL-17 18:08 (MT)

Version: FINAL

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1953755-1 | L1953755-2 | L1953755-3 | L1953755-4 | L1953755-5 |
|-------------------------|----------------------------------|-------------------------|--------------------------|--------------------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 03-JUL-17 | 13:45 | W10 | 03-JUL-17 | 03-JUL-17 | 03-JUL-17 | 04-JUL-17 | 04-JUL-17 |
| | | | | | 13:45 | 14:25 | 14:25 | 07:40 | 08:40 |
| | | | | | W10 | W12 | W14 | W2 | MC1 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000359 | 0.0787 | 0.170 | 0.00138 | 0.00176 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00126 | 0.0046 | 0.0029 | 0.00100 | 0.00106 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.10 ^{DLA} | <0.10 ^{DLA} | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 0.77 | 50.1 | 102 | 1.60 | 1.40 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000153 | 0.0126 | 0.0184 | 0.000196 | 0.000190 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 1.73 | 3.64 | 3.01 | 5.77 | 6.03 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 6.29 | 137 | 200 | 9.78 | 10.3 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.246 | 7.51 | 7.76 | 0.416 | 0.407 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 1.47 | 501 | 743 | 8.21 | 6.97 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 ^{DLM} | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00090 | <0.00060 ^{DLA} | <0.00060 ^{DLA} | <0.00030 | 0.00041 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000076 | 0.00708 | 0.0167 | 0.00171 | 0.00187 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.0010 ^{DLA} | <0.0010 ^{DLA} | 0.00069 | 0.00087 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0015 | 0.0070 | <0.0020 ^{DLA} | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00045 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1953755-6 | L1953755-7 | L1953755-8 | L1953755-9 |
|-------------------------|----------------------------------|--------------|--------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water |
| | | 04-JUL-17 | 09:30 | | 04-JUL-17 | 04-JUL-17 | 04-JUL-17 | 04-JUL-17 |
| | | | | | W3 | W33 | F-BL | DUP |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00448 | 0.000676 | <0.000050 | 0.00174 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00088 | 0.00151 | <0.00050 | 0.00104 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.26 | 0.11 | <0.10 | 1.38 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000350 | 0.000145 | <0.000050 | 0.000215 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.93 | 5.59 | <0.050 | 6.24 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 18.0 | 4.35 | <0.050 | 9.99 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.716 | 0.156 | <0.00020 | 0.405 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 18.6 | 0.94 | <0.50 | 7.33 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00074 | <0.00030 | 0.00035 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00275 | 0.000030 | <0.000010 | 0.00184 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00086 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | 0.00050 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1953755-4, -5, -6, -8, -9 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1953755-1, -2, -3, -4, -5, -6, -7, -8, -9 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

| | |
|----|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |
|----|---|

Reference Information

Chain of Custody Numbers:

2017-07-05-B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L1953755-COFC

| | | | | | | | | | | | | | | | | | |
|--|---|--|------------------|--|---|-------------------------------------|------------------------------|--|--|--|--|---------------------------|--------------------------------|-----------|--|--|----------------------|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Day) | 4 day [P4] <input type="checkbox"/> | | | | 1 Business day [E1] <input type="checkbox"/> | | | | EMERGENCY | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | Add-on Service: <input type="checkbox"/> | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Analysis Request | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 2 | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | |
| PO / AFE: 226337 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: EB/CP | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | | Number of Containers |
| | W10 | 3-Jul-17 | 13:45 | Water | R | R | R | R | R | R | R | R | | | | | 6 |
| | W12 | 3-Jul-17 | 14:25 | Water | R | R | R | R | R | R | R | R | | | | | 6 |
| | W14 | 3-Jul-17 | 14:25 | Water | R | R | R | R | R | R | R | R | | | | | 6 |
| | W2 | 4-Jul-17 | 7:40 | Water | R | R | R | R | R | R | R | R | R | | | | 7 |
| | MC1 | 4-Jul-17 | 8:40 | Water | R | R | R | R | R | R | R | R | R | | | | 7 |
| | W3 | 4-Jul-17 | 9:30 | Water | R | R | R | R | R | R | R | R | R | | | | 7 |
| | W33 | 4-Jul-17 | 10:20 | Water | R | R | R | R | R | R | R | R | R | | | | 6 |
| | F-BL | 4-Jul-17 | | Water | R | R | R | R | R | R | R | R | R | | | | 7 |
| | DUP | 4-Jul-17 | | Water | R | R | R | R | R | R | R | R | R | | | | 7 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | |
| | | | | | 10 | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Colin Prentice | Date: 2017-07-05 | Time: | Received by: EHF | Date: 5 July 2017 | Time: 14:50 | Received by: | Date: | Time: | | | | | | | | | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 12-JUL-17
Report Date: 24-JUL-17 17:46 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1957575
Project P.O. #: PO226337 (WUL)
Job Reference:
C of C Numbers: 2017-07-12 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1957575-1 | L1957575-2 | L1957575-3 | L1957575-4 | L1957575-5 |
|-----------------------------|---|---------------------------------|------------|------------|------------|------------|
| | | WATER | WATER | WATER | WATER | WATER |
| | | 11-JUL-17 | 11-JUL-17 | 11-JUL-17 | 11-JUL-17 | 11-JUL-17 |
| | | 08:10 | 09:15 | 10:45 | 13:40 | 14:20 |
| | | W2 | MC1 | W8A | W3 | W16A |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 353 | 339 | 1100 | 543 | 400 |
| | Hardness (as CaCO3) (mg/L) | 161 | 162 | 546 | 252 | 181 |
| | pH (pH) | 8.31 | 8.35 | 8.18 | 8.33 | 8.24 |
| | Total Suspended Solids (mg/L) | 61.3 | 320 | 34.5 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | 192 | 184 | 697 | 304 | 231 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 165 | 156 | 452 | 230 | 137 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 3.4 | 5.2 | <1.0 | 6.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 169 | 161 | 452 | 236 | 137 |
| | Ammonia, Total (as N) (mg/L) | 0.0097 | 0.0218 | 0.110 | 0.0066 | 0.0461 |
| | Chloride (Cl) (mg/L) | 1.73 | 1.36 | 7.3 | 4.52 | 4.31 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.146 | 0.112 | 3.35 | 0.175 | 2.84 |
| | Nitrate (as N) (mg/L) | 0.146 | 0.112 | 3.28 | 0.175 | 2.77 |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | 0.0720 | <0.0010 | 0.0710 |
| | Sulfate (SO4) (mg/L) | 21.8 | 19.3 | 171 | 53.5 | 54.4 |
| | Anion Sum (meq/L) | 3.89 | 3.67 | 13.0 | 5.97 | 4.20 |
| | Cation Sum (meq/L) | 3.69 | 3.70 | 12.8 | 5.89 | 4.22 |
| | Cation - Anion Balance (%) | -2.5 | 0.3 | -1.1 | -0.6 | 0.2 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 10.0 | 10.8 | | 6.06 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.774 | 5.04 | 1.16 | 0.0049 | 0.0234 |
| | Antimony (Sb)-Total (mg/L) | 0.00017 | 0.00029 | 0.00067 | 0.00010 | 0.00018 |
| | Arsenic (As)-Total (mg/L) | 0.00108 | 0.00318 | 0.00134 | 0.00029 | 0.00048 |
| | Barium (Ba)-Total (mg/L) | 0.0795 | 0.156 | 0.169 | 0.0674 | 0.0652 |
| | Beryllium (Be)-Total (mg/L) | 0.000028 | 0.000180 | 0.000055 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | 0.000066 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | <0.010 | <0.010 | 0.025 | 0.025 | 0.028 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000192 | 0.0000763 | 0.000166 | <0.0000050 | 0.0000102 |
| | Calcium (Ca)-Total (mg/L) | 44.2 | 45.0 | 151 | 57.5 | 49.9 |
| | Chromium (Cr)-Total (mg/L) | 0.00159 | 0.00906 | 0.00146 | <0.00010 | 0.00022 |
| | Cobalt (Co)-Total (mg/L) | 0.00055 | 0.00346 | 0.00179 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | 0.00515 | 0.0167 | 0.415 | 0.00356 | 0.0309 |
| | Iron (Fe)-Total (mg/L) | 1.31 | 7.76 | 5.44 | 0.015 | 0.187 |
| | Lead (Pb)-Total (mg/L) | 0.000371 | 0.00207 | 0.000616 | <0.000050 | 0.00163 |
| | Lithium (Li)-Total (mg/L) | 0.0024 | 0.0050 | 0.0045 | 0.0033 | 0.0014 |
| | Magnesium (Mg)-Total (mg/L) | 14.9 | 16.6 | 44.4 | 27.0 | 14.6 |
| | Manganese (Mn)-Total (mg/L) | 0.0747 | 0.288 | 2.63 | 0.0410 | 0.0748 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1957575-6 | L1957575-7 | | | |
|-----------------------------|---|---------------------------------|------------|------------|------|--|--|
| | | Description | WATER | WATER | | | |
| | | Sampled Date | 11-JUL-17 | 11-JUL-17 | | | |
| | | Sampled Time | 14:50 | | | | |
| | | Client ID | W50 | DUP | | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 399 | 341 | | | |
| | Hardness (as CaCO3) (mg/L) | | 178 | 162 | | | |
| | pH (pH) | | 8.20 | 8.32 | | | |
| | Total Suspended Solids (mg/L) | | <3.0 | 181 | | | |
| | TDS (Calculated) (mg/L) | | 231 | 187 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 133 | 162 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | 3.4 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 133 | 165 | | | |
| | Ammonia, Total (as N) (mg/L) | | 0.0318 | 0.0185 | | | |
| | Chloride (Cl) (mg/L) | | 4.44 | 1.39 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | | 3.31 | 0.112 | | | |
| | Nitrate (as N) (mg/L) | | 3.27 | 0.111 | | | |
| | Nitrite (as N) (mg/L) | | 0.0352 | 0.0014 | | | |
| | Sulfate (SO4) (mg/L) | | 55.4 | 19.5 | | | |
| | Anion Sum (meq/L) | | 4.17 | 3.76 | | | |
| | Cation Sum (meq/L) | | 4.17 | 3.71 | | | |
| | Cation - Anion Balance (%) | | 0.0 | -0.6 | | | |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 19.2 | 11.8 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0182 | 3.99 | | | |
| | Antimony (Sb)-Total (mg/L) | | 0.00014 | 0.00027 | | | |
| | Arsenic (As)-Total (mg/L) | | 0.00058 | 0.00269 | | | |
| | Barium (Ba)-Total (mg/L) | | 0.0627 | 0.134 | | | |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | 0.000131 | | | |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | | 0.029 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000090 | 0.0000598 | | | |
| | Calcium (Ca)-Total (mg/L) | | 49.1 | 44.1 | | | |
| | Chromium (Cr)-Total (mg/L) | | 0.00022 | 0.00731 | | | |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | 0.00262 | | | |
| | Copper (Cu)-Total (mg/L) | | 0.0287 | 0.0138 | | | |
| | Iron (Fe)-Total (mg/L) | | 0.127 | 6.10 | | | |
| | Lead (Pb)-Total (mg/L) | | 0.000747 | 0.00163 | | | |
| | Lithium (Li)-Total (mg/L) | | 0.0015 | 0.0042 | | | |
| | Magnesium (Mg)-Total (mg/L) | | 14.2 | 15.9 | | | |
| | Manganese (Mn)-Total (mg/L) | | 0.0218 | 0.221 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1957575-1 | L1957575-2 | L1957575-3 | L1957575-4 | L1957575-5 |
|-------------------------|---------------------------------------|--------------|--------------|-----------|--------------------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 11-JUL-17 | 08:10 | W2 | 11-JUL-17 | 11-JUL-17 | 11-JUL-17 | 11-JUL-17 | 11-JUL-17 |
| | | | | | 08:10 | 09:15 | 10:45 | 13:40 | 14:20 |
| | | | | | W2 | MC1 | W8A | W3 | W16A |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | | | | <0.000010 ^{DLM} | 0.000014 | 0.000011 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | | | | 0.00168 | 0.00180 | 0.00604 | 0.00499 | 0.00271 |
| | Nickel (Ni)-Total (mg/L) | | | | 0.00246 | 0.0112 | 0.00253 | 0.00098 | 0.00106 |
| | Phosphorus (P)-Total (mg/L) | | | | 0.054 | 0.273 | 0.162 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | | | | 1.52 | 1.81 | 6.27 | 2.17 | 2.39 |
| | Selenium (Se)-Total (mg/L) | | | | 0.000204 | 0.000301 | 0.00477 | 0.000290 | 0.000815 |
| | Silicon (Si)-Total (mg/L) | | | | 7.59 | 16.4 | 11.0 | 6.14 | 2.87 |
| | Silver (Ag)-Total (mg/L) | | | | <0.000010 | 0.000037 | 0.000163 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | | | | 9.91 | 9.87 | 33.4 | 18.0 | 11.9 |
| | Strontium (Sr)-Total (mg/L) | | | | 0.435 | 0.455 | 2.02 | 0.737 | 0.464 |
| | Sulfur (S)-Total (mg/L) | | | | 8.02 | 7.07 | 65.0 | 19.5 | 19.8 |
| | Thallium (Tl)-Total (mg/L) | | | | <0.000010 | 0.000042 | 0.000014 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | | | | <0.000010 | <0.000010 | 0.00013 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | | | | 0.0279 | 0.165 | 0.0504 | <0.00030 | 0.00088 |
| | Uranium (U)-Total (mg/L) | | | | 0.00213 | 0.00222 | 0.00286 | 0.00253 | 0.00101 |
| | Vanadium (V)-Total (mg/L) | | | | 0.00324 | 0.0153 | 0.00587 | <0.00050 | 0.00056 |
| | Zinc (Zn)-Total (mg/L) | | | | 0.0042 | 0.0200 | 0.912 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | | | | 0.00033 | 0.00067 | 0.00052 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | | | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | | | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | | | 0.0105 | 0.0084 | 0.0103 | 0.0027 | 0.0135 |
| | Antimony (Sb)-Dissolved (mg/L) | | | | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | | | | 0.00051 | 0.00052 | 0.00058 | 0.00025 | 0.00045 |
| | Barium (Ba)-Dissolved (mg/L) | | | | 0.0659 | 0.0634 | 0.150 | 0.0687 | 0.0672 |
| | Beryllium (Be)-Dissolved (mg/L) | | | | <0.000020 | <0.000020 | 0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | | | <0.010 | <0.010 | 0.022 | 0.022 | 0.025 |
| | Cadmium (Cd)-Dissolved (mg/L) | | | | <0.0000050 | <0.0000050 | 0.0000970 | <0.0000050 | 0.0000120 |
| | Calcium (Ca)-Dissolved (mg/L) | | | | 39.3 | 40.7 | 141 | 54.9 | 48.2 |
| | Chromium (Cr)-Dissolved (mg/L) | | | | 0.00017 | 0.00018 | 0.00049 | <0.00010 | 0.00017 |
| | Cobalt (Co)-Dissolved (mg/L) | | | | <0.00010 | <0.00010 | 0.00134 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | | | | 0.00245 | 0.00184 | 0.0714 | 0.00341 | 0.0296 |
| | Iron (Fe)-Dissolved (mg/L) | | | | 0.050 | 0.065 | 0.729 | 0.013 | 0.139 |
| | Lead (Pb)-Dissolved (mg/L) | | | | 0.000230 | <0.000050 | 0.000149 | 0.000135 | 0.00173 |
| | Lithium (Li)-Dissolved (mg/L) | | | | 0.0013 | <0.0010 | 0.0035 | 0.0027 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | | | | 15.2 | 14.7 | 47.1 | 28.0 | 14.7 |
| | Manganese (Mn)-Dissolved (mg/L) | | | | 0.0220 | 0.0168 | 2.93 | 0.0376 | 0.0737 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1957575-6 | L1957575-7 |
|-------------------------|---------------------------------------|-------------------------|------------|------------|
| | | Description | WATER | WATER |
| | | Sampled Date | 11-JUL-17 | 11-JUL-17 |
| | | Sampled Time | 14:50 | |
| | | Client ID | W50 | DUP |
| Grouping | Analyte | | | |
| WATER | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | 0.000015 | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00263 | 0.00183 | |
| | Nickel (Ni)-Total (mg/L) | 0.00083 | 0.00909 | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.212 | |
| | Potassium (K)-Total (mg/L) | 2.44 | 1.67 | |
| | Selenium (Se)-Total (mg/L) | 0.000858 | 0.000300 | |
| | Silicon (Si)-Total (mg/L) | 3.26 | 14.2 | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000029 | |
| | Sodium (Na)-Total (mg/L) | 12.0 | 9.66 | |
| | Strontium (Sr)-Total (mg/L) | 0.471 | 0.440 | |
| | Sulfur (S)-Total (mg/L) | 19.9 | 7.00 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | 0.000035 | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Total (mg/L) | <0.00090 ^{DLM} | 0.144 | |
| | Uranium (U)-Total (mg/L) | 0.000949 | 0.00220 | |
| | Vanadium (V)-Total (mg/L) | 0.00055 | 0.0125 | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0164 | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | 0.00059 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0085 | 0.0079 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00050 | 0.00058 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0642 | 0.0643 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | 0.025 | <0.010 | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000052 | <0.0000050 | |
| | Calcium (Ca)-Dissolved (mg/L) | 46.8 | 40.6 | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00018 | 0.00021 | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0263 | 0.00186 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.095 | 0.066 | |
| | Lead (Pb)-Dissolved (mg/L) | 0.000593 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | 0.0011 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 14.9 | 14.9 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0117 | 0.0158 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1957575-1 WATER 11-JUL-17 08:10 W2 | L1957575-2 WATER 11-JUL-17 09:15 MC1 | L1957575-3 WATER 11-JUL-17 10:45 W8A | L1957575-4 WATER 11-JUL-17 13:40 W3 | L1957575-5 WATER 11-JUL-17 14:20 W16A |
|---|---|--|--|---|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00153 | 0.00165 | 0.00549 | 0.00469 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00103 | 0.00117 | 0.00177 | 0.00097 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 1.50 | 1.23 | 6.27 | 2.20 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000158 | 0.000159 | 0.00436 | 0.000314 |
| | Silicon (Si)-Dissolved (mg/L) | 5.70 | 5.95 | 8.32 | 5.81 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000018 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 10.2 | 9.70 | 34.8 | 18.3 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.394 | 0.388 | 1.93 | 0.723 |
| | Sulfur (S)-Dissolved (mg/L) | 7.33 | 6.35 | 58.5 | 17.7 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00055 | 0.00033 | 0.00055 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | 0.00179 | 0.00179 | 0.00271 | 0.00271 |
| | Vanadium (V)-Dissolved (mg/L) | 0.00084 | 0.00092 | 0.00114 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0026 | <0.0010 | 0.377 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00049 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1957575-6 | L1957575-7 | | | |
|-------------------------|----------------------------------|--------------|------------|------------|--|--|--|
| | | Description | WATER | WATER | | | |
| | | Sampled Date | 11-JUL-17 | 11-JUL-17 | | | |
| | | Sampled Time | 14:50 | | | | |
| | | Client ID | W50 | DUP | | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00237 | 0.00167 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00082 | 0.00120 | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.53 | 1.25 | | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000905 | 0.000161 | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 3.16 | 5.85 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 12.4 | 9.84 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.442 | 0.397 | | | | |
| | Sulfur (S)-Dissolved (mg/L) | 17.9 | 6.65 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00042 | 0.00034 | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000821 | 0.00179 | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00096 | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|------------------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1957575-6, -7 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1957575-6, -7 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1957575-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1957575-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1957575-1, -2, -3, -4, -5, -6, -7 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |

Reference Information

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-07-12 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td rowspan="3" style="width:20%; text-align:center; vertical-align:middle;">PRIORITY <small>(Business Days)</small></td> <td colspan="5">Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply</td> <td colspan="5">EMERGENCY</td> </tr> <tr> <td colspan="5">4 day [P4] <input type="checkbox"/></td> <td colspan="5">1 Business day [E1] <input type="checkbox"/></td> </tr> <tr> <td colspan="5">3 day [P3] <input type="checkbox"/></td> <td colspan="5">Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/></td> </tr> <tr> <td colspan="2">Contact: Minto Environment - Coordinator</td> <td colspan="3">Quality Control (QC) Report with Report <input checked="" 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<td>Water</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>7</td> </tr> <tr> <td></td> <td>W50</td> <td></td> <td>11-Jul-17</td> <td>14:50</td> <td>Water</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>7</td> </tr> <tr> <td></td> <td>DUP</td> <td></td> <td>11-Jul-17</td> <td></td> <td>Water</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>7</td> </tr> <tr> <td colspan="2">Drinking Water (DW) Samples¹ (client use)</td> <td colspan="3">Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)</td> <td colspan="10">SAMPLE CONDITION AS RECEIVED (lab use only)</td> </tr> <tr> <td colspan="2">Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO</td> <td colspan="3" 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| PRIORITY <small>(Business Days)</small> | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | EMERGENCY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4 day [P4] <input type="checkbox"/> | | | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: do-mmm-yy hh:mm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 226337 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: SR/EB/MM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | W2 | | 11-Jul-17 | 8:10 | Water | R | R | R | R | R | R | R | R | R | R | | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MC1 | | 11-Jul-17 | 9:15 | Water | R | R | R | R | R | R | R | R | R | R | | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | W8A | | 11-Jul-17 | 10:45 | Water | R | R | R | R | R | R | R | R | R | R | | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | W3 | | 11-Jul-17 | 13:40 | Water | R | R | R | R | R | R | R | R | R | R | | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | W16A | | 11-Jul-17 | 14:20 | Water | R | R | R | R | R | R | R | R | R | R | | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | W50 | | 11-Jul-17 | 14:50 | Water | R | R | R | R | R | R | R | R | R | R | | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | DUP | | 11-Jul-17 | | Water | R | R | R | R | R | R | R | R | R | R | | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-07-12 | | | Time: 10:00 | | | Received by: PH | | | Date: 7/12/17 | | | Time: 15:29 | | | Received by: | | | Date: | | | Time: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 19-JUL-17
Report Date: 27-JUL-17 18:40 (MT)
Version: FINAL REV. 2

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1961156
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: 2017-07-18 A
Legal Site Desc:

Comments: 27-JUL-2017 Please note, this report has been revised to update the sample ID of L1961156-3 and to remove the incorrect job number.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1961156-1 | L1961156-2 | L1961156-3 | L1961156-4 | L1961156-5 |
|-----------------------------------|---|--------------|--------------|-----------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 17-JUL-17 | 08:30 | W16 | 17-JUL-17 | 17:10 | 17-JUL-17 | 11:50 | 18-JUL-17 |
| | | | | | W16 | W17 | W8A | MC1 | W2 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 401 | 456 | 1050 | 347 | 354 | | | |
| | Hardness (as CaCO3) (mg/L) | 185 | 212 | 544 | 174 | 172 | | | |
| | pH (pH) | 8.21 | 8.10 | 7.55 | 8.23 | 8.14 | | | |
| | Total Suspended Solids (mg/L) | 4.4 | <3.0 | 19.6 | 19.6 | 5.2 | | | |
| | TDS (Calculated) (mg/L) | 237 | 264 | 684 | 198 | 209 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 140 | 189 | 435 | 173 | 167 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 140 | 189 | 435 | 173 | 167 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0432 | <0.0050 | 0.164 | 0.0118 | 0.0085 | | | |
| | Chloride (Cl) (mg/L) | 4.76 | 5.26 | 7.20 | 1.69 | 2.79 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 2.90 | 0.482 | 3.19 | 0.138 | 0.176 | | | |
| | Nitrate (as N) (mg/L) | 2.84 | 0.482 | 3.15 | 0.137 | 0.171 | | | |
| | Nitrite (as N) (mg/L) | 0.0592 | <0.0010 | 0.0370 | 0.0012 | 0.0047 | | | |
| | Sulfate (SO4) (mg/L) | 56.3 | 51.6 | 170 | 20.9 | 34.8 | | | |
| | Anion Sum (meq/L) | 4.32 | 5.04 | 12.7 | 3.96 | 4.15 | | | |
| | Cation Sum (meq/L) | 4.32 | 4.96 | 12.7 | 3.98 | 3.90 | | | |
| | Cation - Anion Balance (%) | 0.0 | -0.8 | 0.1 | 0.3 | -3.1 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 19.1 | 10.1 | | 9.45 | 9.44 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0274 | 0.0033 | 0.247 | 0.159 | 0.0558 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00012 | 0.00017 | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00046 | 0.00041 | 0.00085 | 0.00068 | 0.00046 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0683 | 0.0702 | 0.162 | 0.0684 | 0.0745 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | 0.000037 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | 0.027 | 0.032 | 0.025 | <0.010 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000086 | <0.0000050 | 0.000149 | 0.0000052 | <0.0000050 | | | |
| | Calcium (Ca)-Total (mg/L) | 48.5 | 56.8 | 144 | 43.2 | 44.9 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00022 | 0.00015 | 0.00104 | 0.00050 | 0.00026 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00010 | <0.00010 | 0.00160 | 0.00018 | <0.00010 | | | |
| | Copper (Cu)-Total (mg/L) | 0.0296 | 0.00752 | 0.199 | 0.00254 | 0.00282 | | | |
| | Iron (Fe)-Total (mg/L) | 0.148 | <0.010 | 4.10 | 0.335 | 0.113 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | 0.000202 | 0.000093 | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | <0.0010 | 0.0012 | 0.0040 | 0.0013 | 0.0016 | | | |
| | Magnesium (Mg)-Total (mg/L) | 15.3 | 17.5 | 46.9 | 16.0 | 15.0 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0678 | 0.00395 | 2.85 | 0.0223 | 0.0264 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1961156-6 Water 18-JUL-17 10:45 W3 | L1961156-7 Water 18-JUL-17 12:00 DUP | | |
|-----------------------------------|---|---|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 533 | 359 | | |
| | Hardness (as CaCO3) (mg/L) | 256 | 175 | | |
| | pH (pH) | 8.19 | 8.17 | | |
| | Total Suspended Solids (mg/L) | 5.4 | 26.6 | | |
| | TDS (Calculated) (mg/L) | 309 | 202 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 240 | 169 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 240 | 169 | | |
| | Ammonia, Total (as N) (mg/L) | 0.0073 | 0.0098 | | |
| | Chloride (Cl) (mg/L) | 4.72 | 2.49 | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.190 | 0.147 | | |
| | Nitrate (as N) (mg/L) | 0.190 | 0.146 | | |
| | Nitrite (as N) (mg/L) | <0.0010 | 0.0013 | | |
| | Sulfate (SO4) (mg/L) | 54.9 | 25.7 | | |
| | Anion Sum (meq/L) | 6.07 | 4.00 | | |
| | Cation Sum (meq/L) | 5.96 | 3.97 | | |
| | Cation - Anion Balance (%) | -1.0 | -0.4 | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 6.34 | 9.14 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.154 | 0.0829 | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Total (mg/L) | 0.00035 | 0.00049 | | |
| | Barium (Ba)-Total (mg/L) | 0.0716 | 0.0753 | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Total (mg/L) | 0.023 | <0.010 | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000096 | 0.0000056 | | |
| | Calcium (Ca)-Total (mg/L) | 56.9 | 46.1 | | |
| | Chromium (Cr)-Total (mg/L) | 0.00032 | 0.00039 | | |
| | Cobalt (Co)-Total (mg/L) | 0.00019 | 0.00012 | | |
| | Copper (Cu)-Total (mg/L) | 0.00896 | 0.00309 | | |
| | Iron (Fe)-Total (mg/L) | 0.264 | 0.160 | | |
| | Lead (Pb)-Total (mg/L) | 0.000092 | <0.000050 | | |
| | Lithium (Li)-Total (mg/L) | 0.0027 | 0.0017 | | |
| | Magnesium (Mg)-Total (mg/L) | 28.3 | 15.0 | | |
| | Manganese (Mn)-Total (mg/L) | 0.112 | 0.0310 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1961156-1 Water 17-JUL-17 08:30 W16 | L1961156-2 Water 17-JUL-17 17:10 W17 | L1961156-3 Water 17-JUL-17 11:50 W8A | L1961156-4 Water 18-JUL-17 08:40 MC1 | L1961156-5 Water 18-JUL-17 09:35 W2 |
|---|---------------------------------------|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | 0.0000077 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00258 | 0.00514 | 0.00616 | 0.00183 | 0.00133 |
| | Nickel (Ni)-Total (mg/L) | 0.00108 | 0.00064 | 0.00213 | 0.00157 | 0.00122 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | 0.110 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.46 | 3.41 | 6.06 | 1.38 | 1.56 |
| | Selenium (Se)-Total (mg/L) | 0.000792 | 0.000348 | 0.00439 | 0.000145 | 0.000128 |
| | Silicon (Si)-Total (mg/L) | 2.66 | 4.89 | 8.77 | 6.25 | 5.90 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000068 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 12.1 | 14.4 | 34.6 | 10.3 | 10.0 |
| | Strontium (Sr)-Total (mg/L) | 0.452 | 0.581 | 1.88 | 0.431 | 0.451 |
| | Sulfur (S)-Total (mg/L) | 18.5 | 18.1 | 63.6 | 7.49 | 9.25 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.00162 | <0.00030 | 0.0119 | 0.00621 | <0.0018 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.000902 | 0.00162 | 0.00271 | 0.00185 | 0.00175 |
| | Vanadium (V)-Total (mg/L) | 0.00065 | <0.00050 | 0.00293 | 0.00150 | 0.00087 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | 0.410 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | 0.00042 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0132 | 0.0024 | 0.0131 | 0.0156 | 0.0086 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00043 | 0.00035 | 0.00063 | 0.00053 | 0.00039 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0694 | 0.0710 | 0.150 | 0.0687 | 0.0741 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | 0.000026 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.026 | 0.030 | 0.024 | <0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000075 | <0.0000050 | 0.000108 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 48.7 | 56.4 | 141 | 42.5 | 44.6 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00017 | 0.00012 | 0.00049 | 0.00021 | 0.00015 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00135 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0283 | 0.00726 | 0.0804 | 0.00191 | 0.00230 |
| | Iron (Fe)-Dissolved (mg/L) | 0.110 | <0.010 | 0.433 | 0.083 | 0.036 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | 0.0012 | 0.0037 | 0.0012 | 0.0016 |
| | Magnesium (Mg)-Dissolved (mg/L) | 15.5 | 17.4 | 46.7 | 16.5 | 14.7 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0635 | 0.00092 | 2.73 | 0.00954 | 0.0214 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1961156-6 Water 18-JUL-17 10:45 W3 | L1961156-7 Water 18-JUL-17 12:00 DUP | | |
|-------------------------|---|---|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.000010 ^{DLM} | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00444 | 0.00126 | | |
| | Nickel (Ni)-Total (mg/L) | 0.00137 | 0.00129 | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Total (mg/L) | 2.18 | 1.55 | | |
| | Selenium (Se)-Total (mg/L) | 0.000338 | 0.000119 | | |
| | Silicon (Si)-Total (mg/L) | 6.03 | 5.90 | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Total (mg/L) | 17.8 | 9.87 | | |
| | Strontium (Sr)-Total (mg/L) | 0.711 | 0.455 | | |
| | Sulfur (S)-Total (mg/L) | 19.0 | 8.94 | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Total (mg/L) | 0.00859 | 0.00372 | | |
| | Uranium (U)-Total (mg/L) | 0.00256 | 0.00177 | | |
| | Vanadium (V)-Total (mg/L) | 0.00097 | 0.00094 | | |
| | Zinc (Zn)-Total (mg/L) | 0.0037 | <0.0030 | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0238 | 0.0062 | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00023 | 0.00042 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0691 | 0.0749 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | 0.023 | <0.010 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 56.6 | 45.1 | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00017 | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00356 | 0.00228 | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.042 | 0.035 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0027 | 0.0015 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 28.0 | 15.1 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0797 | 0.0216 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1961156-1 | L1961156-2 | L1961156-3 | L1961156-4 | L1961156-5 |
|-------------------------|----------------------------------|--------------|--------------|-------------------------|--|--|--|--|---|
| | | | | | L1961156-1 Water 17-JUL-17 08:30 W16 | L1961156-2 Water 17-JUL-17 17:10 W17 | L1961156-3 Water 17-JUL-17 11:50 W8A | L1961156-4 Water 18-JUL-17 08:40 MC1 | L1961156-5 Water 18-JUL-17 09:35 W2 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | 0.0000051 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00240 | 0.00476 | 0.00573 | 0.00172 | 0.00119 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00100 | 0.00057 | 0.00180 | 0.00112 | 0.00103 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.55 | 3.49 | 6.05 | 1.40 | 1.55 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000762 | 0.000427 | 0.00479 | 0.000157 | 0.000138 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 2.71 | 4.73 | 7.89 | 5.96 | 5.70 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000020 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 12.3 | 14.4 | 34.6 | 10.6 | 9.78 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.445 | 0.573 | 1.82 | 0.421 | 0.443 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 19.1 | 17.6 | 60.6 | 6.95 | 8.57 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00072 | <0.00030 | <0.00060 ^{DLM} | <0.00060 ^{DLM} | <0.00060 ^{DLM} | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000843 | 0.00154 | 0.00252 | 0.00170 | 0.00165 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00117 | 0.00092 | 0.00058 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0013 | 0.0011 | 0.153 | <0.0010 | 0.0014 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00043 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1961156-6 Water 18-JUL-17 10:45 W3 | L1961156-7 Water 18-JUL-17 12:00 DUP | | |
|-------------------------|--|---|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00426 | 0.00120 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00090 | 0.00107 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 2.22 | 1.58 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000274 | 0.000144 | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.67 | 5.71 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 17.7 | 9.97 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.694 | 0.441 | | |
| | Sulfur (S)-Dissolved (mg/L) | 18.3 | 8.66 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.0012 ^{DLM} | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00242 | 0.00164 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00062 | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0038 | <0.0010 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|------------------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Molybdenum (Mo)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Nickel (Ni)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Silicon (Si)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Uranium (U)-Total | MS-B | L1961156-1, -2, -3, -4, -5, -6, -7 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|---|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |

Reference Information

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = $\frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

Reference Information

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-07-18 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



L1961156-COFC

COC Number: 2017-07-18 A

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

| | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|--|--|--|---|------------------------------|------------------------------|-----------------------------|--|--|--|---------------------------|--------------------------------|--|--|--|--|--|--|----------------------|------------------|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | | | | EMERGENCY | | | | | | | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 4 day [P4] <input type="checkbox"/> | | | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | 3 day [P3] <input type="checkbox"/> | | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Analysis Request | | | | | | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | | | | | Number of Containers | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | | | | | | | | | | | | | | | | | PO# | | |
| Job #: | | Major/Minor Code: | | | | | | | | | | | | | | | | | | | Routing Code: | | |
| PO / AFE: 226337 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | | | | | | | | | | | | | | | | | | Sampler: CH/CP | | |
| ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on the report) | | | | | | | | | | | | | | | | | | | Date (dd-mmm-yy) | | |
| | | W16 | | | 17-Jul-17 | | | 8:30 | | | Water | | | | | | | | | | | | |
| | | W17 | | | 17-Jul-17 | | | 17:10 | | | Water | | | | | | | | | | | | |
| | | W8A | | | 17-Jul-17 | | | 11:50 | | | Water | | | | | | | | | | | | |
| | | MC1 | | | 18-Jul-17 | | | 8:40 | | | Water | | | | | | | | | | | | |
| | | W2 | | | 18-Jul-17 | | | 9:35 | | | Water | | | | | | | | | | | | |
| | | W3 | | | 18-Jul-17 | | | 10:45 | | | Water | | | | | | | | | | | | |
| | | DUP | | | 18-Jul-17 | | | | | | Water | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | |
|--|--|---|--|--|---|--|--|--|-------------------|------------------------------|--|---------------------------------|--|--|---------------------|--|--|
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | 3.9 | | | | | 1.9 | | | | | | | |
| | | | | | | | | | | 7.6 | | | | | | | |
| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | |
| Released by: Chris Harry | | | Date: 2017-07-18 11:45 | | | Received by: <i>[Signature]</i> | | | Date: 5 July 2017 | | | Received by: <i>[Signature]</i> | | | Date: July 20 11:00 | | |
| Time: 11:45 | | | | | | Time: 11:15 | | | | | | Time: 11:00 | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.
 OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 26-JUL-17
Report Date: 10-AUG-17 12:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1964854
Project P.O. #: 226337 (WUL)
Job Reference:
C of C Numbers: 2017-07-25 C
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1964854-1 | L1964854-2 | L1964854-3 | L1964854-4 | L1964854-5 |
|-----------------------------------|---|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 24-JUL-17 | 24-JUL-17 | 25-JUL-17 | 25-JUL-17 | 25-JUL-17 |
| | | Sampled Time | 07:34 | 08:20 | 09:00 | 09:25 | |
| | | Client ID | W8A | W16 | W3 | W17 | DUP |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 1110 | 415 | 536 | 458 | 528 |
| | Hardness (as CaCO3) (mg/L) | | 568 | 193 | 258 | 219 | 258 |
| | pH (pH) | | 7.46 | 8.17 | 8.11 | 8.04 | 8.11 |
| | Total Suspended Solids (mg/L) | | 14.0 | 3.2 | <3.0 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | | 733 | 239 | 306 | 264 | 306 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 404 | 139 | 230 | 182 | 231 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 404 | 139 | 230 | 182 | 231 |
| | Ammonia, Total (as N) (mg/L) | | 0.136 | 0.0490 | 0.0053 | <0.0050 | <0.0050 |
| | Chloride (Cl) (mg/L) | | 8.3 | 4.84 | 4.61 | 5.15 | 4.61 |
| | Nitrate and Nitrite (as N) (mg/L) | | 4.36 | 2.65 | 0.179 | 0.396 | 0.181 |
| | Nitrate (as N) (mg/L) | | 4.33 | 2.60 | 0.179 | 0.396 | 0.181 |
| | Nitrite (as N) (mg/L) | | 0.0290 | 0.0486 | <0.0010 | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 218 | 56.6 | 54.8 | 52.3 | 54.7 |
| | Anion Sum (meq/L) | | 13.2 | 4.27 | 5.89 | 4.89 | 5.89 |
| | Cation Sum (meq/L) | | 13.2 | 4.47 | 6.05 | 5.11 | 6.05 |
| | Cation - Anion Balance (%) | | 0.3 | 2.2 | 1.3 | 2.2 | 1.3 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | | 18.2 | 5.80 | 10.2 | 6.13 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0590 | 0.0403 | 0.0087 | 0.0034 | 0.0061 |
| | Antimony (Sb)-Total (mg/L) | | 0.00013 | <0.00010 | <0.00010 | 0.00012 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00087 | 0.00056 | 0.00034 | 0.00048 | 0.00034 |
| | Barium (Ba)-Total (mg/L) | | 0.157 | 0.0703 | 0.0682 | 0.0704 | 0.0683 |
| | Beryllium (Be)-Total (mg/L) | | 0.000028 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.030 | 0.031 | 0.027 | 0.035 | 0.027 |
| | Cadmium (Cd)-Total (mg/L) | | 0.000125 | 0.0000124 | 0.0000076 | 0.0000059 | 0.0000099 |
| | Calcium (Ca)-Total (mg/L) | | 160 | 53.8 | 59.8 | 60.9 | 60.0 |
| | Chromium (Cr)-Total (mg/L) | | 0.00068 | 0.00027 | 0.00013 | 0.00016 | 0.00016 |
| | Cobalt (Co)-Total (mg/L) | | 0.00137 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | | 0.132 | 0.0329 | 0.00487 | 0.00795 | 0.00391 |
| | Iron (Fe)-Total (mg/L) | | 2.91 | 0.176 | 0.025 | <0.010 | 0.019 |
| | Lead (Pb)-Total (mg/L) | | 0.000097 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | 0.0042 | 0.0013 | 0.0032 | 0.0014 | 0.0032 |
| | Magnesium (Mg)-Total (mg/L) | | 45.5 | 14.8 | 26.9 | 16.4 | 26.7 |
| | Manganese (Mn)-Total (mg/L) | | 2.63 | 0.0743 | 0.0388 | 0.00067 | 0.0385 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

10-AUG-17 12:49 (MT)

Version: FINAL

| Sample ID Description Sampled Date Sampled Time Client ID | L1964854-1 Water 24-JUL-17 07:34 W8A | L1964854-2 Water 24-JUL-17 08:20 W16 | L1964854-3 Water 25-JUL-17 09:00 W3 | L1964854-4 Water 25-JUL-17 09:25 W17 | L1964854-5 Water 25-JUL-17 DUP | |
|---|--|--|---|--|---|-------------------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00803 | 0.00290 | 0.00491 | 0.00564 | 0.00495 |
| | Nickel (Ni)-Total (mg/L) | 0.00197 | 0.00123 | 0.00123 | 0.00091 | 0.00136 |
| | Phosphorus (P)-Total (mg/L) | 0.081 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 6.33 | 2.65 | 2.32 | 3.66 | 2.36 |
| | Selenium (Se)-Total (mg/L) | 0.00495 | 0.000807 | 0.000380 | 0.000404 | 0.000262 |
| | Silicon (Si)-Total (mg/L) | 8.44 | 3.05 | 6.15 | 5.06 | 6.12 |
| | Silver (Ag)-Total (mg/L) | 0.000049 | <0.000010 | <0.000010 | <0.000010 | 0.000012 |
| | Sodium (Na)-Total (mg/L) | 37.2 | 12.4 | 18.5 | 14.6 | 18.8 |
| | Strontium (Sr)-Total (mg/L) | 2.10 | 0.504 | 0.761 | 0.632 | 0.769 |
| | Sulfur (S)-Total (mg/L) | 70.0 | 19.2 | 19.3 | 17.5 | 18.1 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.0030 ^{DLM} | <0.0021 ^{DLM} | <0.00060 ^{DLM} | <0.00030 | <0.00060 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.00316 | 0.00106 | 0.00285 | 0.00188 | 0.00256 |
| | Vanadium (V)-Total (mg/L) | 0.00245 | 0.00109 | 0.00081 | 0.00096 | 0.00086 |
| | Zinc (Zn)-Total (mg/L) | 0.239 | <0.0030 | <0.0030 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | 0.00045 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0092 | 0.0109 | 0.0018 | 0.0038 | 0.0044 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00063 | 0.00045 | 0.00024 | 0.00039 | 0.00023 |
| | Barium (Ba)-Dissolved (mg/L) | 0.141 | 0.0705 | 0.0689 | 0.0713 | 0.0693 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.027 | 0.029 | 0.026 | 0.034 | 0.025 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000936 | 0.0000110 | 0.0000082 | 0.0000059 | 0.0000100 |
| | Calcium (Ca)-Dissolved (mg/L) | 155 | 53.0 | 58.8 | 61.1 | 60.0 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00059 | 0.00018 | <0.00010 | 0.00011 | 0.00011 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00105 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0747 | 0.0294 | 0.00290 | 0.00816 | 0.00339 |
| | Iron (Fe)-Dissolved (mg/L) | 0.638 | 0.113 | 0.010 | <0.010 | 0.015 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0041 | 0.0011 | 0.0030 | 0.0014 | 0.0034 |
| | Magnesium (Mg)-Dissolved (mg/L) | 43.9 | 14.7 | 27.1 | 16.3 | 26.4 |
| | Manganese (Mn)-Dissolved (mg/L) | 2.16 | 0.0689 | 0.0366 | 0.0114 ^{DTC} | 0.0363 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1964854-1 | L1964854-2 | L1964854-3 | L1964854-4 | L1964854-5 |
|-------------------------|----------------------------------|-------------------------|-------------------------|------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 24-JUL-17 | 07:34 | W8A | 24-JUL-17 | 24-JUL-17 | 25-JUL-17 | 25-JUL-17 | 25-JUL-17 |
| | | | | | 07:34 | 08:20 | 09:00 | 09:25 | |
| | | | | | W8A | W16 | W3 | W17 | DUP |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00751 | 0.00267 | 0.00430 | 0.00535 | 0.00460 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00178 | 0.00120 | 0.00125 | 0.00087 | 0.00117 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 6.25 | 2.64 | 2.39 | 3.65 | 2.40 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00516 | 0.000861 | 0.000265 | 0.000354 | 0.000258 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 8.05 | 2.83 | 6.04 | 5.02 | 6.17 | | | |
| | Silver (Ag)-Dissolved (mg/L) | 0.000019 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 36.5 | 12.3 | 18.8 | 14.4 | 18.9 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 1.98 | 0.491 | 0.742 | 0.624 | 0.745 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 70.9 | 18.7 | 18.0 | 17.3 | 18.2 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLM} | <0.00060 ^{DLM} | <0.00030 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00292 | 0.000990 | 0.00226 | 0.00172 | 0.00262 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00099 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.320 ^{DTC} | <0.0010 | <0.0010 | 0.0012 | 0.0015 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00038 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Method Blank | Chromium (Cr)-Total | MB-LOR | L1964854-1, -2, -3, -4, -5 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1964854-2, -3, -4, -5 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1964854-2, -3, -4, -5 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1964854-2, -3, -4, -5 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1964854-1, -4 |
| Matrix Spike | Cadmium (Cd)-Dissolved | MS-B | L1964854-1, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1964854-1, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1964854-1, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1964854-1, -4 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1964854-1, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1964854-1, -4 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1964854-1, -4 |
| Matrix Spike | Zinc (Zn)-Dissolved | MS-B | L1964854-1, -4 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1964854-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1964854-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1964854-1, -2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1964854-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1964854-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1964854-1, -2, -3, -4, -5 |
| Matrix Spike | Nitrate (as N) | MS-B | L1964854-1, -2, -3, -4, -5 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1964854-1, -2, -3, -4, -5 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = $\frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-07-25 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1964854-COFC

COC Number: 2017-07-25 C

Page 1 of 1

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| | | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|---|-------------------------------------|---|--|------------------------------|-----------------------------|--|-------------------------|--|---------------------------|--------------------------------|----------------------|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: _____ | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 228337 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: CP | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | |
| W8A | | | | 24-Jul-17 | 7:34 | Water | R | R | R | R | R | R | R | R | R | 6 | | |
| W16 | | | | 24-Jul-17 | 8:20 | Water | R | R | R | R | R | R | R | R | R | 7 | | |
| W3 | | | | 25-Jul-17 | 9:00 | Water | R | R | R | R | R | R | R | R | R | 7 | | |
| W17 | | | | 25-Jul-17 | 9:25 | Water | R | R | R | R | R | R | R | R | R | 7 | | |
| DUP | | | | 25-Jul-17 | | Water | R | R | R | R | R | R | R | R | R | 7 | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | 6.0 | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | |
| Released by: Chris Harry | | Date: 2017-07-25 10:00 | | Time: | | Received by: [Signature] | | Date: 26 July 2017 | | Time: 11:30 | | Received by: Alex | | Date: 27/07/2017 | | Time: 12:20 | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

49/5/16



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 02-AUG-17
Report Date: 24-AUG-17 18:57 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1969064
Project P.O. #: 226337 (WUL)
Job Reference:
C of C Numbers: 2017-08-02 A
Legal Site Desc:

Comments: Please note, the ALS Fort Collins Ra226 detailed analysis report can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1969064-1 | L1969064-2 | L1969064-3 | L1969064-4 | L1969064-5 |
|-----------------------------------|---|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 01-AUG-17 | 01-AUG-17 | 01-AUG-17 | 01-AUG-17 | 01-AUG-17 |
| | | Sampled Time | 07:40 | 08:05 | 08:35 | 09:15 | 09:50 |
| | | Client ID | W3 | W50 | W16A | MC1 | W2 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 451 | 431 | 429 | 351 | 350 |
| | Hardness (as CaCO3) (mg/L) | | 223 | 198 | 199 | 172 | 173 |
| | pH (pH) | | 8.05 | 8.20 | 8.26 | 8.27 | 8.28 |
| | Total Suspended Solids (mg/L) | | 3.0 | 6.6 | <3.0 | 56.2 | 34.8 |
| | TDS (Calculated) (mg/L) | | 271 | 248 | 249 | 193 | 197 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 185 | 151 | 148 | 163 | 168 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 185 | 151 | 148 | 163 | 168 |
| | Ammonia, Total (as N) (mg/L) | | 0.0069 | 0.0280 | 0.0540 | 0.0161 | 0.0061 |
| | Chloride (Cl) (mg/L) | | 5.06 | 5.23 | 5.21 | 1.69 | 1.79 |
| | Nitrate and Nitrite (as N) (mg/L) | | 1.32 | 2.39 | 2.50 | 0.192 | 0.198 |
| | Nitrate (as N) (mg/L) | | 1.32 | 2.36 | 2.46 | 0.189 | 0.196 |
| | Nitrite (as N) (mg/L) | | 0.0021 | 0.0230 | 0.0427 | 0.0024 | 0.0012 |
| | Sulfate (SO4) (mg/L) | | 55.6 | 57.3 | 57.6 | 21.8 | 22.1 |
| | Anion Sum (meq/L) | | 5.10 | 4.53 | 4.50 | 3.78 | 3.90 |
| | Cation Sum (meq/L) | | 5.18 | 4.62 | 4.64 | 3.93 | 3.97 |
| | Cation - Anion Balance (%) | | 0.8 | 1.0 | 1.6 | 1.9 | 0.9 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 12.2 | 16.5 | 17.1 | 11.9 | 11.5 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0125 | 0.0411 | 0.0330 | 1.50 | 0.823 |
| | Antimony (Sb)-Total (mg/L) | | 0.00011 | 0.00011 | 0.00014 | 0.00018 | 0.00015 |
| | Arsenic (As)-Total (mg/L) | | 0.00044 | 0.00056 | 0.00050 | 0.00143 | 0.00114 |
| | Barium (Ba)-Total (mg/L) | | 0.0731 | 0.0785 | 0.0750 | 0.0964 | 0.0872 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | <0.000020 | 0.000050 | 0.000031 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.027 | 0.028 | 0.028 | 0.010 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | | <0.0000050 | 0.0000096 | 0.0000097 | 0.0000251 | 0.0000150 |
| | Calcium (Ca)-Total (mg/L) | | 53.7 | 52.5 | 51.8 | 43.1 | 42.9 |
| | Chromium (Cr)-Total (mg/L) | | 0.00017 | 0.00027 | 0.00026 | 0.00292 | 0.00173 |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 | 0.00097 | 0.00055 |
| | Copper (Cu)-Total (mg/L) | | 0.0142 | 0.0317 | 0.0345 | 0.00776 | 0.00618 |
| | Iron (Fe)-Total (mg/L) | | 0.053 | 0.146 | 0.243 | 2.21 | 1.18 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | 0.000236 | 0.000381 | 0.000585 | 0.000317 |
| | Lithium (Li)-Total (mg/L) | | 0.0020 | 0.0012 | 0.0013 | 0.0024 | 0.0022 |
| | Magnesium (Mg)-Total (mg/L) | | 21.2 | 16.7 | 15.9 | 15.7 | 16.6 |
| | Manganese (Mn)-Total (mg/L) | | 0.0296 | 0.0783 | 0.0892 | 0.0818 | 0.0556 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1969064-6 | L1969064-7 | L1969064-8 | L1969064-9 |
|-----------------------------------|---|--------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 01-AUG-17 | 01-AUG-17 | 01-AUG-17 | 01-AUG-17 |
| | | Sampled Time | 11:20 | 16:00 | 17:15 | |
| | | Client ID | W7 | W35 | W62 | F-BL |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 253 | 423 | 1020 | <2.0 |
| | Hardness (as CaCO3) (mg/L) | | 125 | 202 | 516 | <0.50 |
| | pH (pH) | | 8.08 | 8.14 | 8.21 | 5.44 |
| | Total Suspended Solids (mg/L) | | 21.4 | 6.6 | 5.0 | <3.0 |
| | TDS (Calculated) (mg/L) | | 136 | 254 | 652 | <1.0 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 127 | 139 | 339 | <1.0 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 127 | 139 | 339 | <1.0 |
| | Ammonia, Total (as N) (mg/L) | | 0.0140 | 0.0133 | 0.0132 | <0.0050 |
| | Chloride (Cl) (mg/L) | | 0.28 | 0.66 | 30.0 | <0.10 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.116 | 13.0 | 7.40 | <0.0051 |
| | Nitrate (as N) (mg/L) | | 0.115 | 13.0 | 7.35 | <0.0050 |
| | Nitrite (as N) (mg/L) | | 0.0010 | 0.0220 | 0.0485 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 7.3 | 31.4 | 176 | <5.0 |
| | Anion Sum (meq/L) | | 2.73 | 4.38 | 11.8 | <0.10 |
| | Cation Sum (meq/L) | | 2.86 | 4.46 | 11.5 | <0.10 |
| | Cation - Anion Balance (%) | | 2.3 | 0.9 | -1.6 | 0.0 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 12.4 | 24.6 | | <0.50 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.541 | 0.216 | 0.126 | <0.0030 |
| | Antimony (Sb)-Total (mg/L) | | 0.00013 | <0.00010 | 0.00017 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00071 | 0.00043 | 0.00055 | <0.00010 |
| | Barium (Ba)-Total (mg/L) | | 0.0814 | 0.121 | 0.113 | <0.000050 |
| | Beryllium (Be)-Total (mg/L) | | 0.000023 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | <0.010 | 0.014 | 0.022 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000107 | 0.0000120 | 0.0000248 | <0.000050 |
| | Calcium (Ca)-Total (mg/L) | | 30.2 | 53.9 | 142 | <0.050 |
| | Chromium (Cr)-Total (mg/L) | | 0.00147 | 0.00048 | 0.00044 | <0.00010 |
| | Cobalt (Co)-Total (mg/L) | | 0.00038 | 0.00015 | 0.00023 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | | 0.00280 | 0.0621 | 0.0800 | <0.00050 |
| | Iron (Fe)-Total (mg/L) | | 0.847 | 0.339 | 0.245 | <0.010 |
| | Lead (Pb)-Total (mg/L) | | 0.000210 | 0.000067 | 0.000091 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | 0.0013 | 0.0011 | 0.0032 | <0.0010 |
| | Magnesium (Mg)-Total (mg/L) | | 11.8 | 15.5 | 41.5 | <0.10 |
| | Manganese (Mn)-Total (mg/L) | | 0.0418 | 0.0165 | 0.0599 | <0.00010 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1969064-1 Water 01-AUG-17 07:40 W3 | L1969064-2 Water 01-AUG-17 08:05 W50 | L1969064-3 Water 01-AUG-17 08:35 W16A | L1969064-4 Water 01-AUG-17 09:15 MC1 | L1969064-5 Water 01-AUG-17 09:50 W2 |
|---|---------------------------------------|---|--|---|--|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00411 | 0.00301 | 0.00289 | 0.00200 | 0.00181 |
| | Nickel (Ni)-Total (mg/L) | 0.00123 | 0.00100 | 0.00100 | 0.00423 | 0.00282 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | 0.074 | 0.057 |
| | Potassium (K)-Total (mg/L) | 2.63 | 2.82 | 2.76 | 1.51 | 1.61 |
| | Selenium (Se)-Total (mg/L) | 0.000435 | 0.000692 | 0.000764 | 0.000212 | 0.000164 |
| | Silicon (Si)-Total (mg/L) | 4.36 | 3.15 | 3.01 | 9.10 | 7.54 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | 0.000013 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 15.5 | 13.3 | 12.8 | 10.3 | 11.0 |
| | Strontium (Sr)-Total (mg/L) | 0.586 | 0.509 | 0.500 | 0.440 | 0.441 |
| | Sulfur (S)-Total (mg/L) | 19.0 | 19.9 | 20.2 | 7.52 | 7.52 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | 0.000014 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.00079 | <0.0024 ^{DLM} | <0.0012 ^{DLM} | 0.0518 | 0.0289 |
| | Uranium (U)-Total (mg/L) | 0.00160 | 0.00110 | 0.00109 | 0.00172 | 0.00175 |
| | Vanadium (V)-Total (mg/L) | 0.00053 | 0.00068 | 0.00065 | 0.00553 | 0.00365 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | 0.0062 | 0.0042 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00062 | 0.00041 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0026 | 0.0094 | 0.0099 | 0.0097 | 0.0096 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00035 | 0.00048 | 0.00049 | 0.00064 | 0.00062 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0733 | 0.0755 | 0.0773 | 0.0718 | 0.0733 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.026 | 0.027 | 0.028 | <0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000066 | 0.0000141 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 54.3 | 52.0 | 52.8 | 42.9 | 42.8 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00014 | 0.00015 | 0.00017 | 0.00024 | 0.00043 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0128 | 0.0276 | 0.0322 | 0.00284 | 0.00269 |
| | Iron (Fe)-Dissolved (mg/L) | 0.031 | 0.085 | 0.119 | 0.089 | 0.060 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | 0.000141 | 0.000179 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0019 | 0.0011 | 0.0013 | 0.0017 | 0.0017 |
| | Magnesium (Mg)-Dissolved (mg/L) | 21.2 | 16.6 | 16.4 | 15.7 | 16.0 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0200 | 0.0389 | 0.0871 | 0.0155 | 0.00643 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1969064-6 Water 01-AUG-17 11:20 W7 | L1969064-7 Water 01-AUG-17 16:00 W35 | L1969064-8 Water 01-AUG-17 17:15 W62 | L1969064-9 Water 01-AUG-17 F-BL |
|---|---------------------------------------|---|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00141 | 0.00136 | 0.00645 | <0.000050 |
| | Nickel (Ni)-Total (mg/L) | 0.00214 | 0.00138 | 0.00143 | <0.000050 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 0.90 | 1.63 | 5.65 | <0.10 |
| | Selenium (Se)-Total (mg/L) | 0.000152 | 0.000257 | 0.00290 | <0.000050 |
| | Silicon (Si)-Total (mg/L) | 7.21 | 5.34 | 7.77 | <0.10 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000011 | 0.000015 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 7.58 | 9.05 | 24.6 | <0.050 |
| | Strontium (Sr)-Total (mg/L) | 0.319 | 0.393 | 1.57 | <0.00020 |
| | Sulfur (S)-Total (mg/L) | 2.52 | 10.5 | 58.3 | <0.50 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.0166 | 0.0108 | <0.0063 ^{DLM} | <0.000030 |
| | Uranium (U)-Total (mg/L) | 0.00104 | 0.000364 | 0.00419 | <0.000010 |
| | Vanadium (V)-Total (mg/L) | 0.00289 | 0.00115 | 0.00105 | <0.000050 |
| | Zinc (Zn)-Total (mg/L) | 0.0032 | <0.0030 | 0.289 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | 0.00033 | 0.00032 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0171 | 0.0114 | 0.0060 | <0.0010 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.00013 | <0.000010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00046 | 0.00040 | 0.00042 | <0.000010 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0760 | 0.122 | 0.109 | <0.000050 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.013 | 0.021 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000082 | 0.0000312 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 30.6 | 55.1 | 142 | <0.050 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00033 | 0.00039 | 0.00020 | <0.000010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00011 | <0.000010 | 0.00013 | <0.000010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00239 | 0.0416 | 0.0633 | <0.00020 |
| | Iron (Fe)-Dissolved (mg/L) | 0.140 | 0.025 | 0.037 | <0.010 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0011 | 0.0012 | 0.0030 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | 11.8 | 15.5 | 39.5 | <0.10 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0272 | 0.00734 | 0.0505 | <0.000010 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1969064-1 Water 01-AUG-17 07:40 W3 | L1969064-2 Water 01-AUG-17 08:05 W50 | L1969064-3 Water 01-AUG-17 08:35 W16A | L1969064-4 Water 01-AUG-17 09:15 MC1 | L1969064-5 Water 01-AUG-17 09:50 W2 |
|---|---|--|---|--|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00387 | 0.00274 | 0.00263 | 0.00182 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00107 | 0.00088 | 0.00096 | 0.00135 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 2.65 | 2.87 | 2.87 | 1.35 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000481 | 0.000654 | 0.000737 | 0.000147 |
| | Silicon (Si)-Dissolved (mg/L) | 4.37 | 3.01 | 2.84 | 5.88 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 15.3 | 13.3 | 13.2 | 10.5 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.593 | 0.501 | 0.499 | 0.429 |
| | Sulfur (S)-Dissolved (mg/L) | 19.1 | 19.4 | 19.2 | 7.01 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00056 | 0.00046 |
| | Uranium (U)-Dissolved (mg/L) | 0.00153 | 0.00100 | 0.00100 | 0.00154 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00053 | 0.00109 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | 0.0013 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Radiological Parameters | Ra-226 (Bq/L) | <0.0096 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1969064-6 Water 01-AUG-17 11:20 W7 | L1969064-7 Water 01-AUG-17 16:00 W35 | L1969064-8 Water 01-AUG-17 17:15 W62 | L1969064-9 Water 01-AUG-17 F-BL | |
|---|---|--|--|--|------------|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00131 | 0.00127 | 0.00627 | <0.000050 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00138 | 0.00128 | 0.00116 | <0.000050 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 0.85 | 1.52 | 5.39 | <0.10 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000119 | 0.000270 | 0.00307 | <0.000050 |
| | Silicon (Si)-Dissolved (mg/L) | 6.22 | 5.02 | 7.59 | <0.050 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 7.59 | 8.92 | 23.3 | <0.050 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.317 | 0.394 | 1.55 | <0.00020 |
| | Sulfur (S)-Dissolved (mg/L) | 2.28 | 10.4 | 58.6 | <0.50 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLM} | <0.00060 ^{DLM} | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | 0.000917 | 0.000345 | 0.00395 | <0.000010 |
| | Vanadium (V)-Dissolved (mg/L) | 0.00119 | <0.00050 | 0.00051 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0012 | <0.0010 | 0.193 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Radiological Parameters | Ra-226 (Bq/L) | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|---------------------------|-----------|--|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1969064-2, -3, -4, -5, -6, -7, -9 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1969064-1 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1969064-1 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1969064-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1969064-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1969064-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L1969064-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1969064-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1969064-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1969064-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1969064-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L1969064-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1969064-2, -3, -4, -5 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1969064-6, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1969064-2, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1969064-6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1969064-2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1969064-6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1969064-1 |
| Matrix Spike | Copper (Cu)-Total | MS-B | L1969064-6, -7, -8, -9 |
| Matrix Spike | Iron (Fe)-Total | MS-B | L1969064-2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1969064-2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1969064-6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1969064-1 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1969064-2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1969064-1 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1969064-1 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1969064-2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1969064-6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1969064-1 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1969064-2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1969064-6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1969064-1 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1969064-1 |
| Matrix Spike | Titanium (Ti)-Total | MS-B | L1969064-2, -3, -4, -5 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--------------------------------------|------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH ₃ -NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|----------------------|-------|-------------------------------------|-----------------|
| RA226-MMER-FC | Water | Ra226 by Alpha Scint, MDC=0.01 Bq/L | EPA 903.1 |
| SO4-IC-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

| | | | |
|--------------------|-------|------------------|---------------------------|
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
|--------------------|-------|------------------|---------------------------|

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

| | | | |
|---------------|-------|---------------------------------------|---------------------------|
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
|---------------|-------|---------------------------------------|---------------------------|

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| FC | ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA |
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-08-02 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Wednesday, August 23, 2017

Shane Stack
ALS Environmental
8081 Lougheed Hwy, Suite 100
Burnaby, BC V5A 1W9

Re: ALS Workorder: 1708173
Project Name:
Project Number: L1969064

Dear Mr. Stack:

One water sample was received from ALS Environmental, on 8/9/2017. The sample was scheduled for the following analysis:

Radium-226

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental

For Shiloh J. Summy
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

| ALS Environmental – Fort Collins | |
|----------------------------------|---------------------------------|
| Accreditation Body | License or Certification Number |
| AIHA | 214884 |
| Alaska (AK) | UST-086 |
| Alaska (AK) | CO01099 |
| Arizona (AZ) | AZ0742 |
| California (CA) | 06251CA |
| Colorado (CO) | CO01099 |
| Connecticut (CT) | PH-0232 |
| Florida (FL) | E87914 |
| Idaho (ID) | CO01099 |
| Kansas (KS) | E-10381 |
| Kentucky (KY) | 90137 |
| L-A-B (DoD ELAP/ISO 170250) | L2257 |
| Louisiana (LA) | 05057 |
| Maryland (MD) | 285 |
| Missouri (MO) | 175 |
| Nebraska(NE) | NE-OS-24-13 |
| Nevada (NV) | CO000782008A |
| New York (NY) | 12036 |
| North Dakota (ND) | R-057 |
| Oklahoma (OK) | 1301 |
| Pennsylvania (PA) | 68-03116 |
| Tennessee (TN) | 2976 |
| Texas (TX) | T104704241 |
| Utah (UT) | CO01099 |
| Washington (WA) | C1280 |



1708173

Radium-226:

The sample was prepared and analyzed according to the current revision of SOP 783.

All acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1708173

Client Name: ALS Environmental

Client Project Name:

Client Project Number: L1969064

Client PO Number: L1969064

| Client Sample Number | Lab Sample Number | COC Number | Matrix | Date Collected | Time Collected |
|----------------------|-------------------|------------|--------|----------------|----------------|
| L1969064-1 | 1708173-1 | | WATER | 01-Aug-17 | |



1708173

L1969064

VANCOUVER

Subcontract Request Form

Subcontract To:

ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
225 COMMERCE DRIVE
FORT COLLINS, CO 80524

NOTES: Please reference on final report and invoice: PO# L1969064
ALS requires QC data to be provided with your final results.

Please see enclosed 1 sample(s) in 1 Container(s)

Table with columns: SAMPLE NUMBER, ANALYTICAL REQUIRED, DATE SAMPLED, DUE DATE, Priority Flag. Row 1: L1969064-1 W3, Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1), 8/1/2017, 8/16/2017

Subcontract Info Contact: Walter Lin (604) 253-4188
Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9
Phone: (604) 253-4188 Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to: Shane.Stack@alsglobal.com

Shipped By: _____ Date Shipped: _____

Received By: [Signature] Date Received: 8/9/17 @ 1000

Verified By: _____ Date Verified: _____

Temperature: _____

Sample Integrity Issues: _____



ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: ALS BURNABY

Workorder No: 1708173

Project Manager: SJS

Initials: VA Date: 8/9/10

| | | | |
|---|---------------------------------------|--------------------------------------|---|
| 1. Does this project require any special handling in addition to standard ALS procedures? | | YES | <input checked="" type="radio"/> NO |
| 2. Are custody seals on shipping containers intact? | <input checked="" type="radio"/> NONE | YES | NO |
| 3. Are Custody seals on sample containers intact? | <input checked="" type="radio"/> NONE | YES | NO |
| 4. Is there a COC (Chain-of-Custody) present or other representative documents? | | <input checked="" type="radio"/> YES | NO |
| 5. Are the COC and bottle labels complete and legible? | | <input checked="" type="radio"/> YES | NO |
| 6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.) | | <input checked="" type="radio"/> YES | NO |
| 7. Were airbills / shipping documents present and/or removable? | DROP OFF | <input checked="" type="radio"/> YES | NO |
| 8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles) | N/A | YES | <input checked="" type="radio"/> NO |
| 9. Are all aqueous non-preserved samples pH 4-9? | <input checked="" type="radio"/> N/A | YES | NO |
| 10. Is there sufficient sample for the requested analyses? | | <input checked="" type="radio"/> YES | NO |
| 11. Were all samples placed in the proper containers for the requested analyses? | | <input checked="" type="radio"/> YES | NO |
| 12. Are all samples within holding times for the requested analyses? | | <input checked="" type="radio"/> YES | NO |
| 13. Were all sample containers received intact? (not broken or leaking, etc.) | | <input checked="" type="radio"/> YES | NO |
| 14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ___ < green pea ___ > green pea | <input checked="" type="radio"/> N/A | YES | NO |
| 15. Do any water samples contain sediment? Amount Amount of sediment: ___ dusting ___ moderate ___ heavy | N/A | YES | <input checked="" type="radio"/> NO |
| 16. Were the samples shipped on ice? | | <input checked="" type="radio"/> YES | NO |
| 17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4 | | RAD ONLY | YES <input checked="" type="radio"/> NO |
| Cooler #: <u>1</u> | | | |
| Temperature (°C): <u>12.9</u> | | | |
| No. of custody seals on cooler: <u>0</u> | | | |
| External µR/hr reading: <u>10</u> | | | |
| Background µR/hr reading: <u>10</u> | | | |
| Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? <input checked="" type="radio"/> YES / NO / NA (If no, see Form 008.) | | | |

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

- SAMPLE HAD A PH OF 6. ACID ADDED.

If applicable, was the client contacted? YES / NO / N/A Contact: _____ Date/Time: _____

Project Manager Signature / Date: [Signature]



ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: ALS BURNABY
 Project Manager: SSS

Workorder No: 1708173
 Initials: JA Date: 8/9/17

NOTE:

No pH adjustments shall be made without prior consent of Project Manager. After pH adjustments, hold metals and radchem samples ≥ 16 hrs. before analysis.

Was the pH of any sample adjusted by the laboratory? YES (See Table below) / NO

pH Excursion:

| ALS Sample ID | Client Sample ID | Initial pH | Final pH | Reagent Used | Volume Added (mL) | Lot No. of Reagent | Requested Analysis | Initials / Date / Time |
|---------------|------------------|------------|----------|------------------|-------------------|--------------------|--------------------|------------------------|
| 1708173 -1 | L1969064-1 | 6 | 7.2 | HNO ₃ | 1.5 | 152495 | RAD | JA/8.9/1625 |
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If applicable, was the client contacted? YES / NO / N/A Contact: _____ Date/Time: _____

Project Manager Signature / Date: [Signature]

1708173

DEFINITIONS: On the Air Waybill 'We', 'Our', 'us' and 'FedEx' refer to Federal Express Corporation, its subsidiaries and branches and their respective employees, agents and independent contractors. 'You' and 'your' refer to the shipper, its employees, principals and agents. If your shipment originates outside the United States, your contract of carriage is with the Federal Express subsidiary, branch or independent contractor who originally accepts the shipment from you. 'Package' means any container or envelope that is accepted by us for delivery, including any such items tendered to you utilizing our automated systems, meters, manifests or waybills. 'Shipment' means all packages, which are tendered to and accepted by us on a single Air Waybill.

AGREEMENT TO TERMS. By giving us your shipment, you agree, regardless of whether you sign the front of this Air Waybill, for yourself and as agent for and on behalf of any other person having an interest in this shipment, to all terms on this NON-NEGOTIABLE Air Waybill. In any applicable tariff, and in our current Service Guide or Standard Conditions of Carriage, copies of which are available upon request. If there is a conflict between this Air Waybill and either the tariff, Service Guide or Standard Conditions then in effect, the tariff and the terms of any customer automation agreement between the shipper and Federal Express will control (the Service Guide or Standard Conditions have secondary priority). No one is authorized to alter or modify the terms of our agreement. This Air Waybill shall be binding on us when the shipment is accepted.

YOUR OBLIGATIONS: You warrant that each article in the shipment is properly described on this Air Waybill and is acceptable for transport by us, and that the shipment is properly marked, addressed (including postal codes) and packaged to ensure safe transportation with ordinary care in handling.

NOTE CONCERNING LIMITATIONS OF LIABILITY. Air Carriage Notice. If the carriage of your shipment by air involves an ultimate destination or stop in a country other than the country of departure, the Warsaw Convention, an International treaty relating to international carriage by air, may be applicable, which treaty would then govern and in most cases limit our liability for loss or delay of or damage to your shipment. In the U.S. the Warsaw Convention limits our liability to U.S. \$9.07 per pound (U.S. \$20.38 per kilogram). Unless you declare a higher value for carriage as described below. The interpretation of the Warsaw Convention liability limits may vary in other countries. There are no stopping places which are agreed at the time of tender of the shipment and we reserve the right to route shipments in anyway we deem appropriate.

Road Transport Notice. Shipments transported partly or solely by road be it explicit agreement to do so or not-to, to, from a country which is party to the Convention on the Contract for the International Carriage of Goods by Road (the 'CMR') are subject to the terms and conditions of the CMR, notwithstanding any other provisions of this Agreement to the contrary. For these shipments transported solely by road, if a conflict arises between the provisions of the CMR and this Air Waybill the terms of the CMR shall prevail.

Limitation of Liability, if not governed by the Warsaw Convention or the CMR as described above, our maximum liability for loss, damage or delay is limited by this Air Waybill to U.S. \$100 per shipment or U.S. \$9.07 per pound (U.S. \$20.38 per kilo) (or equivalent local currency), whichever is greater, unless you declare a higher value for carriage as described below. FedEx does not provide cargo liability or all-risk insurance, but you may pay an additional charge to each additional U.S. \$100 (or equivalent local currency) of declared value for carriage. If a higher value for carriage is declared and the additional charge is paid, FedEx maximum liability will be the lesser of the declared value for carriage or your actual damages.

LIABILITIES NOT ASSUMED. IN ANY EVENT, WE WON'T BE LIABLE FOR ANY DAMAGES WHETHER DIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL, IN EXCESS OF THE DECLARED VALUE FOR CARRIAGE (INCLUDING BUT NOT LIMITED TO LOSS OF INCOME OR PROFITS) WHETHER OR NOT WE HAD ANY KNOWLEDGE THAT SUCH DAMAGES MIGHT BE INCURRED, UNLESS SUCH DAMAGES WERE CAUSED BY OUR OWN WILLFUL MICONDUCT OR GROSS NEGLIGENCE.

We won't be liable for your actions or omissions, including but not limited to incorrect declaration of cargo, improper or insufficient packing, securing, marking or addressing of the shipment, or for the acts or omissions of the recipient or anyone else with an interest in the shipment. Also we won't be liable if you (or) the recipient violate any of the terms of our agreement. We won't be liable for loss of or damage to shipments of cash, currency or other prohibited items. We won't be liable for loss, damage or delay caused by events we cannot control, including but not limited to acts of God, perils of the air, weather conditions mechanical delays, acts of public enemies, war, strikes, civil commotions, or acts or omissions of public authorities (including customs and health officials) with actual or apparent authority.

NO WARRANTIES. We make no warranties, express or implied. CLAIM FOR LOSS, DAMAGE FOR DELAY. ALL CLAIMS MUST BE NOTIFIED TO US WITHIN 15 DAYS AFTER DELIVERY OF THE SHIPMENT FAILING WHICH NO ACTION FOR DAMAGES MAY BE BROUGHT. All claims for loss, non-delivery or mis-delivery must be received by us within 90 days after the shipment is accepted by us. The right to damages against us shall be extinguished unless an action is brought within two years from the date of delivery of the shipment or from date on which the shipment should have been delivered. Within 30 days after notification to us (of) the claim, it must be documented by sending us all relevant information about it. We are not obligated to act on any claim until all transportation charges have been paid; the claim amount may not be deducted from those charges. If the recipient accepts the shipment without noting any damage on the delivery record, we will assume the shipment was delivered in good condition. In order for us to consider a claim for damages, the contents, original shipping cartons, and packing must be available to us for inspection.

RIGHT TO INSPECT. Your shipment may, at our option or at the request of governmental authorities, be opened and inspected by us or such authorities or us at any time. CUSTOMS CLEARANCE. It is your responsibility to provide proper customs documentation and confirmation, where required. EXPORT CONTROL. You authorize Federal Express to act as forwarding agent for you for export control and customs purposes. You hereby certify that all statements and information contained in this air waybill relating to exportation are true and correct. Furthermore, you understand that civil and criminal penalties, including forfeiture and sale, may be imposed for making false or fraudulent statements or for the violation of any United States laws on exportation, including but not limited to, 13 USC Sec. 305, 22 USC Sec. 401; 18 USC Sec. 1001; 50 USC app. 2410.

MANDATORY LAW. Insofar as any provision contained or referred to in this air Waybill may be contrary to any applicable international treaty, law government regulations, orders or requirements such provision shall remain in effect as a part of our agreement to the extent that it is not overridden. The invalidity or unenforceability of any provision shall not affect any other part of this Air Waybill. Unless otherwise indicated the Sender's address indicated on the face of this Waybill is the place of execution and the place of departure, and Recipient's address listed on the face of this Waybill is the place of destination. Unless otherwise indicated Federal Express Corporation, P.O. Box 727, Memphis, TN 38194 USA is the first carrier of this shipment.

- After printing this label:
CONSIGNEE COPY - PLEASE PLACE IN FRONT OF POUCH
 1. Fold the printed page along the horizontal line.
 2. Place label in shipping pouch and affix it to your shipment.

TRK# 7012 5069 4006
0430

XH FTCA

CO-US DEN 80524

INTL PRIORITY 10:30A

ORIGIN ID: YBYA (604) 233-4188
 HART JILL
 ALS ENVIRONMENTAL LAB GROUP
 LOUGHREED HIGHWAY
 BURNABY, BC V5A1W9
 CANADA CA

SHIP DATE: 08AUG17
 ACT WGT: 15.00 LB MAN
 CAD: 0347419/CNFE3011

BILL SENDER

TO SAMPLE RECEIVING
ALS ENVIRONMENTAL
225 COMMERCE DRIVE
FORT COLLINS CO 80524
 (970) 490-1511
 DEPT. SUBLETS
 REF: SUBLETS

10-0
12.9 (US)

540C1577E/27F



3161216101002uv

Client: ALS Environmental

Date: 23-Aug-17

Project: L1969064

Work Order: 1708173

Sample ID: L1969064-1

Lab ID: 1708173-1

Legal Location:

Matrix: WATER

Collection Date: 8/1/2017

Percent Moisture:

| Analyses | Result | Qual | Report Limit | Units | Dilution Factor | Date Analyzed |
|---|---------------------|------|----------------|-------|-----------------------------|--------------------|
| Radium-226 by Radon Emanation - Method 903.1 | | | PAI 783 | | Prep Date: 8/10/2017 | PrepBy: HCJ |
| Ra-226 | 0.0036 (+/- 0.0057) | U | 0.0096 | BQ/l | NA | 8/22/2017 12:56 |
| Carr: <i>BARIUM</i> | 90 | | 40-110 | %REC | DL = NA | 8/22/2017 12:56 |

Client: ALS Environmental

Date: 23-Aug-17

Project: L1969064

Work Order: 1708173

Sample ID: L1969064-1

Lab ID: 1708173-1

Legal Location:

Matrix: WATER

Collection Date: 8/1/2017

Percent Moisture:

| Analyses | Result | Qual | Report Limit | Units | Dilution Factor | Date Analyzed |
|----------|--------|------|--------------|-------|-----------------|---------------|
|----------|--------|------|--------------|-------|-----------------|---------------|

Explanation of Qualifiers

Radiochemistry:

- U or ND - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- Y2 - Chemical Yield outside default limits.
- W - DER is greater than Warning Limit of 1.42
- * - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
- # - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.
- G - Sample density differs by more than 15% of LCS density.
- D - DER is greater than Control Limit
- M - Requested MDC not met.
- LT - Result is less than requested MDC but greater than achieved MDC.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS, Matrix Spike Recovery within control limits.
- N - Matrix Spike Recovery outside control limits
- NC - Not Calculated for duplicate results less than 5 times MDC
- B - Analyte concentration greater than MDC.
- B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

- B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).
- U or ND - Indicates that the compound was analyzed for but not detected.
- E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.
- M - Duplicate injection precision was not met.
- N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.
- Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.
- * - Duplicate analysis (relative percent difference) not within control limits.
- S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

- U or ND - Indicates that the compound was analyzed for but not detected.
- B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.
- E - Analyte concentration exceeds the upper level of the calibration range.
- J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).
- A - A tentatively identified compound is a suspected aldol-condensation product.
- X - The analyte was diluted below an accurate quantitation level.
- * - The spike recovery is equal to or outside the control criteria used.
- + - The relative percent difference (RPD) equals or exceeds the control criteria.
- G - A pattern resembling gasoline was detected in this sample.
- D - A pattern resembling diesel was detected in this sample.
- M - A pattern resembling motor oil was detected in this sample.
- C - A pattern resembling crude oil was detected in this sample.
- 4 - A pattern resembling JP-4 was detected in this sample.
- 5 - A pattern resembling JP-5 was detected in this sample.
- H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.
- L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.
- Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
 - gasoline
 - JP-8
 - diesel
 - mineral spirits
 - motor oil
 - Stoddard solvent
 - bunker C

ALS -- Fort Collins

Date: 8/23/2017 10:35

Client: ALS Environmental
 Work Order: 1708173
 Project: L1969064

QC BATCH REPORT

Batch ID: **RE170810-1-1** Instrument ID **Alpha Scin** Method: **Radium-226 by Radon Emanation**

| LCS | | Sample ID: RE170810-1 | | | Units: BQ/I | | Analysis Date: 8/22/2017 12:56 | | | | |
|--------------|------------------|------------------------------|---------|---------------|-----------------------------|---------------|---------------------------------------|---------|-----|-----------|------|
| Client ID: | | Run ID: RE170810-1B | | | Prep Date: 8/10/2017 | | DF: NA | | | | |
| Analyte | Result | ReportLimit | SPK Val | SPK Ref Value | %REC | Control Limit | Decision Level | DER Ref | DER | DER Limit | Qual |
| Ra-226 | 1.85 (+/- 0.457) | 0.0114 | 1.715 | | 108 | 67-120 | | | | | P,M3 |
| Carr: BARIUM | 14000 | | 16220 | | 86.4 | 40-110 | | | | | |

| LCSD | | Sample ID: RE170810-1 | | | Units: BQ/I | | Analysis Date: 8/22/2017 12:56 | | | | |
|--------------|------------------|------------------------------|---------|---------------|-----------------------------|---------------|---------------------------------------|---------|-----|-----------|------|
| Client ID: | | Run ID: RE170810-1B | | | Prep Date: 8/10/2017 | | DF: NA | | | | |
| Analyte | Result | ReportLimit | SPK Val | SPK Ref Value | %REC | Control Limit | Decision Level | DER Ref | DER | DER Limit | Qual |
| Ra-226 | 1.76 (+/- 0.434) | 0.0073 | 1.715 | | 102 | 67-120 | | 1.85 | 0.1 | 2.1 | P |
| Carr: BARIUM | 15700 | | 16220 | | 96.9 | 40-110 | | 14000 | | | |

| MB | | Sample ID: RE170810-1 | | | Units: BQ/I | | Analysis Date: 8/22/2017 12:56 | | | | |
|--------------|----------------|------------------------------|---------|---------------|-----------------------------|---------------|---------------------------------------|---------|-----|-----------|------|
| Client ID: | | Run ID: RE170810-1B | | | Prep Date: 8/10/2017 | | DF: NA | | | | |
| Analyte | Result | ReportLimit | SPK Val | SPK Ref Value | %REC | Control Limit | Decision Level | DER Ref | DER | DER Limit | Qual |
| Ra-226 | 0 (+/- 0.0041) | 0.0081 | | | | | | | | | U |
| Carr: BARIUM | 15600 | | 16220 | | 96.3 | 40-110 | | | | | |

The following samples were analyzed in this batch:



Chain of Custody (COC) / Analytical Request Form



L1969064-COFC

COC Number: 2017-08-02 A

Page 1 of 1

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

| | | | | | | | | | | | | | | | | | |
|--|---|--|---------------------|--------------------|--|-------------------------------------|-------------------------------------|------------------------------------|--|--------------------------------|---|----------------------------------|---------------------------------------|----------------------------|-----------------------------|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | EMERGENCY | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | Analysis Request | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 226337 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (1) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Radium 226 Analysis | Number of Containers | | |
| 1 | W3 | 1-Aug-17 | 7:40 | Water | R | R | R | R | R | R | R | R | R | R | 8 | | |
| 2 | W50 | 1-Aug-17 | 8:05 | Water | R | R | R | R | R | R | R | R | R | R | 7 | | |
| 3 | W16A | 1-Aug-17 | 8:35 | Water | R | R | R | R | R | R | R | R | R | R | 7 | | |
| 4 | MC1 | 1-Aug-17 | 9:15 | Water | R | R | R | R | R | R | R | R | R | R | 7 | | |
| 5 | W2 | 1-Aug-17 | 9:50 | Water | R | R | R | R | R | R | R | R | R | R | 7 | | |
| 6 | W7 | 1-Aug-17 | 11:20 | Water | R | R | R | R | R | R | R | R | R | R | 7 | | |
| 7 | W35 | 1-Aug-17 | 16:00 | Water | R | R | R | R | R | R | R | R | R | R | 7 | | |
| 8 | W62 | 1-Aug-17 | 17:15 | Water | R | R | R | R | R | R | R | R | R | R | 6 | | |
| 9 | F-BL | 1-AUG-17 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | |
| | | | | | 7 °C | | | | | | 14.8 15.6 | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | |
| Released by: Corey Roberts | Date: 17-08-02 | Time: | Received by: JMC | Date: Aug 2, 2017 | Time: 15:25 | Received by: TP | Date: Aug 3 | Time: 15:25 | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 09-AUG-17
Report Date: 18-AUG-17 16:00 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1972393
Project P.O. #: 226337
Job Reference:
C of C Numbers: 2017-08-09 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

18-AUG-17 16:00 (MT)

Version: FINAL

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1972393-1 | L1972393-2 | L1972393-3 | L1972393-4 | L1972393-5 |
|-----------------------------------|---|--------------|--------------|-----------|--------------------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 08-AUG-17 | 08:20 | W3 | 08-AUG-17 | 08-AUG-17 | 08-AUG-17 | 08-AUG-17 | 08-AUG-17 |
| | | | | | W3 | W2 | MC1 | W45 | DUP |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 507 | 348 | 347 | 3350 | 521 | | | |
| | Hardness (as CaCO3) (mg/L) | 250 | 168 | 174 | 1700 | 259 | | | |
| | pH (pH) | 8.09 | 8.07 | 8.20 | 7.76 | 8.13 | | | |
| | Total Suspended Solids (mg/L) | <3.0 | 4.7 | 6.7 | 44.7 | <3.0 | | | |
| | TDS (Calculated) (mg/L) | 300 | 185 | 187 | 3140 | 306 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 225 | 144 | 150 | 114 | 232 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 225 | 144 | 150 | 114 | 232 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0075 | 0.0070 | 0.0117 | 4.55 | 0.0071 | | | |
| | Chloride (Cl) (mg/L) | 4.57 | 2.39 | 1.75 | 34.4 | 4.57 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.196 | 0.148 | 0.121 | 21.2 | 0.195 | | | |
| | Nitrate (as N) (mg/L) | 0.196 | 0.148 | 0.120 | 13.9 | 0.195 | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | 0.0015 | 7.35 | <0.0010 | | | |
| | Sulfate (SO4) (mg/L) | 56.2 | 26.1 | 22.3 | 2040 | 56.2 | | | |
| | Anion Sum (meq/L) | 5.81 | 3.49 | 3.53 | 47.3 | 5.95 | | | |
| | Cation Sum (meq/L) | 5.84 | 3.86 | 4.00 | 45.0 | 6.02 | | | |
| | Cation - Anion Balance (%) | 0.2 | 5.1 | 6.3 | -2.5 | 0.6 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 6.07 | 8.37 | 9.21 | | 6.43 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0262 | 0.0490 | 0.182 | 0.498 | 0.0073 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00011 | 0.00012 | 0.00045 | <0.00010 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00029 | 0.00053 | 0.00074 | 0.00047 | 0.00027 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0717 | 0.0782 | 0.0753 | 0.138 | 0.0698 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000040 ^{DLA} | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | 0.027 | <0.010 | <0.010 | 0.373 ^{DLM} | 0.026 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000053 | <0.0000050 | 0.0000064 | <0.00016 | <0.0000050 | | | |
| | Calcium (Ca)-Total (mg/L) | 56.5 | 45.3 | 43.7 | 554 | 55.7 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00016 | 0.00028 | 0.00056 | 0.00029 | 0.00013 | | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | <0.00010 | 0.00018 | 0.00203 | <0.00010 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00500 | 0.00220 | 0.00251 | 0.0826 | 0.00351 | | | |
| | Iron (Fe)-Total (mg/L) | 0.051 | 0.123 | 0.419 | 1.32 | 0.026 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | 0.000093 | 0.00166 | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0034 | 0.0020 | 0.0018 | 0.0367 | 0.0033 | | | |
| | Magnesium (Mg)-Total (mg/L) | 28.1 | 15.4 | 16.3 | 88.5 | 28.2 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0519 | 0.0226 | 0.0282 | 1.99 | 0.0483 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1972393-1 | L1972393-2 | L1972393-3 | L1972393-4 | L1972393-5 |
|-------------------------|---------------------------------------|--------------|--------------|------------|--------------------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 08-AUG-17 | 08:20 | W3 | 08-AUG-17 | 08-AUG-17 | 08-AUG-17 | 08-AUG-17 | 08-AUG-17 |
| | | | | | W3 | W2 | MC1 | W45 | DUP |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00463 | 0.00148 | 0.00190 | 0.117 | 0.00466 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00106 | 0.00112 | 0.00149 | 0.0192 | 0.00102 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | <0.10 ^{DLA} | <0.050 | | | |
| | Potassium (K)-Total (mg/L) | 2.27 | 1.61 | 1.48 | 86.6 | 2.27 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000336 | 0.000172 | 0.000181 | 0.0187 | 0.000310 | | | |
| | Silicon (Si)-Total (mg/L) | 6.04 | 6.12 | 6.72 | 5.16 | 6.18 | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 18.9 | 10.6 | 11.0 | 186 | 19.1 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.731 | 0.487 | 0.464 | 7.66 | 0.728 | | | |
| | Sulfur (S)-Total (mg/L) | 19.6 | 9.32 | 7.93 | 774 | 20.0 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00030 | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.00138 | 0.00245 | 0.00808 | <0.030 ^{DLM} | 0.00035 | | | |
| | Uranium (U)-Total (mg/L) | 0.00279 | 0.00216 | 0.00187 | 0.00880 | 0.00286 | | | |
| | Vanadium (V)-Total (mg/L) | 0.00054 | 0.00096 | 0.00167 | 0.0020 | <0.00050 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | 0.0091 | <0.0030 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0027 | 0.0071 | 0.0402 | 0.0147 | 0.0035 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00029 | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00025 | 0.00044 | 0.00055 | 0.00034 | 0.00026 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0677 | 0.0739 | 0.0699 | 0.130 | 0.0636 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000040 ^{DLA} | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.024 | <0.010 | <0.010 | 0.350 | 0.022 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | 0.0000065 | 0.000111 | 0.0000053 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 56.4 | 42.9 | 43.7 | 540 | 57.0 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00015 | 0.00019 | <0.00020 ^{DLA} | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00158 | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00342 | 0.00200 | | 0.00499 | 0.00324 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.017 | 0.044 | 0.157 | 0.056 | 0.015 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | 0.000077 | <0.00010 ^{DLA} | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0033 | 0.0021 | 0.0019 | 0.0356 | 0.0027 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 26.4 | 14.8 | 15.7 | 86.0 | 28.3 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0414 | 0.0171 | 0.0150 | 1.84 | 0.0404 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1972393-1 | L1972393-2 | L1972393-3 | L1972393-4 | L1972393-5 |
|-------------------------|----------------------------------|--------------|--------------|------------------------|--------------------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 08-AUG-17 | 08:20 | W3 | 08-AUG-17 | 08-AUG-17 | 08-AUG-17 | 08-AUG-17 | 08-AUG-17 |
| | | | | | 09:35 | 09:35 | 10:35 | 11:30 | |
| | | | | | W2 | W2 | MC1 | W45 | DUP |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00436 | 0.00125 | 0.00173 | 0.110 | 0.00451 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00096 | 0.00097 | 0.00107 | 0.0064 | 0.00094 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.10 ^{DLA} | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.25 | 1.63 | 1.46 | 88.6 | 2.21 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000351 | 0.000137 | 0.000158 | 0.0179 | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.83 | 5.80 | 6.07 | 4.12 | 6.29 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 18.2 | 10.6 | 11.0 | 191 | 18.1 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.697 | 0.433 | 0.442 | 6.96 | 0.700 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 18.1 | 8.67 | 7.19 | 752 | 19.7 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00020 ^{DLA} | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00200 | <0.00060 ^{DLA} | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00250 | 0.00175 | 0.00165 | 0.00774 | 0.00265 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00067 | 0.00101 | <0.0010 ^{DLA} | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0040 ^{DLB} | <0.0020 ^{DLA} | 0.0013 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00076 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|----------------------|-----------|-----------------------------|
| Method Blank | Zinc (Zn)-Dissolved | MB-LOR | L1972393-1, -2, -3, -4, -5 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1972393-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1972393-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1972393-1, -2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1972393-1, -2, -3, -4, -5 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1972393-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1972393-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1972393-1, -2, -3, -4, -5 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1972393-1, -2, -3, -4, -5 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLA | Detection Limit adjusted for required dilution |
| DLB | Detection Limit Raised. Analyte detected at comparable level in Method Blank. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |

Reference Information

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-08-09 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



COC Number: 2017-08-09 A

Canada Toll Free: 1 800 668 9878

L1972393-COFC

www.alsglobal.com

| | | | | | | | | | | | | | | | | | | |
|--|---|------------------|--|------------------|------------------------------|--|--|--|--|--|-------------|--|--|--|--|--|--|--|
| Report To Contact and company name below will appear on the final report | | | Report Format / Distribution | | | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | | | 4 day [P4] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | |
| Phone: | 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | 3 day [P3] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Company address below will appear on the final report | | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | PRIORITY (Business Days) | | EMERGENCY | | | | | | | | |
| Street: | 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | | | Date and Time Required for all E&P TATs: | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | | Email 2 | | | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | |
| Postal Code: | V6B 0M3 | | Email 3 | | | | | Analysis Request | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | P F/P P F/P P F/P | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | | | | Number of Containers | | | | | | | | | | |
| Contact: | Ruth Cayetano | | Email 2 | | | | | pH / Conductivity / Alkalinity / Anions | | | | | | | | | | |
| Project Information | | | Oil and Gas Required Fields (client use) | | | | | Total Suspended Solids (TSS) | | | | | | | | | | |
| ALS Account # / Quote #: | Job #: | | AFE/Cost Center: | | PO# | | Total Dissolved Solids (TDS) | | | | | | | | | | | |
| PO / AFE: 226337 (WUL) | Major/Minor Code: | | Routing Code: | | Total Metals (TM), Hardness | | | | | | | | | | | | | |
| LSD: | Requisitioner: | | Location: | | | | | Dissolved Metals (DM) (Filtered and preserved) | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | ALS Contact: Shane Stack | | Sampler: | | Total Mercury, Hardness | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Dissolved Mercury [1] (Filtered + preserved) | | | | | | | | | | | |
| | W3 | | | 8-Aug-17 | 8:20 | Water | Total Nutrients (Ammonia) | | | | | | | | | | | |
| | W2 | | | 8-Aug-17 | 9:35 | Water | Dissolved Organic Carbon (DOC) | | | | | | | | | | | |
| | MC1 | | | 8-Aug-17 | 10:35 | Water | | | | | | | | | | | | |
| | W45 | | | 8-Aug-17 | 11:30 | Water | | | | | | | | | | | | |
| | DUP | | | 8-Aug-17 | | Water | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | |
| | | | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | |
| | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | | | | | |
| | | | | | | | | FINAL COOLER TEMPERATURES °C 12.5 19.1 11.7 | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | |
| Released by: Corey Roberts | | Date: 2017-08-09 | Received by: JMC | | Date: Aug 9 2017 15:32 | Received by: MS | | Date: Aug 10 2017 14:55 | | | Time: 11:55 | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-AUG-17
Report Date: 25-AUG-17 18:02 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1976078
Project P.O. #: 226973
Job Reference:
C of C Numbers: 2017-08-16 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1976078-1 Water 15-AUG-17 08:15 W3 | L1976078-2 Water 15-AUG-17 13:45 MC1 | L1976078-3 Water 15-AUG-17 14:20 W2 | L1976078-4 Water 15-AUG-17 DUP | |
|---|---|--|---|---|-----------|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 528 | 363 | 349 | 521 |
| | Hardness (as CaCO3) (mg/L) | 238 | 170 | 168 | 241 |
| | pH (pH) | 8.34 | 8.43 | 8.12 | 8.11 |
| | Total Suspended Solids (mg/L) | <3.0 | 10.0 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | 308 | 207 | 195 | 299 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 238 | 176 | 158 | 230 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 8.6 | 10.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 246 | 186 | 158 | 230 |
| | Ammonia, Total (as N) (mg/L) | 0.0056 | 0.0073 | <0.0050 | 0.0063 |
| | Chloride (Cl) (mg/L) | 4.48 | 1.80 | 2.53 | 4.49 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.188 | 0.112 | 0.111 | 0.188 |
| | Nitrate (as N) (mg/L) | 0.188 | 0.111 | 0.111 | 0.188 |
| | Nitrite (as N) (mg/L) | <0.0010 | 0.0014 | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | 56.1 | 22.8 | 27.6 | 56.1 |
| | Anion Sum (meq/L) | 6.23 | 4.25 | 3.82 | 5.90 |
| | Cation Sum (meq/L) | 5.59 | 3.90 | 3.82 | 5.64 |
| | Cation - Anion Balance (%) | -5.4 | -4.3 | 0.1 | -2.3 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 6.97 | 9.31 | 8.64 | 6.47 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0084 | 0.256 | 0.0277 | 0.0107 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00011 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00029 | 0.00074 | 0.00045 | 0.00028 |
| | Barium (Ba)-Total (mg/L) | 0.0704 | 0.0743 | 0.0733 | 0.0683 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.027 | <0.010 | <0.010 | 0.026 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000052 | 0.0000081 | <0.0000050 | 0.0000055 |
| | Calcium (Ca)-Total (mg/L) | 55.9 | 44.8 | 46.1 | 54.9 |
| | Chromium (Cr)-Total (mg/L) | 0.00020 | 0.00064 | 0.00021 | 0.00012 |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00023 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | 0.00354 | 0.00288 | 0.00303 | 0.00359 |
| | Iron (Fe)-Total (mg/L) | 0.028 | 0.523 | 0.091 | 0.030 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.000116 | 0.000067 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0028 | 0.0014 | 0.0018 | 0.0028 |
| | Magnesium (Mg)-Total (mg/L) | 29.3 | 17.1 | 15.5 | 28.9 |
| | Manganese (Mn)-Total (mg/L) | 0.0496 | 0.0397 | 0.0268 | 0.0498 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1976078-1 Water 15-AUG-17 08:15 W3 | L1976078-2 Water 15-AUG-17 13:45 MC1 | L1976078-3 Water 15-AUG-17 14:20 W2 | L1976078-4 Water 15-AUG-17 DUP |
|---|---------------------------------------|---|--|---|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00492 | 0.00198 | 0.00136 | 0.00487 |
| | Nickel (Ni)-Total (mg/L) | 0.00100 | 0.00149 | 0.00101 | 0.00111 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.26 | 1.47 | 1.66 | 2.21 |
| | Selenium (Se)-Total (mg/L) | 0.000325 | 0.000156 | 0.000136 | 0.000332 |
| | Silicon (Si)-Total (mg/L) | 6.35 | 6.93 | 6.09 | 6.35 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 19.4 | 11.3 | 10.9 | 19.5 |
| | Strontium (Sr)-Total (mg/L) | 0.750 | 0.481 | 0.488 | 0.742 |
| | Sulfur (S)-Total (mg/L) | 20.2 | 8.32 | 9.76 | 20.3 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.00030 | 0.0104 | 0.00119 | 0.00047 |
| | Uranium (U)-Total (mg/L) | 0.00276 | 0.00174 | 0.00222 | 0.00276 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00173 | 0.00071 | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0019 | 0.0064 | 0.0044 | 0.0027 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00023 | 0.00055 | 0.00035 | 0.00020 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0655 | 0.0688 | 0.0707 | 0.0650 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.023 | <0.010 | <0.010 | 0.023 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 53.1 | 43.3 | 44.7 | 54.2 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00014 | 0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00277 | 0.00166 | 0.00170 | 0.00306 |
| | Iron (Fe)-Dissolved (mg/L) | 0.015 | 0.115 | 0.046 | 0.017 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0031 | 0.0015 | 0.0020 | 0.0032 |
| | Magnesium (Mg)-Dissolved (mg/L) | 25.7 | 15.1 | 13.7 | 25.7 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0424 | 0.0138 | 0.0224 | 0.0423 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1976078-1 | L1976078-2 | L1976078-3 | L1976078-4 |
|-------------------------|----------------------------------|--------------|------------------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water |
| | | 15-AUG-17 | 08:15 | | 15-AUG-17 | 13:45 | 14:20 | 15-AUG-17 |
| | | | | | W3 | MC1 | W2 | DUP |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00423 | 0.00175 | 0.00117 | 0.00427 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00100 | 0.00102 | 0.00092 | 0.00091 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.19 | 1.39 | 1.62 | 2.19 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000321 | 0.000157 | 0.000132 | 0.000301 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.93 | 6.06 | 5.76 | 5.84 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 17.7 | 10.4 | 9.75 | 17.4 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.709 | 0.455 | 0.467 | 0.716 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 17.5 | 7.27 | 8.72 | 17.1 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | 0.00129 ^{DTC} | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00039 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00271 | 0.00177 | 0.00216 | 0.00271 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00074 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | 0.0064 | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Copper (Cu)-Total | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1976078-1, -2, -3, -4 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1976078-1, -2, -3, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|---|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

Reference Information

WR ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2017-08-16 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 24-AUG-17
Report Date: 06-SEP-17 17:15 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1980621
Project P.O. #: 226973
Job Reference:
C of C Numbers: 2017-08-23 C
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1980621-1 | L1980621-2 | L1980621-3 | L1980621-4 | L1980621-5 |
|-----------------------------------|---|--------------|--------------|-----------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 19-AUG-17 | 14:10 | MN-1.5 | 19-AUG-17 | 20-AUG-17 | 21-AUG-17 | 21-AUG-17 | 21-AUG-17 |
| | | | | | 14:10 | 12:50 | 09:00 | 11:00 | 14:15 |
| | | | | | MN-1.5 | UG1 | W16 | W8A | MN-4.5 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 119 | 2520 | 440 | 1130 | 233 | | | |
| | Hardness (as CaCO3) (mg/L) | 56.4 | 1420 | 207 | 576 | 113 | | | |
| | pH (pH) | 7.92 | 7.95 | 8.29 | 7.98 | 8.17 | | | |
| | Total Suspended Solids (mg/L) | 3.8 | 73.6 | <3.0 | 16.0 | <3.0 | | | |
| | TDS (Calculated) (mg/L) | 62.3 | 2350 | 263 | 785 | 127 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 62.7 | 164 | 161 | 349 | 115 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | 2.2 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 62.7 | 164 | 163 | 349 | 115 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0068 | 13.8 | 0.0379 | 0.112 | <0.0050 | | | |
| | Chloride (Cl) (mg/L) | <0.50 | <10 | 6.46 | 10.7 | 0.58 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.0106 | 36.0 | 2.02 | 6.09 | 0.109 | | | |
| | Nitrate (as N) (mg/L) | 0.0106 | 33.9 | 1.99 | 6.06 | 0.109 | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | 2.09 | 0.0228 | 0.0231 | <0.0010 | | | |
| | Sulfate (SO4) (mg/L) | 0.94 | 1450 | 61.8 | 287 | 10.3 | | | |
| | Anion Sum (meq/L) | 1.27 | 36.1 | 4.88 | 13.7 | 2.55 | | | |
| | Cation Sum (meq/L) | 1.31 | 33.0 | 4.77 | 13.5 | 2.53 | | | |
| | Cation - Anion Balance (%) | 1.3 | -4.5 | -1.1 | -0.7 | -0.4 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 13.7 | | 14.6 | | 8.70 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0588 | 3.03 | 0.0443 | 0.744 | 0.0325 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00086 | <0.00010 | 0.00023 | 0.00014 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00068 | 0.00115 | 0.00048 | 0.00097 | 0.00037 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0411 | 0.0843 | 0.0712 | 0.165 | 0.0548 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | 0.000095 | <0.000020 | 0.000048 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | 0.000059 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | <0.010 | 0.783 | 0.035 | 0.035 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | 0.000356 | 0.0000090 | 0.000236 | <0.0000050 | | | |
| | Calcium (Ca)-Total (mg/L) | 16.5 | 526 | 57.1 | 170 | 32.7 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00059 | 0.00225 | 0.00018 | 0.00122 | 0.00018 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00064 | 0.00191 | <0.00010 | 0.00153 | <0.00010 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00358 | 0.392 | 0.0304 | 0.423 | 0.00158 | | | |
| | Iron (Fe)-Total (mg/L) | 1.03 | 4.55 | 0.156 | 7.16 | 0.051 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.00533 | <0.000050 | 0.000553 | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | <0.0010 | 0.0119 | <0.0010 | 0.0041 | 0.0013 | | | |
| | Magnesium (Mg)-Total (mg/L) | 4.82 | 50.7 | 16.1 | 44.1 | 9.32 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.141 | 0.233 | 0.0638 | 2.33 | 0.00385 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1980621-6 | L1980621-7 | L1980621-8 | L1980621-9 | L1980621-10 |
|-----------------------------------|---|--------------|--------------|------------|------------|------------|------------|------------|-------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 21-AUG-17 | 15:50 | MN-2.5 | 21-AUG-17 | 19-AUG-17 | 22-AUG-17 | 22-AUG-17 | 22-AUG-17 |
| | | | | | | DUP | 09:00 | 09:30 | 13:50 |
| | | | | | | | W3 | W17 | MC1 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 200 | 119 | 532 | 472 | 354 | | | |
| | Hardness (as CaCO3) (mg/L) | 98.6 | 59.1 | 252 | 223 | 173 | | | |
| | pH (pH) | 8.17 | 7.93 | 8.38 | 8.31 | 8.36 | | | |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | <3.0 | <3.0 | <3.0 | | | |
| | TDS (Calculated) (mg/L) | 108 | 63.4 | 305 | 274 | 200 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 105 | 62.9 | 231 | 193 | 173 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | 7.2 | 4.4 | 5.4 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 105 | 62.9 | 238 | 198 | 179 | | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.0082 | 0.0054 | <0.0050 | 0.0104 | | | |
| | Chloride (Cl) (mg/L) | 0.51 | <0.50 | 4.24 | 5.53 | 1.47 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.0293 | 0.0111 | 0.181 | 0.188 | 0.102 | | | |
| | Nitrate (as N) (mg/L) | 0.0293 | 0.0111 | 0.181 | 0.188 | 0.102 | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | | |
| | Sulfate (SO4) (mg/L) | 4.00 | 0.93 | 53.9 | 52.9 | 20.1 | | | |
| | Anion Sum (meq/L) | 2.22 | 1.28 | 6.04 | 5.24 | 4.06 | | | |
| | Cation Sum (meq/L) | 2.17 | 1.36 | 5.86 | 5.15 | 3.94 | | | |
| | Cation - Anion Balance (%) | -1.0 | 3.1 | -1.5 | -0.9 | -1.5 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 8.30 | 13.8 | 5.44 | 9.15 | 8.11 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0338 | 0.0700 | 0.0066 | 0.0035 | 0.0762 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00030 | 0.00072 | 0.00025 | 0.00038 | 0.00063 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0423 | 0.0438 | 0.0671 | 0.0713 | 0.0657 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | <0.010 | <0.010 | 0.027 | 0.034 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | 0.0000051 | <0.0000050 | <0.0000050 | <0.0000050 | | | |
| | Calcium (Ca)-Total (mg/L) | 28.8 | 16.7 | 59.7 | 64.3 | 46.6 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00024 | 0.00068 | 0.00012 | 0.00013 | 0.00036 | | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00071 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00134 | 0.00387 | 0.00290 | 0.00693 | 0.00172 | | | |
| | Iron (Fe)-Total (mg/L) | 0.086 | 1.23 | 0.027 | <0.010 | 0.246 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | <0.0010 | <0.0010 | 0.0028 | <0.0010 | 0.0012 | | | |
| | Magnesium (Mg)-Total (mg/L) | 7.46 | 5.05 | 27.5 | 17.4 | 15.8 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0321 | 0.143 | 0.0488 | 0.00670 | 0.0263 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1980621-11 | L1980621-12 | L1980621-13 | | |
|-----------------------------------|---|--------------|--------------|------------|-------------|-------------|-------------|--|--|
| | | | | | WATER | WATER | WATER | | |
| | | 22-AUG-17 | 14:50 | | 22-AUG-17 | 19-AUG-17 | 21-AUG-17 | | |
| | | | | | W2 | DUP | MN-0.5 | | |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 358 | 529 | 237 | | | | | |
| | Hardness (as CaCO3) (mg/L) | 173 | 255 | 112 | | | | | |
| | pH (pH) | 8.36 | 8.39 | 8.18 | | | | | |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | <3.0 | | | | | |
| | TDS (Calculated) (mg/L) | 204 | 311 | 130 | | | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 172 | 232 | 118 | | | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 5.4 | 9.6 | <1.0 | | | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | | | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 177 | 241 | 118 | | | | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | <0.0050 | <0.0050 | | | | | |
| | Chloride (Cl) (mg/L) | 1.95 | 4.53 | <0.50 | | | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.110 | 0.187 | 0.0657 | | | | | |
| | Nitrate (as N) (mg/L) | 0.110 | 0.187 | 0.0657 | | | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | <0.0010 | | | | | |
| | Sulfate (SO4) (mg/L) | 23.4 | 56.9 | 12.3 | | | | | |
| | Anion Sum (meq/L) | 4.11 | 6.15 | 2.63 | | | | | |
| | Cation Sum (meq/L) | 3.92 | 5.92 | 2.53 | | | | | |
| | Cation - Anion Balance (%) | -2.4 | -1.9 | -1.9 | | | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 7.45 | 5.57 | 8.88 | | | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0303 | 0.0135 | 0.0231 | | | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | | | | | |
| | Arsenic (As)-Total (mg/L) | 0.00046 | 0.00026 | 0.00036 | | | | | |
| | Barium (Ba)-Total (mg/L) | 0.0670 | 0.0669 | 0.0521 | | | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | | | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | | | | | |
| | Boron (B)-Total (mg/L) | <0.010 | 0.026 | <0.010 | | | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | | | | | |
| | Calcium (Ca)-Total (mg/L) | 48.2 | 60.0 | 33.9 | | | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00021 | 0.00014 | 0.00022 | | | | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | | | | | |
| | Copper (Cu)-Total (mg/L) | 0.00180 | 0.00295 | 0.00108 | | | | | |
| | Iron (Fe)-Total (mg/L) | 0.094 | 0.030 | 0.035 | | | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | | | | | |
| | Lithium (Li)-Total (mg/L) | 0.0014 | 0.0028 | <0.0010 | | | | | |
| | Magnesium (Mg)-Total (mg/L) | 14.8 | 27.8 | 8.22 | | | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0162 | 0.0500 | 0.00344 | | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1980621-1 WATER 19-AUG-17 14:10 MN-1.5 | L1980621-2 WATER 20-AUG-17 12:50 UG1 | L1980621-3 WATER 21-AUG-17 09:00 W16 | L1980621-4 WATER 21-AUG-17 11:00 W8A | L1980621-5 WATER 21-AUG-17 14:15 MN-4.5 |
|-------------------------|---|---|--|--|--|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000051 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.000445 | 0.0221 | 0.00312 | 0.0130 | 0.00104 |
| | Nickel (Ni)-Total (mg/L) | 0.00128 | 0.00290 | 0.00084 | 0.00185 | 0.00081 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.104 | <0.050 | 0.170 | <0.050 |
| | Potassium (K)-Total (mg/L) | 0.26 | 12.7 | 2.69 | 6.41 | 0.98 |
| | Selenium (Se)-Total (mg/L) | 0.000058 | 0.00121 | 0.000719 | 0.00641 | 0.000175 |
| | Silicon (Si)-Total (mg/L) | 6.58 | 13.2 | 3.02 | 8.84 | 6.13 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000285 | <0.000010 | 0.000164 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 3.29 | 86.2 | 13.0 | 39.5 | 6.29 |
| | Strontium (Sr)-Total (mg/L) | 0.0857 | 9.59 | 0.577 | 2.24 | 0.222 |
| | Sulfur (S)-Total (mg/L) | <0.50 | 501 | 20.4 | 91.4 | 3.97 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | 0.000039 | <0.000010 | 0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | 0.00014 | <0.00010 | 0.00015 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.00250 | 0.216 | 0.00438 | 0.0464 | <0.0012 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.000032 | 0.0119 | 0.00126 | 0.00355 | 0.00104 |
| | Vanadium (V)-Total (mg/L) | 0.00083 | 0.0105 | 0.00058 | 0.00498 | 0.00069 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0291 | 0.0080 | 0.585 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | 0.00048 | <0.00030 | <0.00030 | 0.00046 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0354 | 0.0074 | 0.0051 | 0.0119 | 0.0054 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00078 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00052 | 0.00077 | 0.00041 | 0.00054 | 0.00032 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0386 | 0.0271 | 0.0751 | 0.134 | 0.0534 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000040 ^{DLA} | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.651 | 0.028 | 0.029 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.000225 | 0.0000071 | 0.000184 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 15.0 | 490 | 55.8 | 159 | 32.4 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00047 | 0.00086 | <0.00010 | 0.00038 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00058 | 0.00056 | <0.00010 | 0.00102 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00318 | 0.0218 | 0.0267 | 0.100 | 0.00133 |
| | Iron (Fe)-Dissolved (mg/L) | 0.563 | <0.020 ^{DLA} | 0.071 | 0.197 | 0.016 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | 0.0101 | 0.0016 | 0.0043 | 0.0017 |
| | Magnesium (Mg)-Dissolved (mg/L) | 4.57 | 46.9 | 16.4 | 43.5 | 7.85 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.122 | 0.103 | 0.0254 | 1.96 | 0.00314 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1980621-6 WATER 21-AUG-17 15:50 MN-2.5 | L1980621-7 WATER 19-AUG-17 DUP | L1980621-8 WATER 22-AUG-17 09:00 W3 | L1980621-9 WATER 22-AUG-17 09:30 W17 | L1980621-10 WATER 22-AUG-17 13:50 MC1 | |
|---|---|---|---|--|---|------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.000922 | 0.000466 | 0.00504 | 0.00565 | 0.00193 |
| | Nickel (Ni)-Total (mg/L) | 0.00094 | 0.00129 | 0.00110 | 0.00064 | 0.00114 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 0.87 | 0.27 | 2.26 | 3.52 | 1.39 |
| | Selenium (Se)-Total (mg/L) | 0.000061 | 0.000067 | 0.000293 | 0.000386 | 0.000112 |
| | Silicon (Si)-Total (mg/L) | 6.05 | 6.46 | 6.12 | 5.13 | 6.39 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 4.28 | 3.33 | 18.3 | 14.5 | 10.6 |
| | Strontium (Sr)-Total (mg/L) | 0.144 | 0.0868 | 0.783 | 0.672 | 0.480 |
| | Sulfur (S)-Total (mg/L) | 1.61 | 0.54 | 19.3 | 19.4 | 7.18 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.00190 | 0.00224 | 0.00055 | <0.00030 | 0.00360 |
| | Uranium (U)-Total (mg/L) | 0.000238 | 0.000034 | 0.00289 | 0.00197 | 0.00170 |
| | Vanadium (V)-Total (mg/L) | 0.00051 | 0.00092 | <0.00050 | 0.00051 | 0.00106 |
| | Zinc (Zn)-Total (mg/L) | 0.0044 | <0.0030 | <0.0030 | 0.0030 | 0.0069 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | 0.00052 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0050 | 0.0336 | 0.0022 | 0.0028 | 0.0044 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00029 | 0.00057 | 0.00023 | 0.00036 | 0.00052 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0419 | 0.0403 | 0.0680 | 0.0720 | 0.0650 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | 0.023 | 0.029 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 27.5 | 16.0 | 55.7 | 61.2 | 44.2 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00013 | 0.00042 | <0.00010 | 0.00012 | 0.00014 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00060 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00117 | 0.00315 | 0.00266 | 0.00649 | 0.00139 |
| | Iron (Fe)-Dissolved (mg/L) | 0.039 | 0.568 | 0.017 | <0.010 | 0.119 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0015 | <0.0010 | 0.0036 | 0.0018 | 0.0020 |
| | Magnesium (Mg)-Dissolved (mg/L) | 7.27 | 4.63 | 27.4 | 17.1 | 15.3 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0276 | 0.130 | 0.0435 | 0.00108 | 0.0164 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1980621-11 WATER 22-AUG-17 14:50 W2 | L1980621-12 WATER 19-AUG-17 DUP | L1980621-13 WATER 21-AUG-17 15:15 MN-0.5 | |
|-------------------------|---|--|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00152 | 0.00494 | 0.00136 | |
| | Nickel (Ni)-Total (mg/L) | 0.00092 | 0.00096 | 0.00076 | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | |
| | Potassium (K)-Total (mg/L) | 1.52 | 2.28 | 0.84 | |
| | Selenium (Se)-Total (mg/L) | 0.000123 | 0.000340 | 0.000222 | |
| | Silicon (Si)-Total (mg/L) | 5.88 | 6.09 | 5.62 | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Sodium (Na)-Total (mg/L) | 10.2 | 18.5 | 6.42 | |
| | Strontium (Sr)-Total (mg/L) | 0.494 | 0.780 | 0.256 | |
| | Sulfur (S)-Total (mg/L) | 8.58 | 18.9 | 4.16 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Total (mg/L) | 0.00184 | <0.00060 ^{DLM} | <0.0012 ^{DLM} | |
| | Uranium (U)-Total (mg/L) | 0.00209 | 0.00282 | 0.000740 | |
| | Vanadium (V)-Total (mg/L) | 0.00074 | <0.00050 | 0.00069 | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0040 | 0.0063 | 0.0074 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00039 | 0.00022 | 0.00033 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0666 | 0.0691 | 0.0520 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.023 | <0.010 | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Calcium (Ca)-Dissolved (mg/L) | 45.7 | 56.1 | 31.5 | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00011 | <0.00010 | 0.00013 | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00147 | 0.00334 | 0.00101 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.055 | 0.026 | 0.018 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0023 | 0.0036 | 0.0015 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 14.4 | 27.8 | 8.20 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0126 | 0.0440 | 0.00179 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1980621-1 | L1980621-2 | L1980621-3 | L1980621-4 | L1980621-5 |
|-------------------------|----------------------------------|-------------------------|--------------------------|------------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | | | | 19-AUG-17 | 20-AUG-17 | 21-AUG-17 | 21-AUG-17 | 21-AUG-17 |
| | | | | | 14:10 | 12:50 | 09:00 | 11:00 | 14:15 |
| | | | | | MN-1.5 | UG1 | W16 | W8A | MN-4.5 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000405 | 0.0208 | 0.00271 | 0.0116 | 0.000959 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00114 | 0.0024 | 0.00076 | 0.00142 | 0.00063 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.10 ^{DLA} | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 0.24 | 11.1 | 2.72 | 6.37 | 0.88 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000056 | 0.00107 | 0.000726 | 0.00682 | 0.000155 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.07 | 6.85 | 3.00 | 7.12 | 5.43 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000010 | 0.000016 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 3.10 | 78.7 | 12.9 | 39.3 | 5.60 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.0788 | 8.79 | 0.522 | 1.96 | 0.209 | | | |
| | Sulfur (S)-Dissolved (mg/L) | <0.50 | 492 | 20.2 | 89.9 | 3.28 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00020 ^{DLA} | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00090 ^{DLM} | <0.00060 ^{DLA} | 0.00037 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000030 | 0.0112 | 0.00111 | 0.00310 | 0.000940 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00053 | <0.0010 ^{DLA} | <0.00050 | 0.00104 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | 0.0060 | <0.0010 | 0.157 | 0.0020 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00048 | <0.00030 | <0.00030 | 0.00035 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1980621-6 | L1980621-7 | L1980621-8 | L1980621-9 | L1980621-10 |
|-------------------------|----------------------------------|--------------|--------------|------------|------------|------------|------------|------------|-------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 21-AUG-17 | 15:50 | | 21-AUG-17 | 19-AUG-17 | 22-AUG-17 | 22-AUG-17 | 22-AUG-17 |
| | | | | | MN-2.5 | DUP | W3 | W17 | MC1 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000772 | 0.000404 | 0.00426 | 0.00509 | 0.00169 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00086 | 0.00112 | 0.00086 | 0.00054 | 0.00089 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 0.82 | 0.22 | 2.25 | 3.52 | 1.34 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000065 | 0.000051 | 0.000341 | 0.000402 | 0.000123 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.89 | 6.18 | 5.95 | 4.89 | 6.06 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 4.08 | 3.10 | 17.6 | 13.7 | 9.84 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.131 | 0.0784 | 0.707 | 0.624 | 0.439 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 1.36 | <0.50 | 18.3 | 18.4 | 6.87 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00062 | <0.00030 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000205 | 0.000029 | 0.00255 | 0.00173 | 0.00157 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00054 | <0.00050 | <0.00050 | 0.00068 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | 0.00047 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1980621-11 WATER 22-AUG-17 14:50 W2 | L1980621-12 WATER 19-AUG-17 DUP | L1980621-13 WATER 21-AUG-17 15:15 MN-0.5 | |
|-------------------------|---|--|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00135 | 0.00430 | 0.00118 | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00082 | 0.00089 | 0.00070 | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | |
| | Potassium (K)-Dissolved (mg/L) | 1.46 | 2.26 | 0.79 | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000130 | 0.000309 | 0.000177 | |
| | Silicon (Si)-Dissolved (mg/L) | 5.65 | 6.06 | 5.61 | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Sodium (Na)-Dissolved (mg/L) | 9.49 | 17.6 | 6.03 | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.452 | 0.711 | 0.233 | |
| | Sulfur (S)-Dissolved (mg/L) | 7.94 | 19.0 | 4.12 | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00048 | <0.00030 | |
| | Uranium (U)-Dissolved (mg/L) | 0.00192 | 0.00255 | 0.000676 | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00055 | <0.00050 | 0.00058 | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1980621-1, -10, -11, -12, -13, -3, -5, -6, -7, -8, -9 |
| Matrix Spike | Chloride (Cl) | MS-B | L1980621-10, -11, -13, -5, -6, -8, -9 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1980621-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1980621-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1980621-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1980621-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1980621-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1980621-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1980621-5 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1980621-5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1980621-5 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1980621-5 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1980621-5 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

| | |
|----|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |
|----|---|

Reference Information

Chain of Custody Numbers:

2017-08-23 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



L1980621-COFC

COC Number: 2017-08-23 C

Page 1 of 2

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

| | | | | | | | | | | | | | | | | | |
|--|--|--|---------------------|--|---|-------------------------------------|------------------------------|--|---|--|---|---------------------------|--------------------------------|--|--|----------------------|---|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Analysis Request | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 2 | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: CH/CP | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM, Hardness | Dissolved Metals (DM) (filtered and preserved | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | Number of Containers | |
| | MN-1.5 | 19-Aug-17 | 14:10 | Water | R | R | R | R | R | R | R | R | R | | | | 7 |
| | UG1 | 20-Aug-17 | 12:50 | Water | R | R | R | R | R | R | R | R | R | | | | 6 |
| | W16 | 21-Aug-17 | 9:00 | Water | R | R | R | R | R | R | R | R | R | | | | 7 |
| | W8A | 21-Aug-17 | 11:00 | Water | R | R | R | R | R | R | R | R | R | | | | 6 |
| | MN-4.5 | 21-Aug-17 | 14:15 | Water | R | R | R | R | R | R | R | R | R | | | | 7 |
| | MN-0.5 | 21-Aug-17 | 15:15 | Water | R | R | R | R | R | R | R | R | R | | | | 7 |
| | MN-2.5 | 21-Aug-17 | 15:50 | Water | R | R | R | R | R | R | R | R | R | | | | 7 |
| | DUP | 19-Aug-17 | | Water | R | R | R | R | R | R | R | R | R | | | | 7 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | |
| | | | | | 4.0 | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Chris Harry | Date: 2017-08-23 8:00 | Time: | Received by: LEHF | Date: 23 Aug 2017 | Time: 15:40 | Received by: Mirkelle | Date: Aug 24 2017 | Time: 11:45 | 3.5°C | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

2c, 12c, 5.5°C



Chain of Custody (COC) / Analytical Request Form



L1980621-COFC

COC Number: 2017-08-23 C

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

| | | | | | | | | | | | | | | | | | |
|--|---|--|---------------------|--------------------|---|-------------------------------------|--|------------------------------------|---|---|---|-----------------------------------|---------------------------------------|-----------------------------|--|--------------------|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | EMERGENCY | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | Analysis Request | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | | Sampler: CH | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | | |
| | W3 | 22-Aug-17 | 9:00 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| | W17 | 22-Aug-17 | 9:30 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| | MC1 | 22-Aug-17 | 13:50 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| | W2 | 22-Aug-17 | 14:50 | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| | DUP | 22-Aug-17 | | Water | R | R | R | R | R | R | R | R | R | 7 | | | |
| Drinking Water (DW) Samples¹ (client use) | | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | |
| | | | | | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | |
| | | | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | | | | | | 4.0 | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | |
| Released by: Chris Harry | | Date: 2017-08-23 8:00 | | Time: | | Received by: <i>GHF</i> | | Date: <i>23 Aug 2017</i> | | Time: <i>15:40</i> | | Received by: <i>Michelle 35°C</i> | | Date: <i>Aug 24, 2017</i> | | Time: <i>11:45</i> | |

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OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

2°C, 12°C, 5:5°C



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 30-AUG-17
Report Date: 11-SEP-17 13:28 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1983900
Project P.O. #: 226973
Job Reference:
C of C Numbers: 2017-08-30 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1983900-1 | L1983900-2 | L1983900-3 |
|-----------------------------|---|---------------------------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 29-AUG-17 | 29-AUG-17 | 29-AUG-17 |
| | | Sampled Time | 10:10 | 10:50 | 12:10 |
| | | Client ID | MC1 | W2 | W3 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 349 | 353 | 516 |
| | Hardness (as CaCO3) (mg/L) | | 175 | 179 | 260 |
| | pH (pH) | | 8.30 | 8.27 | 8.25 |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | | 200 | 203 | 307 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 172 | 172 | 236 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | 3.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 175 | 172 | 236 |
| | Ammonia, Total (as N) (mg/L) | | <0.0050 | <0.0050 | 0.0062 |
| | Chloride (Cl) (mg/L) | | 1.54 | 2.08 | 4.27 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.0717 | 0.0768 | 0.173 |
| | Nitrate (as N) (mg/L) | | 0.0717 | 0.0768 | 0.173 |
| | Nitrite (as N) (mg/L) | | <0.0010 | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 20.8 | 24.4 | 54.2 |
| | Anion Sum (meq/L) | | 3.99 | 4.00 | 5.98 |
| | Cation Sum (meq/L) | | 3.99 | 4.07 | 6.02 |
| | Cation - Anion Balance (%) | | 0.1 | 0.8 | 0.4 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 8.29 | 7.72 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0290 | 0.0047 | 0.0069 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00067 | 0.00039 | 0.00026 |
| | Barium (Ba)-Total (mg/L) | | 0.0679 | 0.0724 | 0.0709 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | <0.010 | <0.010 | 0.026 |
| | Cadmium (Cd)-Total (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Total (mg/L) | | 45.5 | 48.8 | 59.2 |
| | Chromium (Cr)-Total (mg/L) | | 0.00031 | 0.00018 | <0.00010 |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | | 0.00278 | 0.00174 | 0.00285 |
| | Iron (Fe)-Total (mg/L) | | 0.200 | 0.061 | 0.024 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | 0.0015 | 0.0019 | 0.0032 |
| | Magnesium (Mg)-Total (mg/L) | | 16.4 | 15.5 | 28.9 |
| | Manganese (Mn)-Total (mg/L) | | 0.0218 | 0.0192 | 0.0474 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1983900-1 | L1983900-2 | L1983900-3 |
|-------------------------|---------------------------------------|--------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 29-AUG-17 | 29-AUG-17 | 29-AUG-17 |
| | | Sampled Time | 10:10 | 10:50 | 12:10 |
| | | Client ID | MC1 | W2 | W3 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | | 0.00186 | 0.00150 | 0.00502 |
| | Nickel (Ni)-Total (mg/L) | | 0.00098 | 0.00090 | 0.00093 |
| | Phosphorus (P)-Total (mg/L) | | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | | 1.41 | 1.63 | 2.29 |
| | Selenium (Se)-Total (mg/L) | | 0.000136 | 0.000129 | 0.000290 |
| | Silicon (Si)-Total (mg/L) | | 6.49 | 6.22 | 6.38 |
| | Silver (Ag)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | | 10.5 | 10.3 | 18.5 |
| | Strontium (Sr)-Total (mg/L) | | 0.469 | 0.507 | 0.781 |
| | Sulfur (S)-Total (mg/L) | | 6.90 | 8.11 | 18.4 |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | | 0.00129 | <0.00030 | <0.00030 |
| | Uranium (U)-Total (mg/L) | | 0.00159 | 0.00209 | 0.00279 |
| | Vanadium (V)-Total (mg/L) | | 0.00093 | 0.00064 | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | | <0.0030 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0059 | 0.0073 | 0.0024 |
| | Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00059 | 0.00042 | 0.00024 |
| | Barium (Ba)-Dissolved (mg/L) | | 0.0671 | 0.0697 | 0.0694 |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | <0.010 | <0.010 | 0.025 |
| | Cadmium (Cd)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | | 43.9 | 46.4 | 57.6 |
| | Chromium (Cr)-Dissolved (mg/L) | | 0.00019 | 0.00016 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00145 | 0.00167 | 0.00267 |
| | Iron (Fe)-Dissolved (mg/L) | | 0.142 | 0.074 | 0.016 |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | | 0.0016 | 0.0017 | 0.0034 |
| | Magnesium (Mg)-Dissolved (mg/L) | | 15.8 | 15.4 | 28.2 |
| | Manganese (Mn)-Dissolved (mg/L) | | 0.0179 | 0.0203 | 0.0459 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1983900-1 | L1983900-2 | L1983900-3 | | |
|-------------------------|----------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 29-AUG-17 | 29-AUG-17 | 29-AUG-17 | | |
| | | Sampled Time | 10:10 | 10:50 | 12:10 | | |
| | | Client ID | MC1 | W2 | W3 | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00170 | 0.00133 | 0.00490 | | |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00091 | 0.00092 | 0.00089 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | | 1.49 | 1.56 | 2.19 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000122 | 0.000133 | 0.000348 | | |
| | Silicon (Si)-Dissolved (mg/L) | | 6.11 | 5.91 | 6.10 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 10.4 | 10.2 | 17.8 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.458 | 0.475 | 0.771 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 7.11 | 8.55 | 18.8 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.00151 | 0.00200 | 0.00271 | | |
| | Vanadium (V)-Dissolved (mg/L) | | 0.00072 | 0.00058 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0012 | <0.0010 | <0.0010 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1983900-1, -2, -3 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1983900-1, -2, -3 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1983900-2, -3 |
| Matrix Spike | Cadmium (Cd)-Dissolved | MS-B | L1983900-2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1983900-2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1983900-2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1983900-2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1983900-2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1983900-2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1983900-2, -3 |
| Matrix Spike | Zinc (Zn)-Dissolved | MS-B | L1983900-2, -3 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1983900-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1983900-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1983900-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1983900-1, -2, -3 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1983900-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |

Reference Information

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-08-30 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



COC Number: 2017-08-30 A

Page 1 of 1

Canada Toll Free: 1 800 668 9878

L1983900-COFC

www.alsglobal.com

| | | | | | | | | | | | | | | | | | | |
|--|---|--|---------------------------------|-----------------|---|---------------------------------|--|-----------------------------|--|-------------------------|---|---------------------------|--------------------------------|---|--|----------------------|--|---|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | EMERGENCY | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Analysis Request | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | |
| Same as Report To | <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report | <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 2 | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: EB/RH | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Short Holding Time Rush Processing | | Number of Containers | | |
| | MC1 | 29-Aug-17 | 10:10 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| | W2 | 29-Aug-17 | 10:50 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| | W3 | 29-Aug-17 | 12:10 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | 7°C | | | | | | 10 | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | |
| Released by: Chris Harry | Date: 2017-08-30 7:45 | Time: | Received by: <i>[Signature]</i> | Date: Aug 30/17 | Time: 14:33 | Received by: <i>[Signature]</i> | Date: 9/1/17 | Time: 18:30 | | | | | | | | | | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 06-SEP-17
Report Date: 15-SEP-17 17:56 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1986966
Project P.O. #: 226973
Job Reference:
C of C Numbers: 2017-09-06 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1986966-1 | L1986966-2 | L1986966-3 | L1986966-4 | L1986966-5 |
|---|---|---------------------------------|--------------------------|--------------------------|------------|------------|
| | | Water | Water | Water | Water | Water |
| | | 03-SEP-17 | 03-SEP-17 | 03-SEP-17 | 03-SEP-17 | 03-SEP-17 |
| | | 08:35 | 09:15 | 09:30 | 10:15 | 10:55 |
| | | W35 | W14 | W12 | W10 | W33 |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 388 | 2840 | 2660 | 495 | 677 |
| | Hardness (as CaCO3) (mg/L) | 190 | 1120 | 1270 | 228 | 312 |
| | pH (pH) | 7.95 | 8.08 | 7.98 | 7.76 | 7.69 |
| | Total Suspended Solids (mg/L) | 8.0 | 155 | 10.0 | 9.3 | 3.3 |
| | TDS (Calculated) (mg/L) | 227 | 2480 | 2330 | 288 | 423 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 150 | 85.2 | 171 | 191 | 127 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 150 | 85.2 | 171 | 191 | 127 |
| | Ammonia, Total (as N) (mg/L) | 0.0789 | 2.90 | 3.98 | 0.0067 | 0.0114 |
| | Chloride (Cl) (mg/L) | 0.88 | 37.7 | 34.3 | 0.62 | 1.81 |
| | Nitrate and Nitrite (as N) (mg/L) | 6.68 | 25.9 | 18.9 | 15.7 | 40.8 |
| | Nitrate (as N) (mg/L) | 6.67 | 19.9 | 13.1 | 15.6 | 40.7 |
| | Nitrite (as N) (mg/L) | 0.0121 | 6.08 | 5.80 | 0.0121 | 0.0544 |
| | Sulfate (SO4) (mg/L) | 30.5 | 1580 | 1450 | 10.0 | 46.1 |
| | Anion Sum (meq/L) | 4.14 | 37.4 | 35.8 | 5.17 | 6.45 |
| | Cation Sum (meq/L) | 4.27 | 34.3 | 33.4 | 4.99 | 6.76 |
| | Cation - Anion Balance (%) | 1.5 | -4.4 | -3.5 | -1.8 | 2.4 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 19.2 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.507 | 0.363 | 0.149 | 0.0383 | 0.0238 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00035 | 0.00039 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00050 | 0.00055 | 0.00052 | 0.00014 | 0.00041 |
| | Barium (Ba)-Total (mg/L) | 0.108 | 0.176 | 0.112 | 0.222 | 0.152 |
| | Beryllium (Be)-Total (mg/L) | 0.000031 | <0.000040 ^{DLA} | <0.000040 ^{DLA} | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | <0.010 | 0.217 | 0.257 | 0.018 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000266 | <0.00015 ^{DLM} | <0.00020 ^{DLM} | <0.0000050 | 0.0000092 |
| | Calcium (Ca)-Total (mg/L) | 48.2 | 326 | 402 | 71.5 | 77.0 |
| | Chromium (Cr)-Total (mg/L) | 0.00066 | 0.00083 | 0.00025 | <0.00010 | 0.00045 |
| | Cobalt (Co)-Total (mg/L) | 0.00050 | 0.00186 | 0.00141 | 0.00012 | 0.00027 |
| | Copper (Cu)-Total (mg/L) | 0.0697 | 1.03 | 0.131 | 0.00781 | 0.0121 |
| | Iron (Fe)-Total (mg/L) | 0.982 | 0.839 | 0.347 | 0.210 | 0.199 |
| | Lead (Pb)-Total (mg/L) | 0.000187 | 0.00033 | 0.00035 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0011 | 0.0385 | 0.0233 | 0.0011 | <0.0010 |
| | Magnesium (Mg)-Total (mg/L) | 17.5 | 88.0 | 70.0 | 15.3 | 29.5 |
| | Manganese (Mn)-Total (mg/L) | 0.167 | 1.34 | 1.40 | 0.0528 | 0.0837 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1986966-6 | L1986966-7 | L1986966-8 | L1986966-9 | L1986966-10 |
|---|---|------------|------------|--------------------------|-------------------------|-------------|
| | | Water | Water | Water | Water | Water |
| | | 03-SEP-17 | 03-SEP-17 | 03-SEP-17 | 03-SEP-17 | 04-SEP-17 |
| | | 11:20 | 11:40 | 12:00 | | 08:45 |
| | | W30 | W15 | W45 | DUP | W62 |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 422 | 834 | 3170 | 3200 | 1010 |
| | Hardness (as CaCO3) (mg/L) | 194 | 428 | 1420 | 1400 | 479 |
| | pH (pH) | 8.27 | 8.34 | 7.93 | 7.93 | 8.32 |
| | Total Suspended Solids (mg/L) | <3.0 | 9.3 | 139 | 98.7 | 11.3 |
| | TDS (Calculated) (mg/L) | 251 | 544 | 2560 | 2930 | 610 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 126 | 258 | 121 | 121 | 327 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | 7.6 | <1.0 | <1.0 | 7.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 126 | 265 | 121 | 121 | 334 |
| | Ammonia, Total (as N) (mg/L) | 0.0317 | 0.0263 | 5.52 | 6.56 | 0.0091 |
| | Chloride (Cl) (mg/L) | 2.32 | 4.24 | 30.1 | 36.5 | 22.9 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.181 | 9.75 | 22.1 | 26.8 | 5.94 |
| | Nitrate (as N) (mg/L) | 0.178 | 9.73 | 17.7 | 21.5 | 5.89 |
| | Nitrite (as N) (mg/L) | 0.0027 | 0.0180 | 4.37 | 5.31 | 0.0467 |
| | Sulfate (SO4) (mg/L) | 92.1 | 168 | 1560 | 1910 | 164 |
| | Anion Sum (meq/L) | 4.51 | 9.61 | 37.2 | 45.1 | 11.2 |
| | Cation Sum (meq/L) | 4.55 | 9.38 | 39.8 | 39.6 | 10.7 |
| | Cation - Anion Balance (%) | 0.4 | -1.2 | 3.3 | -6.5 | -2.0 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 15.7 | | | 12.8 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0531 | 0.471 | 1.12 | 1.30 | 0.0318 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00021 | 0.00038 | 0.00039 | 0.00012 |
| | Arsenic (As)-Total (mg/L) | 0.00075 | 0.00056 | 0.00061 | 0.00064 | 0.00043 |
| | Barium (Ba)-Total (mg/L) | 0.0700 | 0.109 | 0.150 | 0.157 | 0.109 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | 0.000028 | <0.000040 ^{DLA} | 0.000041 ^{DLA} | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 |
| | Boron (B)-Total (mg/L) | <0.010 | <0.010 | 0.341 ^{DLM} | 0.345 ^{DLM} | 0.023 |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | 0.0000160 | <0.00020 | <0.00020 | 0.0000201 |
| | Calcium (Ca)-Total (mg/L) | 42.6 | 120 | 434 | 439 | 136 |
| | Chromium (Cr)-Total (mg/L) | <0.00010 | 0.00040 | 0.00047 | 0.00188 | 0.00022 |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00034 | 0.00334 | 0.00364 | 0.00016 |
| | Copper (Cu)-Total (mg/L) | 0.0187 | 0.0493 | 0.247 | 0.274 | 0.0508 |
| | Iron (Fe)-Total (mg/L) | 0.141 | 0.842 | 2.45 | 3.00 | 0.079 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.000188 | 0.00261 | 0.00255 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0018 | 0.0013 | 0.0366 | 0.0379 | 0.0026 |
| | Magnesium (Mg)-Total (mg/L) | 21.9 | 34.8 | 93.8 | 97.0 | 41.4 |
| | Manganese (Mn)-Total (mg/L) | 0.0616 | 0.0766 | 2.27 | 2.24 | 0.0602 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1986966-11 | L1986966-12 | L1986966-13 | L1986966-14 | L1986966-15 |
|-----------------------------|---|---------------------------------|-------------|-------------|-------------|-------------|-------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 04-SEP-17 | 04-SEP-17 | 04-SEP-17 | 04-SEP-17 | 04-SEP-17 |
| | | Sampled Time | 09:10 | 09:30 | 09:50 | 10:20 | 13:00 |
| | | Client ID | AMP-1B | W17 | W16 | W8A | W51 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 489 | 488 | 455 | 1250 | 1030 |
| | Hardness (as CaCO3) (mg/L) | | 224 | 225 | 213 | 615 | 447 |
| | pH (pH) | | 8.28 | 8.30 | 8.28 | 8.00 | 8.12 |
| | Total Suspended Solids (mg/L) | | 84.7 | <3.0 | 4.0 | 46.7 | 70.7 |
| | TDS (Calculated) (mg/L) | | 276 | 280 | 268 | 851 | 644 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 214 | 201 | 171 | 393 | 310 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | 3.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 214 | 204 | 171 | 393 | 310 |
| | Ammonia, Total (as N) (mg/L) | | 0.0164 | <0.0050 | 0.0334 | 0.0744 | 1.94 |
| | Chloride (Cl) (mg/L) | | 5.63 | 6.06 | 6.55 | 10.9 | <2.5 |
| | Nitrate and Nitrite (as N) (mg/L) | | <0.0051 | 0.180 | 1.82 | 6.40 | 12.4 |
| | Nitrate (as N) (mg/L) | | <0.0050 | 0.180 | 1.80 | 6.33 | 11.8 |
| | Nitrite (as N) (mg/L) | | <0.0010 | <0.0010 | 0.0174 | 0.0686 | 0.555 |
| | Sulfate (SO4) (mg/L) | | 46.8 | 54.6 | 60.3 | 310 | 224 |
| | Anion Sum (meq/L) | | 5.40 | 5.39 | 4.98 | 15.1 | 11.8 |
| | Cation Sum (meq/L) | | 5.17 | 5.17 | 4.94 | 14.3 | 10.6 |
| | Cation - Anion Balance (%) | | -2.2 | -2.1 | -0.5 | -2.7 | -5.0 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 10.2 | 10.1 | 14.8 | 19.1 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 2.95 | 0.0129 | 0.0445 | 0.565 | 5.24 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | 0.00014 | 0.00011 | 0.00032 | 0.00049 |
| | Arsenic (As)-Total (mg/L) | | 0.00131 | 0.00042 | 0.00047 | 0.00086 | 0.00176 |
| | Barium (Ba)-Total (mg/L) | | 0.155 | 0.0778 | 0.0757 | 0.146 | 0.131 |
| | Beryllium (Be)-Total (mg/L) | | 0.000129 | <0.000020 | <0.000020 | 0.000050 | 0.000196 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.00111 |
| | Boron (B)-Total (mg/L) | | 0.032 | 0.030 | 0.029 | 0.029 | 0.101 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000621 | 0.0000333 | 0.0000438 | 0.000136 | 0.000261 |
| | Calcium (Ca)-Total (mg/L) | | 66.4 | 62.8 | 59.2 | 179 | 82.3 |
| | Chromium (Cr)-Total (mg/L) | | 0.00213 | 0.00018 | 0.00017 | 0.00111 | 0.00187 |
| | Cobalt (Co)-Total (mg/L) | | 0.00260 | <0.00010 | <0.00010 | 0.00104 | 0.00366 |
| | Copper (Cu)-Total (mg/L) | | 0.0831 | 0.00899 | 0.0301 | 0.220 | 5.17 |
| | Iron (Fe)-Total (mg/L) | | 4.56 | 0.018 | 0.136 | 2.44 | 15.6 |
| | Lead (Pb)-Total (mg/L) | | 0.000897 | <0.000050 | <0.000050 | 0.000376 | 0.00342 |
| | Lithium (Li)-Total (mg/L) | | 0.0035 | 0.0012 | 0.0013 | 0.0041 | 0.0144 |
| | Magnesium (Mg)-Total (mg/L) | | 21.2 | 19.3 | 18.1 | 48.9 | 67.8 |
| | Manganese (Mn)-Total (mg/L) | | 0.928 | 0.00771 | 0.0514 | 1.62 | 0.503 |

DLDS

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1986966-16 | L1986966-17 | L1986966-18 | L1986966-19 |
|-----------------------------|---|---------------------------------|-------------|-------------|-------------|-------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 04-SEP-17 | 05-SEP-17 | 05-SEP-17 | 05-SEP-17 |
| | | Sampled Time | | 07:40 | 08:35 | 09:10 |
| | | Client ID | DUP | W3 | MC1 | W2 |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 1220 | 549 | 374 | 375 |
| | Hardness (as CaCO3) (mg/L) | | 615 | 261 | 179 | 179 |
| | pH (pH) | | 8.05 | 8.35 | 8.37 | 8.34 |
| | Total Suspended Solids (mg/L) | | 31.3 | <3.0 | 4.7 | 8.7 |
| | TDS (Calculated) (mg/L) | | 847 | 316 | 206 | 210 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 384 | 239 | 179 | 178 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | 7.4 | 6.2 | 4.8 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 384 | 247 | 185 | 183 |
| | Ammonia, Total (as N) (mg/L) | | 0.0984 | <0.0050 | <0.0050 | 0.0091 |
| | Chloride (Cl) (mg/L) | | 11.0 | 4.46 | 1.60 | 2.14 |
| | Nitrate and Nitrite (as N) (mg/L) | | 6.46 | 0.326 | 0.0246 | 0.0286 |
| | Nitrate (as N) (mg/L) | | 6.39 | 0.326 | 0.0246 | 0.0286 |
| | Nitrite (as N) (mg/L) | | 0.0715 | <0.0010 | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 312 | 55.3 | 20.9 | 24.4 |
| | Anion Sum (meq/L) | | 14.9 | 6.23 | 4.17 | 4.22 |
| | Cation Sum (meq/L) | | 14.3 | 6.09 | 4.07 | 4.08 |
| | Cation - Anion Balance (%) | | -2.4 | -1.2 | -1.3 | -1.7 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 19.8 | 6.38 | 9.10 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.900 | 0.0057 | 0.0187 | 0.120 |
| | Antimony (Sb)-Total (mg/L) | | 0.00035 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00108 | 0.00027 | 0.00057 | 0.00048 |
| | Barium (Ba)-Total (mg/L) | | 0.159 | 0.0700 | 0.0684 | 0.0736 |
| | Beryllium (Be)-Total (mg/L) | | 0.000059 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.030 | 0.026 | <0.010 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | | 0.000157 | <0.0000050 | <0.0000050 | 0.0000059 |
| | Calcium (Ca)-Total (mg/L) | | 181 | 57.6 | 46.5 | 47.7 |
| | Chromium (Cr)-Total (mg/L) | | 0.00125 | 0.00012 | 0.00024 | 0.00039 |
| | Cobalt (Co)-Total (mg/L) | | 0.00126 | <0.00010 | <0.00010 | 0.00012 |
| | Copper (Cu)-Total (mg/L) | | 0.353 | 0.00301 | 0.00174 | 0.00279 |
| | Iron (Fe)-Total (mg/L) | | 4.62 | 0.025 | 0.152 | 0.532 |
| | Lead (Pb)-Total (mg/L) | | 0.000603 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | 0.0042 | 0.0031 | 0.0015 | 0.0018 |
| | Magnesium (Mg)-Total (mg/L) | | 50.2 | 29.7 | 17.4 | 16.7 |
| | Manganese (Mn)-Total (mg/L) | | 1.68 | 0.0491 | 0.0152 | 0.0253 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

15-SEP-17 17:56 (MT)

Version: FINAL

| Sample ID Description Sampled Date Sampled Time Client ID | L1986966-1 Water 03-SEP-17 08:35 W35 | L1986966-2 Water 03-SEP-17 09:15 W14 | L1986966-3 Water 03-SEP-17 09:30 W12 | L1986966-4 Water 03-SEP-17 10:15 W10 | L1986966-5 Water 03-SEP-17 10:55 W33 | |
|---|--|--|--|--|--|------------------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | 0.0000298 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00114 | 0.146 | 0.0871 | 0.000776 | 0.000751 |
| | Nickel (Ni)-Total (mg/L) | 0.00170 | 0.0023 ^{DLA} | 0.0044 ^{DLA} | <0.00050 | 0.00154 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.10 ^{DLA} | <0.10 ^{DLA} | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 1.04 | 83.6 | 57.1 | 1.87 | 0.85 |
| | Selenium (Se)-Total (mg/L) | 0.000153 | 0.0185 | 0.0136 | 0.000171 | 0.000383 |
| | Silicon (Si)-Total (mg/L) | 6.49 | 3.91 | 4.03 | 3.35 | 6.48 |
| | Silver (Ag)-Total (mg/L) | 0.000015 | 0.000057 | 0.000044 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 10.1 | 226 | 147 | 9.61 | 11.1 |
| | Strontium (Sr)-Total (mg/L) | 0.349 | 5.45 | 7.14 | 0.452 | 0.559 |
| | Sulfur (S)-Total (mg/L) | 10.7 | 576 | 511 | 3.91 | 17.0 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.0241 | 0.0157 | 0.00681 | 0.00183 | <0.0012 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.000260 | 0.00943 | 0.00761 ^{DLA} | 0.000330 | 0.000094 |
| | Vanadium (V)-Total (mg/L) | 0.00237 | 0.0016 | <0.0010 ^{DLA} | <0.00050 | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | 0.0069 | 0.0063 | 0.0159 | 0.0036 | 0.0058 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | 0.00039 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0134 | 0.0329 | 0.0077 | 0.0027 | 0.0194 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00026 | 0.00027 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00034 | 0.00043 | 0.00048 | <0.00010 | 0.00040 |
| | Barium (Ba)-Dissolved (mg/L) | 0.105 | 0.198 ^{DLA} | 0.115 ^{DLA} | 0.210 | 0.161 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000040 ^{DLA} | <0.000040 ^{DLA} | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.203 ^{DLM} | 0.244 ^{DLM} | 0.016 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000182 | <0.00011 ^{DLA} | <0.00018 ^{DLA} | <0.0000050 | 0.0000078 |
| | Calcium (Ca)-Dissolved (mg/L) | 47.9 | 313 ^{DLA} | 397 ^{DLA} | 68.9 | 77.7 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00032 | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | 0.00043 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00018 | 0.00151 | 0.00128 | <0.00010 | 0.00028 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0262 | 0.0124 ^{DLA} | 0.0389 ^{DLA} | 0.00310 | 0.00965 |
| | Iron (Fe)-Dissolved (mg/L) | 0.062 | <0.020 ^{DLA} | <0.020 ^{DLA} | 0.013 | 0.150 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0011 | 0.0357 | 0.0222 | <0.0010 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | 17.1 | 82.6 | 66.7 | 13.7 | 28.7 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.127 | 1.37 | 1.43 | 0.00934 | 0.0867 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

15-SEP-17 17:56 (MT)

Version: FINAL

| Sample ID Description Sampled Date Sampled Time Client ID | L1986966-6 Water 03-SEP-17 11:20 W30 | L1986966-7 Water 03-SEP-17 11:40 W15 | L1986966-8 Water 03-SEP-17 12:00 W45 | L1986966-9 Water 03-SEP-17 DUP | L1986966-10 Water 04-SEP-17 08:45 W62 | |
|---|--|--|--|---|---|------------------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00177 | 0.00363 | 0.111 | 0.112 | 0.00667 |
| | Nickel (Ni)-Total (mg/L) | 0.00050 | 0.00113 | 0.0192 | 0.0390 | 0.00101 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.056 | <0.10 ^{DLA} | <0.10 ^{DLA} | <0.050 |
| | Potassium (K)-Total (mg/L) | 3.13 | 3.96 | 81.5 | 82.7 | 5.03 |
| | Selenium (Se)-Total (mg/L) | 0.000853 | 0.00197 | 0.0160 | 0.0164 | 0.00325 |
| | Silicon (Si)-Total (mg/L) | 0.55 | 5.23 | 5.79 | 6.16 | 7.68 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000010 | 0.000048 | 0.000058 | 0.000010 |
| | Sodium (Na)-Total (mg/L) | 13.4 | 17.0 | 206 | 205 | 26.7 |
| | Strontium (Sr)-Total (mg/L) | 0.483 | 1.11 | 6.61 | 6.73 | 1.50 |
| | Sulfur (S)-Total (mg/L) | 34.1 | 62.6 | 639 | 669 | 66.0 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | 0.000026 | 0.000028 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | 0.00042 | 0.00109 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.00232 | 0.0291 | 0.0677 | 0.0755 | <0.0018 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.000444 | 0.00374 | 0.00819 | 0.00834 | 0.00472 |
| | Vanadium (V)-Total (mg/L) | 0.00056 | 0.00201 | 0.0044 | 0.0050 | 0.00077 |
| | Zinc (Zn)-Total (mg/L) | 0.0034 | 0.0050 | 0.0126 | 0.0175 | 0.0612 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0055 | 0.0068 | 0.0114 | 0.0130 | 0.0022 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00012 | 0.00029 | 0.00028 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00077 | 0.00045 | 0.00039 | 0.00039 | 0.00036 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0781 | 0.108 | 0.139 | 0.140 | 0.105 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000040 ^{DLA} | <0.000040 ^{DLA} | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | 0.332 | 0.328 | 0.021 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000077 | <0.00015 | <0.00015 ^{DLM} | 0.0000145 |
| | Calcium (Ca)-Dissolved (mg/L) | 41.3 | 115 | 421 | 412 | 131 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00016 | <0.00020 ^{DLA} | <0.00020 ^{DLA} | 0.00016 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00012 | 0.00272 | 0.00268 | 0.00013 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0129 | 0.0211 | 0.0128 | 0.0116 | 0.0422 |
| | Iron (Fe)-Dissolved (mg/L) | 0.045 | 0.079 | 0.172 | 0.143 | 0.023 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0014 | 0.0010 | 0.0350 | 0.0343 | 0.0026 |
| | Magnesium (Mg)-Dissolved (mg/L) | 22.0 | 33.8 | 89.1 | 89.9 | 36.5 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0220 | 0.0556 | 2.25 | 2.27 | 0.0574 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1986966-11 Water 04-SEP-17 09:10 AMP-1B | L1986966-12 Water 04-SEP-17 09:30 W17 | L1986966-13 Water 04-SEP-17 09:50 W16 | L1986966-14 Water 04-SEP-17 10:20 W8A | L1986966-15 Water 04-SEP-17 13:00 W51 |
|---|---------------------------------------|--|---|---|---|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000060 | <0.000025 ^{DLM} |
| | Molybdenum (Mo)-Total (mg/L) | 0.00510 | 0.00561 | 0.00318 | 0.0144 | 0.0342 |
| | Nickel (Ni)-Total (mg/L) | 0.00475 | 0.00073 | 0.00087 | 0.00167 | 0.00176 |
| | Phosphorus (P)-Total (mg/L) | 0.173 | <0.050 | <0.050 | 0.133 | 0.649 |
| | Potassium (K)-Total (mg/L) | 3.59 | 3.80 | 3.01 | 6.96 | 9.19 |
| | Selenium (Se)-Total (mg/L) | 0.000181 | 0.000382 | 0.000684 | 0.00981 | 0.00324 |
| | Silicon (Si)-Total (mg/L) | 12.2 | 5.22 | 3.36 | 8.49 | 16.2 |
| | Silver (Ag)-Total (mg/L) | 0.000030 | <0.000010 | <0.000010 | 0.000082 | 0.00226 |
| | Sodium (Na)-Total (mg/L) | 16.0 | 15.1 | 14.0 | 44.5 | 31.7 |
| | Strontium (Sr)-Total (mg/L) | 0.578 | 0.658 | 0.593 | 2.21 | 2.20 |
| | Sulfur (S)-Total (mg/L) | 16.9 | 19.7 | 22.1 | 120 | 76.1 |
| | Thallium (Tl)-Total (mg/L) | 0.000022 | <0.000010 | <0.000010 | 0.000011 | 0.000134 |
| | Tin (Sn)-Total (mg/L) | 0.00011 | <0.00010 | <0.00010 | <0.00010 | 0.00030 |
| | Titanium (Ti)-Total (mg/L) | 0.125 | 0.00066 | 0.00211 | 0.0260 | 0.345 |
| | Uranium (U)-Total (mg/L) | 0.00221 | 0.00207 | 0.00131 | 0.00362 | 0.00672 |
| | Vanadium (V)-Total (mg/L) | 0.00972 | 0.00058 | 0.00068 | 0.00366 | 0.0247 |
| | Zinc (Zn)-Total (mg/L) | 0.0229 | 0.0069 | 0.0035 | 0.692 | 0.0566 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00037 | 0.00074 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0022 | 0.0013 | 0.0061 | 0.0066 | 0.0045 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.00045 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00031 | 0.00035 | 0.00043 | 0.00048 | 0.00083 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0703 | 0.0707 | 0.0759 | 0.138 | 0.0238 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.030 | 0.030 | 0.028 | 0.030 | 0.101 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000114 | 0.0000485 | 0.000138 | <0.000050 ^{DLM} |
| | Calcium (Ca)-Dissolved (mg/L) | 61.4 | 62.3 | 57.2 | 172 | 74.7 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00013 | 0.00027 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00086 | 0.00027 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00382 | 0.00634 | 0.0268 | 0.0683 | 0.0354 |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | <0.010 | 0.047 | 0.272 | <0.010 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0015 | 0.0014 | 0.0012 | 0.0040 | 0.0120 |
| | Magnesium (Mg)-Dissolved (mg/L) | 17.1 | 16.8 | 17.1 | 45.1 | 63.1 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00356 | 0.00113 | 0.0220 | 1.97 | 0.107 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1986966-16 Water 04-SEP-17 DUP | L1986966-17 Water 05-SEP-17 07:40 W3 | L1986966-18 Water 05-SEP-17 08:35 MC1 | L1986966-19 Water 05-SEP-17 09:10 W2 |
|---|---------------------------------------|--|--|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | 0.0000067 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.0141 | 0.00485 | 0.00188 | 0.00154 |
| | Nickel (Ni)-Total (mg/L) | 0.00175 | 0.00103 | 0.00099 | 0.00114 |
| | Phosphorus (P)-Total (mg/L) | 0.213 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 7.10 | 2.42 | 1.57 | 1.86 |
| | Selenium (Se)-Total (mg/L) | 0.00968 | 0.000326 | 0.000118 | 0.000134 |
| | Silicon (Si)-Total (mg/L) | 9.02 | 6.11 | 6.36 | 6.10 |
| | Silver (Ag)-Total (mg/L) | 0.000158 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 44.3 | 19.1 | 10.9 | 10.9 |
| | Strontium (Sr)-Total (mg/L) | 2.23 | 0.788 | 0.488 | 0.502 |
| | Sulfur (S)-Total (mg/L) | 117 | 19.8 | 7.49 | 8.77 |
| | Thallium (Tl)-Total (mg/L) | 0.000016 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | 0.00012 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.0499 | <0.00030 | <0.0012 ^{DLM} | 0.00488 |
| | Uranium (U)-Total (mg/L) | 0.00372 | 0.00286 | 0.00170 | 0.00212 |
| | Vanadium (V)-Total (mg/L) | 0.00552 | 0.00050 | 0.00089 | 0.00098 |
| | Zinc (Zn)-Total (mg/L) | 0.938 | <0.0030 | <0.0030 | 0.0108 |
| | Zirconium (Zr)-Total (mg/L) | 0.00040 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0062 | 0.0024 | 0.0042 | 0.0034 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00050 | 0.00025 | 0.00054 | 0.00041 |
| | Barium (Ba)-Dissolved (mg/L) | 0.139 | 0.0715 | 0.0660 | 0.0750 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.031 | 0.025 | <0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000124 | <0.0000050 | <0.0000050 | 0.0000051 |
| | Calcium (Ca)-Dissolved (mg/L) | 173 | 56.4 | 44.6 | 46.1 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00027 | <0.00010 | 0.00017 | 0.00015 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00086 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0666 | 0.00276 | 0.00148 | 0.00166 |
| | Iron (Fe)-Dissolved (mg/L) | 0.251 | 0.019 | 0.108 | 0.052 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0040 | 0.0032 | 0.0016 | 0.0018 |
| | Magnesium (Mg)-Dissolved (mg/L) | 44.4 | 29.1 | 16.3 | 15.6 |
| | Manganese (Mn)-Dissolved (mg/L) | 1.95 | 0.0476 | 0.0135 | 0.0167 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1986966-1 | L1986966-2 | L1986966-3 | L1986966-4 | L1986966-5 |
|-------------------------|----------------------------------|-------------------------|--------------------------|--------------------------|------------|-------------------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 03-SEP-17 | 08:35 | W35 | 03-SEP-17 | 03-SEP-17 | 03-SEP-17 | 03-SEP-17 | 03-SEP-17 |
| | | | | | 09:15 | 09:15 | 09:30 | 10:15 | 10:55 |
| | | | | | W14 | W14 | W12 | W10 | W33 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00106 | 0.139 | 0.0847 | 0.000697 | 0.000673 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00139 | 0.0021 | 0.0040 | <0.00050 | 0.00148 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.10 ^{DLA} | <0.10 ^{DLA} | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 0.93 | 94.0 | 65.4 | 1.76 | 0.85 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000140 | 0.0178 | 0.0131 | 0.000155 | 0.000429 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.45 | 3.04 | 3.68 | 3.14 | 6.38 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 9.83 | 212 | 140 | 8.65 | 11.2 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.340 | 5.15 | 7.06 | 0.438 | 0.566 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 10.0 | 518 | 477 | 3.34 | 15.3 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 ^{DLM} | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLM} | <0.00060 ^{DLA} | <0.00060 ^{DLA} | <0.00030 | <0.00090 ^{DLM} | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000217 | 0.00862 | 0.00708 | 0.000302 | 0.000084 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00058 | <0.0010 ^{DLA} | <0.0010 ^{DLA} | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0015 | <0.0020 ^{DLA} | 0.0073 | <0.0010 | 0.0014 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | 0.00040 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1986966-6 | L1986966-7 | L1986966-8 | L1986966-9 | L1986966-10 |
|-------------------------|----------------------------------|--------------|-------------------------|--------------------------|--------------------------|------------|------------|------------|-------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 03-SEP-17 | 11:20 | W30 | 03-SEP-17 | 03-SEP-17 | 03-SEP-17 | 03-SEP-17 | 04-SEP-17 |
| | | | | | | | | DUP | 08:45 |
| | | | | | | | | | W62 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00153 | 0.00315 | 0.106 | 0.105 | 0.00597 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | 0.00091 | 0.0059 | 0.0063 | 0.00088 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.10 ^{DLA} | <0.10 ^{DLA} | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 3.52 | 4.09 | 89.0 | 90.3 | 5.05 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000903 | 0.00204 | 0.0147 | 0.0152 | 0.00341 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 0.417 | 4.27 | 3.61 | 3.64 | 7.04 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 13.4 | 16.6 | 199 | 201 | 23.7 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.461 | 1.05 | 6.47 | 6.34 | 1.44 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 31.6 | 58.3 | 597 | 604 | 56.9 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00090 ^{DLM} | <0.00060 ^{DLA} | <0.00060 ^{DLA} | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000366 | 0.00311 | 0.00761 | 0.00741 | 0.00425 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.0010 ^{DLA} | <0.0010 ^{DLA} | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0020 ^{DLA} | 0.0021 | 0.0484 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1986966-11 | L1986966-12 | L1986966-13 | L1986966-14 | L1986966-15 |
|-------------------------|----------------------------------|--------------|--------------|------------|-------------|-------------|-------------|-------------|-------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 04-SEP-17 | 09:10 | AMP-1B | 04-SEP-17 | 04-SEP-17 | 04-SEP-17 | 04-SEP-17 | 04-SEP-17 |
| | | | | | 09:30 | 09:30 | 09:50 | 10:20 | 13:00 |
| | | | | | W17 | W17 | W16 | W8A | W51 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00579 | 0.00527 | 0.00283 | 0.0121 | 0.0333 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00123 | 0.00057 | 0.00076 | 0.00134 | <0.00050 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.99 | 3.75 | 3.07 | 6.97 | 7.73 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000144 | 0.000394 | 0.000673 | 0.00871 | 0.00319 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.12 | 4.88 | 3.16 | 7.20 | 6.73 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | 0.000014 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 14.3 | 13.4 | 13.4 | 39.6 | 31.4 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.543 | 0.667 | 0.571 | 2.23 | 2.11 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 14.8 | 17.1 | 20.1 | 96.2 | 70.5 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00043 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00171 | 0.00184 | 0.00118 | 0.00336 | 0.00601 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00098 | 0.00066 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | 0.0020 | 0.125 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | 0.00039 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1986966-16 | L1986966-17 | L1986966-18 | L1986966-19 |
|-------------------------|----------------------------------|-------------------------|--------------|------------|-------------|-------------|-------------|-------------|
| | | | | | Water | Water | Water | Water |
| | | 04-SEP-17 | | | 04-SEP-17 | 05-SEP-17 | 05-SEP-17 | 05-SEP-17 |
| | | | | | DUP | 07:40 | 08:35 | 09:10 |
| | | | | | | W3 | MC1 | W2 |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0123 | 0.00449 | 0.00167 | 0.00139 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00127 | 0.00092 | 0.00091 | 0.00089 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 6.93 | 2.54 | 1.54 | 1.86 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00802 | 0.000312 | 0.000129 | 0.000116 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.60 | 6.28 | 6.32 | 5.93 | | | |
| | Silver (Ag)-Dissolved (mg/L) | 0.000013 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 38.9 | 18.6 | 10.4 | 10.3 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 2.24 | 0.765 | 0.468 | 0.484 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 87.2 | 19.0 | 6.96 | 8.01 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLM} | <0.00030 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00337 | 0.00255 | 0.00152 | 0.00195 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00100 | <0.00050 | 0.00073 | 0.00059 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.123 | <0.0010 | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00039 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1986966-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -7 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1986966-12, -13, -14, -2 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1986966-12, -13, -14, -2 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1986966-12, -13, -14, -2 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1986966-12, -13, -14, -2 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1986966-12, -13, -14, -2 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1986966-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1986966-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1986966-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1986966-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1986966-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1986966-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|---|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". | | | |
| The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-MAN-WR | Water | Total Suspended Solids by Gravimetric | APHA 2540 D |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Reference Information

VA

Chain of Custody Numbers:

2017-09-06 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form



L1986966-COFC

COC Number: 2017-09-06 A

Page 1 of 2

ALS Environmental

Canada Toll Free: 1 800 668 9878

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| | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|--|--------------------|---|--|--|------------------------------|--|-------------------------|--|---------------------------|--------------------------------|----------------------|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | | 1 Business day [E1] <input type="checkbox"/> | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: dd-mm-yy hh:mm | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | Requisitioner: | | Location: | | | | | | | | | | | | | |
| LSD: | | ALS Contact: Shane Stack | | Sampler: | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (1) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | |
| W35 | | | | 3-Sep-17 | 8:35 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| W14 | | | | 3-Sep-17 | 9:15 | | R | R | R | R | R | R | R | R | R | 6 | |
| W12 | | | | 3-Sep-17 | 9:30 | | R | R | R | R | R | R | R | R | R | 6 | |
| W10 | | | | 3-Sep-17 | 10:15 | | R | R | R | R | R | R | R | R | R | 6 | |
| W33 | | | | 3-Sep-17 | 10:55 | | R | R | R | R | R | R | R | R | R | 6 | |
| W30 | | | | 3-Sep-17 | 11:20 | | R | R | R | R | R | R | R | R | R | 6 | |
| W15 | | | | 3-Sep-17 | 11:40 | | R | R | R | R | R | R | R | R | R | 7 | |
| W45 | | | | 3-Sep-17 | 12:00 | | R | R | R | R | R | R | R | R | R | 6 | |
| DUP | | | | 3-Sep-17 | | | R | R | R | R | R | R | R | R | R | 6 | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | 6°C | | | | | 8.4 | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Emilia Bouchard | | Date: September 6th, 2017 | | Time: | | Received by: | | Date: Sept 6/17 | | Time: 14:31 | | Received by: | | Date: Sept. 7 | | Time: 1600 | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 (REV)

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form



L1986966-COFC

COC Number: 2017-09-06 A

Page 2 of 2

ALS Environmental

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| | | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|--|---------------------------------|---------------------|--|--------------------|--|--|---------------------------------|--|---------------|--|------------|--|--|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | Priority (Business days) | | | | | EMERGENCY | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 4 day [P4] <input type="checkbox"/> | | | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | 3 day [P3] <input type="checkbox"/> | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only): | | ALS Contact: Shane Stack | | | Sampler: | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | | Time (hh:mm) | | Sample Type | | | | | | | | | | | |
| W62 | | | | | 4-Sep-17 | | 8:45 | | Water | | | | | | | | | | | |
| AMP-1B | | | | | 4-Sep-17 | | 9:10 | | | | | | | | | | | | | |
| W17 | | | | | 4-Sep-17 | | 9:30 | | | | | | | | | | | | | |
| W16 | | | | | 4-Sep-17 | | 9:50 | | | | | | | | | | | | | |
| W8A | | | | | 4-Sep-17 | | 10:20 | | | | | | | | | | | | | |
| W51 | | | | | 4-Sep-17 | | 13:00 | | | | | | | | | | | | | |
| DUP | | | | | 4-Sep-17 | | | | | | | | | | | | | | | |
| W3 | | | | | 5-Sep-17 | | 7:40 | | | | | | | | | | | | | |
| MC1 | | | | | 5-Sep-17 | | 8:35 | | | | | | | | | | | | | |
| W2 | | | | | 5-Sep-17 | | 9:10 | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | |
| | | | | | 10°C | | | | | 8.4 | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | |
| Released by: Emilie Bouchard | | Date: September 6, 2017 | | Time: | | Received by: <i>(Signature)</i> | | Date: Sept 6/17 | | Time: 14:31 | | Received by: <i>(Signature)</i> | | Date: Sept. 7 | | Time: 1600 | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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OCTOBER 2015 FRONT



L1986966-COFC

ALS Burnaby – Login Instruction Sheet

Please login in the analyses listed on the Client Chain-of-Custody with the noted Whitehorse (WR) products where sub-samples were taken and retained for analysis.

L1986966
ALS# ~~1986964~~

| Sample # | Anions-All-IC-WR | TSS-Man (or low)-WR * | -L-IC-N-WR ** | -L-IC-N-WR ** | -L-IC-N-WR ** | SO4-IC-WR | Additional information *Use TSS Man or Low as needed based on Client/Quote information (**Enter single anions; Br, F, Cl, NO3, NO2) |
|----------|------------------|-----------------------|---------------|---------------|---------------|-----------|---|
| 1 | X | X | | | | | |
| 2 | X | X | | | | | |
| 3 | X | X | | | | | |
| 4 | X | X | | | | | |
| 5 | X | X | | | | | |
| 6 | X | X | | | | | |
| 7 | X | X | | | | | |
| 8 | X | X | | | | | |
| 9 | X | X | | | | | |
| 10 | X | X | | | | | |
| 11 | X | X | | | | | |
| 12 | X | X | | | | | |
| 13 | X | X | | | | | |
| 14 | X | X | | | | | |
| 15 | X | X | | | | | |
| 16 | X | X | | | | | |
| 17 | X | X | | | | | |
| 18 | X | X | | | | | |
| 19 | X | X | | | | | |
| 20 | | | | | | | |
| 21 | | | | | | | |
| 22 | | | | | | | |
| 23 | | | | | | | |
| 24 | | | | | | | |

Please contact ALS Whitehorse at 1-867-668-6689 if you have any questions. Thanks.



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 13-SEP-17
Report Date: 07-NOV-17 13:26 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1990955
Project P.O. #: 224159 (MMER)
Job Reference:
C of C Numbers: 2017-09-13 B
Legal Site Desc:

Comments: Please note, the Nautilus report for Ceriodaphnia dubia and 72-h P. subcapitata growth can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | | | | |
|---|---------|--|--|--|--|
| Grouping | Analyte | | | | |
| | | | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|------------------|--------------------|
|---------------|--------|------------------|--------------------|

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

Chain of Custody Numbers:

2017-09-13 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Toxicity testing for L1990955-1 W3

Sample collected on Sept 12, 2017

Final Report

November 1, 2017

Submitted to: **ALS Environmental**
Burnaby, BC

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APPENDIX C – Chain-of-Custody Forms

SIGNATURE PAGE

Report By:
Jillian Sones, BAS.
Laboratory Biologist



Reviewed By:
Armando Tang, R.P. Bio
Laboratory Manager

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

SUMMARY

Sample Information and Test Type

| | |
|----------------------------|--|
| Sample ID | L1990955-1 W3 |
| Sample collection date | September 12, 2017 |
| Sample receipt date | September 14, 2017 |
| Sample receipt temperature | 9.5°C |
| Test types | <i>Ceriodaphnia dubia</i> survival and reproduction 72-h <i>Pseudokirchneriella subcapitata</i> growth inhibition |

Summary of Results

| Endpoint | % v/v (95% CL) |
|--|----------------|
| <i>Ceriodaphnia dubia</i> | |
| Survival LC50 | >100 |
| Reproduction IC25 | >100 |
| Reproduction IC50 | >100 |
| <i>Pseudokirchneriella subcapitata</i> | |
| Growth IC25 | >95.2 |
| Growth IC50 | >95.2 |

LC = Lethal Concentration, IC = Inhibition Concentration, CL = Confidence Limits

1.0 INTRODUCTION

Nautilus Environmental Company Inc. conducted sub-lethal toxicity tests for ALS Environmental. Sample L1990955-1 W3 was collected on September 12, 2017 and delivered to the Nautilus Environmental laboratory in Burnaby, BC on September 14, 2017. Testing was initiated on September 14, 2017 for *C. dubia* and *P. subcapitata*. The sample was transported in eight 1-L plastic containers and was received at a temperature of 9.5°C. The sample was stored in the dark at $4 \pm 2^\circ\text{C}$ prior to testing. The following toxicity tests were performed on the sample:

- *Ceriodaphnia dubia* survival and reproduction
- 72-h *Pseudokirchneriella subcapitata* growth inhibition

This report describes the results of these toxicity tests. Copies of raw laboratory data sheets and statistical analyses for each test species are provided in Appendices A and B. The chain-of-custody form is provided in Appendix C.

2.0 METHODS

Methods for the toxicity tests are summarized in Tables 1 and 2. Testing using *C. dubia*, and *P. subcapitata* were conducted according to procedures described by Environment Canada (2007a and 2007b). Statistical analyses for all the tests were performed using CETIS (Tidepool Scientific Software, 2013).

Table 1. Summary of test conditions: *Ceriodaphnia dubia* survival and reproduction test.

| | |
|--|---|
| Test species | <i>Ceriodaphnia dubia</i> |
| Organism source | In-house culture |
| Organism age | <24 hour old neonates, produced within a 12 hour window |
| Test type | Static-renewal |
| Test duration | 7 ± 1 day |
| Test vessel | 20-mL glass test tube |
| Test volume | 15 mL |
| Test solution depth | 10 cm |
| Test concentrations | Seven concentrations, plus laboratory control |
| Test replicates | 10 per treatment |
| Number of organisms | 1 per replicate |
| Control/dilution water | 20% Perrier water and 80% deionized water + 5 µg/L Se and 2 µg/L vitamin B12 |
| Test solution renewal | Daily (100% renewal) |
| Test temperature | 25 ± 1°C |
| Feeding | Daily with <i>Pseudokirchneriella subcapitata</i> and YCT (3:1 ratio) |
| Light intensity | 100 to 600 lux at water surface |
| Photoperiod | 16 hours light / 8 hours dark |
| Aeration | None |
| Test measurements | Temperature, dissolved oxygen, pH and conductivity measured daily; hardness and alkalinity of undiluted sample measured at test initiation; survival and reproduction checked daily |
| Test protocol | Environment Canada (2007a), EPS 1/RM/21 |
| Statistical software | CETIS Version 1.8.7 |
| Test endpoints | Survival and reproduction ≥80% survival; ≥15 young per surviving control producing three broods; ≥60% of controls producing three or more broods; no ephippia present |
| Test acceptability criteria for controls | |
| Reference toxicant | Sodium chloride (NaCl) |

Table 2. Summary of test conditions: *Pseudokirchneriella subcapitata* growth inhibition test.

| | |
|---|--|
| Test species | <i>Lemna minor</i> , strain CPCC# 490 |
| Organism source | In-house axenic culture, obtained from Canadian Phycological Culture Centre, and originally isolated from Wainfleet, Stinking Barn, Niagara Peninsula, Ontario, Canada |
| Organism age | 7- to 10-day old culture |
| Test type | Static |
| Test duration | 7 days |
| Test vessel | 250-mL glass container |
| Test volume | 100 mL |
| Test solution depth | 4 cm |
| Test concentrations | Seven concentrations, plus laboratory control |
| Test replicates | 4 per treatment |
| Number of organisms | Two 3-frond plants per replicate |
| Control/dilution water | Modified APHA media (deionized water plus 1% of each APHA stock solution A, B and C) |
| Test solution renewal | None |
| Test temperature | 25 ± 2°C |
| Feeding | None |
| Light intensity | 4000 to 5600 lux |
| Photoperiod | 24 hours light |
| Aeration | None |
| Test measurements | Test area temperature measured daily; temperature, pH and conductivity measured in all concentrations at test initiation; dissolved oxygen of highest concentration measured at test initiation; temperature and pH measured at test termination |
| Test protocol | Environment Canada (2007b), EPS 1/RM/37 |
| Statistical software | CETIS Version 1.8.7 |
| Test endpoints | Number of fronds and dry weight |
| Test acceptability criterion for controls | ≥ 8-fold increase in number of fronds |
| Reference toxicant | Potassium chloride (KCl) |

3.0 RESULTS

Results of the toxicity tests are summarized in Tables 3 and 4. There were no adverse effects observed on survival and reproduction of *C. dubia* (Table 3), or cell yield of *P. subcapitata* (Table 4). The LC and IC values were therefore greater than the highest test concentration for each of these endpoints in the toxicity tests. Stimulatory effects were observed for *P. subcapitata* cell yield; percent stimulation ranged from 6.72 to 363.9%.

Table 3. Results: *Ceriodaphnia dubia* survival and reproduction test.

| Concentration (% v/v) | Survival (%) | Reproduction (Mean ± SD) |
|------------------------------|--------------|--------------------------|
| Laboratory Control | 100 | 18.3 ± 11.5 |
| 1.56 | 100 | 18.1 ± 7.5 |
| 3.12 | 100 | 23.4 ± 4.1 |
| 6.25 | 100 | 21.0 ± 8.4 |
| 12.5 | 90 | 21.8 ± 8.6 |
| 25 | 100 | 22.0 ± 12.5 |
| 50 | 80 | 13.2 ± 14.7 |
| 100 | 100 | 18.4 ± 11.9 |
| Test Endpoint (% v/v) | | |
| LC50 | >100 | -- |
| IC25 | -- | >100 |
| IC50 | -- | >100 |

SD = Standard Deviation, LC = Lethal Concentration, IC = Inhibition Concentration

Table 4. Results: *Pseudokirchneriella subcapitata* growth inhibition test.

| Concentration (% v/v) | Cell Yield (x 10 ⁴ cells/mL) (Mean ± SD) | Stimulation (%) |
|------------------------------|--|-----------------|
| Laboratory Control | 29.8 ± 2.4 | -- |
| 1.5 | 31.8 ± 3.3 | 6.72 |
| 3.0 | 31.8 ± 1.3 | 6.72 |
| 6.0 | 40.2 ± 3.0* | 35.29 |
| 11.9 | 81.8 ± 4.5* | 174.8 |
| 23.8 | 135.3 ± 5.7* | 354.6 |
| 47.6 | 138.0 ± 8.3* | 363.9 |
| 95.2 | 127.0 ± 3.2* | 326.9 |
| Test Endpoint (% v/v) | | |
| IC25 | >95.2 | -- |
| IC50 | >95.2 | -- |

SD = Standard Deviation, IC = Inhibition Concentration

* = Indicates cell yield that were significantly greater than the control

4.0 QA/QC

The health history of the test organisms used in the exposure was acceptable and met the requirements of the Environment Canada protocol. The tests met all control acceptability criteria and water quality parameters remained within ranges specified in the protocol throughout the tests. There were no deviations from the test methodology. Uncertainty associated with the tests is best described by the standard deviation around the mean and/or the confidence intervals around the point estimates.

Results of the reference toxicant tests conducted during the testing program are summarized in Table 5. These tests were performed under the same conditions as the sample tested. Results for *P. subcapitata* fell within the acceptable range for organism performance of mean and two standard deviation range, based on historical results obtained by the laboratory with these tests. Thus, the sensitivity of the organisms used in this test was appropriate.

Reproduction results fell within the range of mean and two standard deviations in the reference toxicant test with *C. dubia*. However, survival results fell slightly outside of three standard deviations range. A thorough investigation was performed and the results indicated that proper

procedures were followed and that no technical errors occurred during testing. Thus, this may indicate that survival in this batch of organisms used in this test may have been more sensitive compared to previous batches of *C. dubia*.

Table 5. Reference toxicant test results.

| Test Species | Endpoint | Historical Mean (2 SD Range) | CV (%) | Test Date |
|-----------------------|-----------------------------------|---------------------------------|-----------|--------------------|
| <i>C. dubia</i> | Survival (LC50): 1.7 g/L NaCl | 2.0 (1.9 – 2.2) | 5 | September 25, 2017 |
| | Reproduction (IC50): 1.4 g/L NaCl | 1.5 (1.0 – 2.1) | 20 | |
| <i>P. subcapitata</i> | Growth (IC50): 34.9 µg/L Zn | 32.8 (26.5 – 40.5) | 11 | September 22, 2017 |

SD = Standard Deviation, CV = Coefficient of Variation, LC = Lethal Concentration, IC = Inhibition Concentration

5.0 REFERENCES

Environment Canada. 2007a. Biological test method: test of reproduction and survival using the cladoceran *Ceriodaphnia dubia*. Environmental Protection Series. Report EPS 1/RM/21, Second Edition, February 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 74 pp.

Environment Canada. 2007b. Biological test method: growth inhibition test using the freshwater alga. Environmental Protection Series, Report EPS 1/RM/25. Second Edition, March 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 53 pp.

Tidepool Scientific Software. 2013. CETIS comprehensive environmental toxicity information system, version 1.8.7.16 Tidepool Scientific Software, McKinleyville, CA. 275 pp.

APPENDIX A – *Ceriodaphnia dubia* Toxicity Test Data

Ceriodaphnia dubia Summary Sheet

Client: Ais/Minto
 Work Order No.: 170989

Start Date/Time: Sept 14/17 @ 1700h
 Set up by: JS

Sample Information:

Sample ID: L1990955-1 W3
 Sample Date: Sept 12/17
 Date Received: Sept 13/17
 Sample Volume: 8 x 1L^{JS}

Test Validity Criteria:

- 1) Mean survival of first generation controls is $\geq 80\%$
- 2) At least 60% of controls have produced three broods within 8 days
- 3) An average of ≥ 15 live young produced per surviving female in the control solutions during the first three broods.
- 4) Invalid if ephippia observed in any control solution at any time.

WQ Ranges:

T ($^{\circ}$ C) = 25 ± 1 ; DO (mg/L) = 3.3 to 8.4 ; pH = 6.0 to 8.5

Test Organism Information:

Broodstock No.: 090617B
 Age of young (Day 0): <24-h (within 12-h)
 Avg No. young in first 3 broods of previous 7 d: 21
 Mortality (%) in previous 7 d: 0
 Individual female # used ≥ 8 young on test day: 21-29, 31-34, 40, 37, 40
^{JS}
_{JS}

NaCl Reference Toxicant Results:

Reference Toxicant ID: CD167165
 Stock Solution ID: 17NaO5
 Date Initiated: Oct 4/17 Sept 25/17
 7-d LC50 (95% CL): 1.7 (1.3-2.1)^{em} g/L NaCl
 7-d IC50 (95% CL): 1.9 (1.6-2.1)^{em} g/L NaCl
 7-d LC50 Reference Toxicant Mean and Historical Range: 2.0 (1.6-2.5)^{em} g/L NaCl CV (%): 12.5^{em}
 7-d IC50 Reference Toxicant Mean and Historical Range: 1.9 (1.0-2.1)^{em} g/L NaCl CV (%): 20

Test Results:

| | Survival | Reproduction |
|-----------------------|----------|--------------|
| LC50 % (v/v) (95% CL) | 2100 | |
| IC25 % (v/v) (95% CL) | | 7100 |
| IC50 % (v/v) (95% CL) | | 7100 |

Reviewed by:

Date reviewed: Oct. 27, 2017

Chronic Freshwater Toxicity Test Initial and Final Water Quality Measurements

Client: ALIS/Minato
 Sample ID: 5243 L19909SS-1 W3
 Work Order #: 170989

Start Date & Time: Sept 14/17 @ 1700h
 Stop Date & Time: Sept 21/17 @ 830h
 CER #: 4
 Test Species: Ceriodaphnia dubia

| Concentration <i>control</i> | Days | | | | | | | | | | | | | |
|---------------------------------|-------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| | 0 | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 |
| | init. | old | new | old | new | old | new | old | new | old | new | old | new | final |
| Temperature (°C) | 15.0 | 25.0 | 15.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 |
| DO (mg/L) | 8.0 | 7.6 | 8.0 | 7.6 | 8.1 | 7.5 | 8.2 | 7.7 | 8.2 | 7.7 | 8.2 | 7.4 | 8.1 | 7.6 |
| pH | 8.0 | 7.7 | 8.1 | 7.7 | 8.0 | 7.7 | 8.1 | 7.7 | 8.2 | 7.8 | 8.2 | 7.9 | 8.0 | 7.9 |
| Cond. (µS/cm) | 205 | 204 | | 212 | | 207 | | 207 | | 207 | | 209 | | 200 |
| Initials | JS | JS | | A | | A | | EMM | | JS | | EMM | | EMM |

| Concentration <i>(V/V)</i> 1.56% | Days | | | | | | | | | | | | | |
|--|-------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| | 0 | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 |
| | init. | old | new | old | new | old | new | old | new | old | new | old | new | final |
| Temperature (°C) | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 |
| DO (mg/L) | 8.2 | 7.5 | 8.0 | 7.5 | 7.8 | 7.6 | 8.1 | 7.7 | 8.2 | 7.1 | 8.2 | 7.2 | 8.2 | 7.6 |
| pH | 8.0 | 7.8 | 8.0 | 7.9 | 8.1 | 7.9 | 8.1 | 7.7 | 8.2 | 7.8 | 8.2 | 7.9 | 8.0 | 7.9 |
| Cond. (µS/cm) | 217 | 214 | | 212 | | 221 | | 220 | | 214 | | 207 | | 203 |
| Initials | JS | JS | | A | | A | | EMM | | JS | | EMM | | EMM |

| Concentration <i>(V/V)</i> 12.5% | Days | | | | | | | | | | | | | |
|--|-------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| | 0 | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 |
| | init. | old | new | old | new | old | new | old | new | old | new | old | new | final |
| Temperature (°C) | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 |
| DO (mg/L) | 8.2 | 7.5 | 8.1 | 7.5 | 7.8 | 7.6 | 8.1 | 7.7 | 8.2 | 7.1 | 8.2 | 7.2 | 8.2 | 7.5 |
| pH | 8.0 | 7.9 | 8.0 | 8.0 | 8.0 | 8.0 | 8.1 | 7.8 | 8.2 | 7.9 | 8.2 | 8.0 | 8.0 | 7.3 |
| Cond. (µS/cm) | 248 | 258 | | 259 | | 261 | | 258 | | 254 | | 250 | | 261 |
| Initials | JS | JS | | A | | A | | EMM | | JS | | EMM | | EMM |

| Concentration <i>(V/V)</i> 100% | Days | | | | | | | | | | | | | |
|---------------------------------------|-------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| | 0 | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 |
| | init. | old | new | old | new | old | new | old | new | old | new | old | new | final |
| Temperature (°C) | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 | 24.0 | 25.0 |
| DO (mg/L) | 8.2 | 7.6 | 8.1 | 7.5 | 7.8 | 7.6 | 8.1 | 7.1 | 8.2 | 7.0 | 8.2 | 7.2 | 8.1 | 7.5 |
| pH | 7.8 | 8.2 | 7.9 | 8.3 | 8.0 | 8.4 | 8.0 | 8.1 | 7.9 | 8.1 | 7.9 | 8.3 | 8.9 | 6.9 |
| Cond. (µS/cm) | 556 | 555 | | 551 | | 547 | | 550 | | 555 | | 551 | | 558 |
| Initials | JS | JS | | A | | A | | EMM | | JS | | EMM | | EMM |

Thermometer: 4 DO meter/probe: 112 pH meter/probe: 112 Conductivity meter/probe: 112

| | Control | 100% (V/V) |
|-------------|---------|------------|
| Hardness* | 100 | 92 |
| Alkalinity* | 96 | 100 |

Analysts: EMM, JS, Amb
 Reviewed by: [Signature]
 Date reviewed: Oct 26, 2017

* mg/L as CaCO3

Sample Description: light yellow, clear, odourless, no particulates

Comments: Broodboard Used: 090617B (21-29, 31-34, 37, 40)

**Chronic Freshwater Toxicity Test
C. dubia Reproduction Data**

Client: ACS/Minto
 Sample ID: JS 170989 LP90955-1 W3
 Work Order: 170989

Start Date & Time: Sept 14/17 @ 1700h
 Stop Date & Time: Sept 21/17 @ 830h
 Set up by: JS

1/0 (V/V)

| Days | Concentration: control | | | | | | | | | | | Concentration: 1.56 | | | | | | | | | | | Concentration: 3.12 | | | | | | | | | | |
|-------|------------------------|---|----|----|----|----|---|----|----|----|------|---------------------|---|----|----|----|----|----|----|----|----|------|---------------------|----|----|----|----|----|----|----|----|----|------|
| | A | B | C | D | E | F | G | H | I | J | Init | A | B | C | D | E | F | G | H | I | J | Init | A | B | C | D | E | F | G | H | I | J | Init |
| 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | JW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | JW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | JW |
| 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A |
| 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A |
| 4 | 3 | ✓ | 3 | 4 | ✓ | ✓ | ✓ | 3 | 3 | 4 | mm | 3 | 3 | 3 | 3 | 3 | 4 | 4 | ✓ | 3 | ✓ | mm | 2 | 3 | 3 | 3 | 4 | 3 | 3 | 2 | 3 | 4 | mm |
| 5 | 9 | ✓ | 8 | 4 | ✓ | 5 | 4 | 9 | 9 | ✓ | mm | 8 | 9 | 10 | 8 | ✓ | ✓ | ✓ | 4 | ✓ | ✓ | mm | ✓ | ✓ | ✓ | 9 | ✓ | ✓ | 9 | 6 | 7 | 8 | mm |
| 6 | 15 | ✓ | ✓ | 5 | 15 | 15 | 5 | 12 | 15 | 10 | JS | ✓ | ✓ | ✓ | 10 | 8 | 5 | 5 | 6 | 8 | ✓ | JS | 8 | 13 | 13 | 14 | 10 | 8 | 6 | 12 | ✓ | ✓ | JS |
| 7 | ✓ | ✓ | 10 | 8 | ✓ | 11 | ✓ | ✓ | ✓ | 13 | mm | 10 | 9 | 12 | 10 | 10 | 13 | 9 | ✓ | 11 | ✓ | mm | 11 | 14 | 13 | ✓ | 12 | 9 | ✓ | ✓ | 13 | 9 | mm |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | 27 | 0 | 21 | 17 | 0 | 31 | 9 | 24 | 17 | 27 | JS | 21 | 2 | 25 | 21 | 21 | 18 | 10 | 22 | 0 | JS | 21 | 30 | 29 | 26 | 26 | 20 | 18 | 20 | 23 | 21 | JS | |

| Days | Concentration: 6.25 | | | | | | | | | | | Concentration: 12.5 | | | | | | | | | | | Concentration: 25 | | | | | | | | | | |
|-------|---------------------|----|----|----|----|---|----|----|----|----|------|---------------------|----|----|----|----|----|----|----|----|---|------|-------------------|---|----|----|----|---|----|----|----|----|------|
| | A | B | C | D | E | F | G | H | I | J | Init | A | B | C | D | E | F | G | H | I | J | Init | A | B | C | D | E | F | G | H | I | J | Init |
| 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | JW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | JW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | JW |
| 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A |
| 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A |
| 4 | 3 | ✓ | 4 | 3 | ✓ | ✓ | 4 | 3 | 3 | 3 | mm | 4 | ✓ | ✓ | 3 | 4 | ✓ | ✓ | 4 | ✓ | ✓ | mm | 4 | ✓ | ✓ | 3 | ✓ | ✓ | ✓ | ✓ | 4 | ✓ | mm |
| 5 | 6 | 5 | 4 | ✓ | ✓ | 5 | ✓ | 8 | 6 | ✓ | mm | 4 | 6 | 7 | 6 | 6 | 3 | ✓ | 5 | ✓ | ✓ | mm | 6 | ✓ | 5 | ✓ | 5 | ✓ | 4 | 4 | ✓ | 3 | mm |
| 6 | ✓ | 13 | 10 | 6 | 7 | ✓ | 10 | 8 | 13 | ✓ | JS | 7 | 8 | 8 | 14 | 15 | 10 | ✓ | 9 | 9 | ✓ | JS | ✓ | ✓ | 11 | 14 | 14 | ✓ | 16 | 12 | 12 | 15 | JS |
| 7 | 11 | 14 | 12 | 9 | 10 | ✓ | 12 | 9 | ✓ | 12 | mm | 12 | 13 | 10 | ✓ | ✓ | 12 | 11 | 14 | 12 | ✓ | mm | 12 | ✓ | 14 | 16 | 10 | ✓ | 12 | ✓ | 13 | 14 | mm |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | 10 | 32 | 26 | 19 | 20 | 0 | 27 | 21 | 24 | 21 | JS | 23 | 27 | 25 | 23 | 25 | 28 | 14 | 27 | 26 | 0 | JS | 25 | 0 | 20 | 33 | 29 | 0 | 26 | 16 | 29 | 32 | JS |

| Days | Concentration: 50 | | | | | | | | | | | Concentration: 100 | | | | | | | | | | | Concentration: | | | | | | | | | | |
|-------|-------------------|----|----|---|----|----|---|---|---|---|------|--------------------|---|----|----|----|---|----|----|----|----|------|----------------|---|---|---|---|---|---|---|---|---|------|
| | A | B | C | D | E | F | G | H | I | J | Init | A | B | C | D | E | F | G | H | I | J | Init | A | B | C | D | E | F | G | H | I | J | Init |
| 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | JW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | JW | | | | | | | | | | | |
| 2 | ✓ | ✓ | ✓ | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | | | | | | | | | | | |
| 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | A | | | | | | | | | | | |
| 4 | ✓ | ✓ | 3 | ✓ | 4 | 4 | ✓ | X | ✓ | ✓ | mm | ✓ | ✓ | 3 | 3 | ✓ | ✓ | 4 | ✓ | ✓ | ✓ | mm | | | | | | | | | | | |
| 5 | 2 | 4 | 4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | mm | 5 | ✓ | ✓ | ✓ | 5 | ✓ | 4 | ✓ | 5 | 4 | mm | | | | | | | | | | | |
| 6 | 4 | 13 | ✓ | ✓ | 15 | 12 | ✓ | ✓ | ✓ | ✓ | JS | 13 | ✓ | 11 | 13 | 10 | ✓ | 13 | 12 | 12 | 11 | JS | | | | | | | | | | | |
| 7 | 9 | 12 | 12 | ✓ | 13 | 16 | ✓ | ✓ | ✓ | ✓ | mm | 14 | ✓ | 12 | 14 | ✓ | ✓ | 16 | ✓ | ✓ | ✓ | mm | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | 15 | 29 | 24 | 0 | 32 | 32 | 0 | 0 | 0 | 0 | JS | 32 | 0 | 26 | 30 | 15 | 0 | 17 | 32 | 17 | 15 | JS | | | | | | | | | | | |

Notes: X = mortality.

Sample Description: See water quality page
 Comments: Total # Young only based on the first 3 Broods. Fourth and subsequent broods not included in total count.

Reviewed by: [Signature]

Date reviewed: Oct 26, 2017

CETIS Analytical Report

Report Date: 12 Oct-17 18:48 (p 1 of 2)
 Test Code: 170989 | 09-6785-8480

| Ceriodaphnia 7-d Survival and Reproduction Test | | | | Nautilus Environmental | | | |
|---|-----------------|------------|----------------------------|------------------------|-------------------|--|--|
| Analysis ID: | 20-7747-5959 | Endpoint: | 7d Survival Rate | CETIS Version: | CETISv1.8.7 | | |
| Analyzed: | 12 Oct-17 18:46 | Analysis: | Linear Regression (MLE) | Official Results: | Yes | | |
| Batch ID: | 03-0188-1705 | Test Type: | Reproduction-Survival (7d) | Analyst: | Jill Sones | | |
| Start Date: | 14 Sep-17 17:00 | Protocol: | EC/EPS 1/RM/21 | Diluent: | 20% Perrier Water | | |
| Ending Date: | 21 Sep-17 08:30 | Species: | Ceriodaphnia dubia | Brine: | | | |
| Duration: | 6d 15h | Source: | In-House Culture | Age: | <24h | | |
| Sample ID: | 13-9188-2167 | Code: | 52F66FB7 | Client: | ALS | | |
| Sample Date: | 12 Sep-17 08:40 | Material: | Water Sample | Project: | | | |
| Receive Date: | 14 Sep-17 15:55 | Source: | ALS | | | | |
| Sample Age: | 56h (9.5 °C) | Station: | L1990955-1 W3 | | | | |

Linear Regression Options

| Model Function | Threshold Option | Threshold | Optimized | Pooled | Het Corr | Weighted |
|------------------------------------|-------------------|-----------|-----------|--------|----------|----------|
| Log-Angle [Asin(P^0.5)=A+B*log(X)] | Control Threshold | 0.0000001 | No | Yes | No | Yes |

Regression Summary

| Iters | LL | AICc | BIC | Mu | Sigma | Adj R2 | F Stat | Critical | P-Value | Decision(α:5%) |
|-------|-------|------|-------|---------|-------|--------|--------|----------|---------|------------------------|
| 20 | -11.4 | 29.2 | 26.95 | 0.02053 | | 0.4048 | | | | Lack of Fit Not Tested |

Point Estimates

| Level | % | 95% LCL | 95% UCL | TU | 95% LCL | 95% UCL |
|-------|-------|---------|---------|----------|---------|---------|
| EC5 | 22.5 | N/A | N/A | 4.444 | NA | NA |
| EC10 | 83.29 | N/A | N/A | 1.201 | NA | NA |
| EC15 | 233.9 | N/A | N/A | 0.4275 | NA | NA |
| EC20 | 573.5 | N/A | N/A | 0.1744 | NA | NA |
| EC25 | 1296 | N/A | N/A | 0.07717 | NA | NA |
| EC40 | 11590 | N/A | N/A | 0.008629 | NA | NA |
| EC50 | 45560 | N/A | N/A | 0.002195 | NA | NA |

*>100% (VW)
em*

Regression Parameters

| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision(α:5%) |
|-----------|-----------|-----------|----------|---------|--------|---------|---------------------------|
| Slope | 0.1693 | 0.09922 | -0.02514 | 0.3638 | 1.707 | 0.1388 | Non-Significant Parameter |
| Intercept | -0.003477 | 0.1241 | -0.2468 | 0.2399 | -0.028 | 0.9786 | Non-Significant Parameter |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|----------|-------------|-------------|----|--------|---------|-----------------|
| Model | 5.258572 | 5.258572 | 1 | 5.76 | 0.0533 | Non-Significant |
| Residual | 5.477359 | 0.9128931 | 6 | | | |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|-----------------|-------------------------------|-----------|----------|---------|-------------------------------|
| Goodness-of-Fit | Pearson Chi-Sq GOF | 5.477 | 12.59 | 0.4842 | Non-Significant Heterogeneity |
| | Likelihood Ratio GOF | 6.285 | 12.59 | 0.3920 | Non-Significant Heterogeneity |
| Distribution | Shapiro-Wilk W Normality | 0.9044 | 0.6805 | 0.3166 | Normal Distribution |
| | Anderson-Darling A2 Normality | 0.4539 | 2.492 | 0.2745 | Normal Distribution |

7d Survival Rate Summary

| C-% | Control Type | Count | Calculated Variate(A/B) | | | | | | | | |
|------|------------------|-------|-------------------------|-----|-----|---------|---------|--------|---------|----|----|
| | | | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
| 0 | Negative Control | 10 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% | 10 | 10 |
| 1.56 | | 10 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% | 10 | 10 |
| 3.12 | | 10 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% | 10 | 10 |
| 6.25 | | 10 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% | 10 | 10 |
| 12.5 | | 10 | 0.9 | 0 | 1 | 0.1 | 0.3162 | 35.14% | 10.0% | 9 | 10 |
| 25 | | 10 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% | 10 | 10 |
| 50 | | 10 | 0.8 | 0 | 1 | 0.1333 | 0.4216 | 52.7% | 20.0% | 8 | 10 |
| 100 | | 10 | 1 | 1 | 1 | 0 | 0 | 0.0% | 0.0% | 10 | 10 |

Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 20-7747-5959
 Analyzed: 12 Oct-17 18:46

Endpoint: 7d Survival Rate
 Analysis: Linear Regression (MLE)

CETIS Version: CETISv1.8.7
 Official Results: Yes

7d Survival Rate Detail

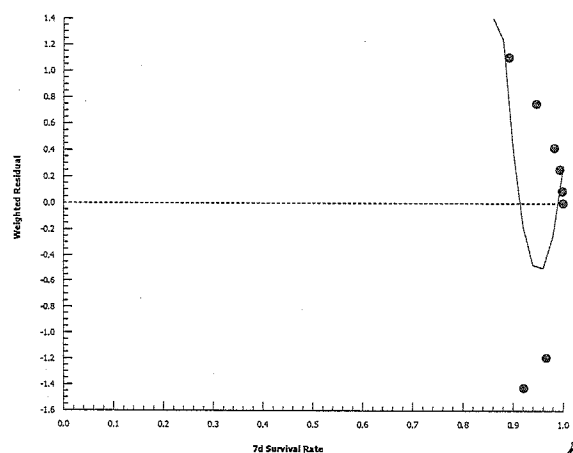
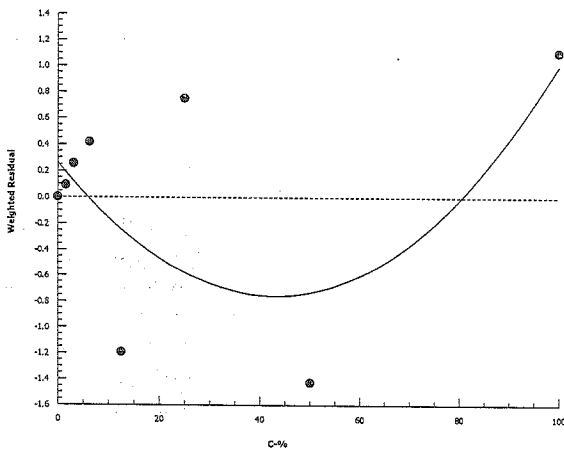
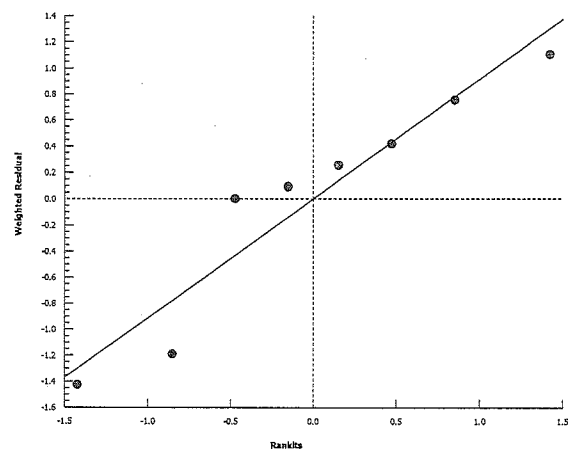
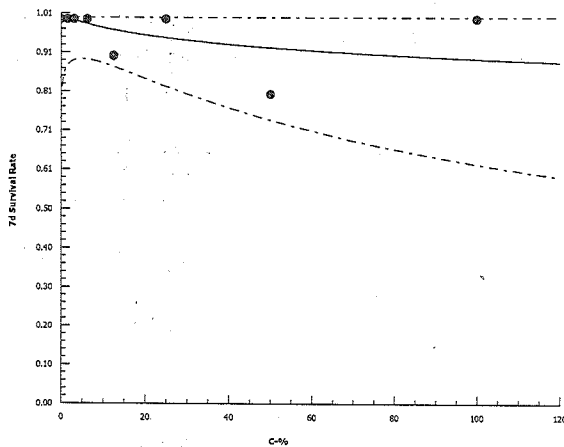
| C-% | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|------|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | Negative Control | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1.56 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3.12 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 6.25 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 12.5 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 25 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 50 | | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 |
| 100 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

7d Survival Rate Binomials

| C-% | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|------|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | Negative Control | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 1.56 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 3.12 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 6.25 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 12.5 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 0/1 |
| 25 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 50 | | 1/1 | 1/1 | 1/1 | 0/1 | 1/1 | 1/1 | 1/1 | 0/1 | 1/1 | 1/1 |
| 100 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |

Graphics

Log-Angle [Asin(P^0.5)=A+B*log(X)]



CETIS Analytical Report

Report Date: 12 Oct-17 18:48 (p 1 of 2)
 Test Code: 170989 | 09-6785-8480

Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

| | | |
|--------------------------------------|---|-----------------------------------|
| Analysis ID: 00-2122-7028 | Endpoint: Reproduction | CETIS Version: CETISv1.8.7 |
| Analyzed: 12 Oct-17 18:47 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 03-0188-1705 | Test Type: Reproduction-Survival (7d) | Analyst: Jill Sones |
| Start Date: 14 Sep-17 17:00 | Protocol: EC/EPS 1/RM/21 | Diluent: 20% Perrier Water |
| Ending Date: 21 Sep-17 08:30 | Species: Ceriodaphnia dubia | Brine: |
| Duration: 6d 15h | Source: In-House Culture | Age: <24h |
| Sample ID: 13-9188-2167 | Code: 52F66FB7 | Client: ALS |
| Sample Date: 12 Sep-17 08:40 | Material: Water Sample | Project: |
| Receive Date: 14 Sep-17 15:55 | Source: ALS | |
| Sample Age: 56h (9.5 °C) | Station: L1990955-1 W3 | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 526497 | 200 | Yes | Two-Point Interpolation |

Point Estimates

| Level | % | 95% LCL | 95% UCL | TU | 95% LCL | 95% UCL |
|-------|-------|---------|---------|-------|---------|---------|
| IC5 | 28.93 | 0.4314 | 70.14 | 3.456 | 1.426 | 231.8 |
| IC10 | 33.46 | 1.049 | N/A | 2.989 | NA | 95.32 |
| IC15 | 38.67 | 13.38 | N/A | 2.586 | NA | 7.476 |
| IC20 | 44.67 | 17.22 | N/A | 2.239 | NA | 5.806 |
| IC25 | >100 | N/A | N/A | <1 | NA | NA |
| IC40 | >100 | N/A | N/A | <1 | NA | NA |
| IC50 | >100 | N/A | N/A | <1 | NA | NA |

Reproduction Summary

Calculated Variate

| C-% | Control Type | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
|------|------------------|-------|------|-----|-----|---------|---------|--------|---------|
| 0 | Negative Control | 10 | 18.3 | 0 | 31 | 3.63 | 11.48 | 62.73% | 0.0% |
| 1.56 | | 10 | 18.1 | 0 | 25 | 2.369 | 7.49 | 41.38% | 1.09% |
| 3.12 | | 10 | 23.4 | 18 | 30 | 1.301 | 4.115 | 17.59% | -27.87% |
| 6.25 | | 10 | 21 | 0 | 32 | 2.662 | 8.42 | 40.09% | -14.75% |
| 12.5 | | 10 | 21.8 | 0 | 28 | 2.728 | 8.626 | 39.57% | -19.13% |
| 25 | | 10 | 22 | 0 | 33 | 3.961 | 12.53 | 56.93% | -20.22% |
| 50 | | 10 | 13.2 | 0 | 32 | 4.652 | 14.71 | 111.4% | 27.87% |
| 100 | | 10 | 18.4 | 0 | 32 | 3.751 | 11.86 | 64.47% | -0.55% |

Reproduction Detail

| C-% | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|------|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | Negative Control | 27 | 0 | 21 | 17 | 0 | 31 | 9 | 24 | 27 | 27 |
| 1.56 | | 21 | 21 | 25 | 21 | 21 | 22 | 18 | 10 | 22 | 0 |
| 3.12 | | 21 | 30 | 29 | 26 | 26 | 20 | 18 | 20 | 23 | 21 |
| 6.25 | | 20 | 32 | 26 | 19 | 20 | 0 | 27 | 21 | 24 | 21 |
| 12.5 | | 23 | 27 | 25 | 23 | 25 | 28 | 14 | 27 | 26 | 0 |
| 25 | | 25 | 0 | 30 | 33 | 29 | 0 | 26 | 16 | 29 | 32 |
| 50 | | 15 | 29 | 24 | 0 | 32 | 32 | 0 | 0 | 0 | 0 |
| 100 | | 32 | 0 | 26 | 30 | 15 | 0 | 17 | 32 | 17 | 15 |

CETIS Analytical Report

Report Date: 12 Oct-17 18:48 (p 2 of 2)
Test Code: 170989 | 09-6785-8480

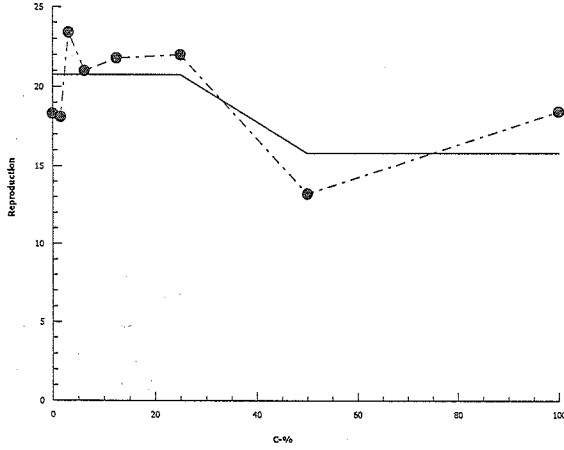
Ceriodaphnia 7-d Survival and Reproduction Test

Nautilus Environmental

Analysis ID: 00-2122-7028 Endpoint: Reproduction
Analyzed: 12 Oct-17 18:47 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



Client: ALSY/minto

W.O.#: 170989

Hardness and Alkalinity Datasheet

| Sample ID | Subsample Date | Date Measured | Alkalinity | | | | Hardness | | | Technician |
|-----------|----------------|---------------|--------------------|--|---|--|--------------------|--------------------------------|--|------------|
| | | | Sample Volume (mL) | (mL) 0.02N HCL/H ₂ SO ₄ used to pH 4.5 | (mL) of 0.02N HCL/H ₂ SO ₄ used to pH 4.2 | Total Alkalinity (mg/L CaCO ₃) | Sample Volume (mL) | Volume of 0.01M EDTA Used (mL) | Total Hardness (mg/L CaCO ₃) | |
| 20% perme | Sept 15/17 | Sept 15/17 | 5.0 | 4.9 | 5.0 | 96 | 50 | 5.0 | 100 | FMM |
| W3 | Sept 15/17 | Sept 15/17 | 50 | 5.1 | 5.2 | 100 | 50 | 4.6 | 92 | ↓ |
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Notes:

Reviewed by:  Date Reviewed: Oct 26, 2017

APPENDIX B – *Pseudokirchneriella subcapitata* Toxicity Test Data

Pseudokirchneriella subcapitata Summary Sheet

Client: ALS/minto
Work Order No.: 170990

Start Date: SEPT 15/17
Set up by: MLI

Sample Information:

Sample ID: L1990955-1 W3
Sample Date: Sept 12/15th 17
Date Received: Sept 14/17
Sample Volume: 8x1L

Test Organism Information:

Culture Date: Sept 8/17
Age of culture (Day 0): 7d

Zinc Reference Toxicant Results:


Reference Toxicant ID: SC161
Stock Solution ID: 17Zn03
Date Initiated: Sept 22/17

72-h IC50 (95% CL): 34.9 (32.9-37.0) µg/L Zn

72-h IC50 Reference Toxicant Mean and Range: 32.8 (26.5-40.5) µg/L Zn CV (%): 11

Test Results:

| | Algal Growth |
|----------------------|--------------|
| IC25 %(v/v) (95% CL) | <u>795.2</u> |
| IC50 %(v/v) (95% CL) | <u>795.2</u> |

Reviewed by: 

Date reviewed: Oct 5, 2017

72-h Algal Growth Inhibition Toxicity Test Water Quality Measurements

Client: ALS/minto Setup by: MLG
 Sample ID: L1990955-1 WS Test Date/Time: Sept 15/17 @ 0805h
 Work Order No.: 170990 CER #: 4
 Test Species: Pseudokirchneriella subcapitata
 Culture Date: Sept 8/17 Age of Culture: 7d Culture Health: Good
 Culture Count: 1 460 2 445 Average: 452.5 Culture Cell Density (c1): 452.5 x 10⁴ cells/mL

$$v1 = \frac{220,000 \text{ cells/ml} \times 100 \text{ ml}}{(c1) \quad 452.5 \times 10^4 \text{ cells/ml}} = 4.86 \text{ mL}$$

Time Zero Counts: 1 22 2 23 Average: 22.5 #^{10⁴}

No. of Cells/mL: 22.5 x 10⁴ Initial Density: # cells/mL ÷ 220 µL x 10 µL = 10227 cells/mL

| Concentration %(v/v) | Water Quality | | Incubator Temperature (°C) | | | | Microplates rotated 2X per day? | | | |
|-------------------------|---------------|-----------|-------------------------------|------|------|------|---------------------------------|------|------|------|
| | pH | Temp (°C) | °C | | | | 0 h | 24 h | 48 h | 72 h |
| | | | 0 h | 24 h | 48 h | 72 h | | | | |
| Control | 7.0 | 23.0 | 24.5 | 24.6 | 24.5 | 24.0 | ✓ | / | / | ✓ |
| 1.9 | 7.0 | 23.0 | ↓ | ↓ | ↓ | ↓ | ✓ | / | / | ✓ |
| 3.0 | 7.2 | 23.0 | ↓ | ↓ | ↓ | ↓ | ✓ | / | / | ✓ |
| 6.0 | 7.4 | 23.0 | ↓ | ↓ | ↓ | ↓ | ✓ | / | / | ✓ |
| 11.9 | 7.6 | 23.0 | ↓ | ↓ | ↓ | ↓ | ✓ | / | / | ✓ |
| 23.8 | 7.9 | 23.0 | ↓ | ↓ | ↓ | ↓ | ✓ | / | / | ✓ |
| 47.6 | 8.1 | 23.0 | ↓ | ↓ | ↓ | ↓ | ✓ | / | / | ✓ |
| 90.2 | 8.2 | 23.0 | ↓ | ↓ | ↓ | ↓ | ✓ | / | / | ✓ |
| Initials | MLG | MLG | MLG | A | A | MLG | MLG | A | A | MLG |

Initial control pH: Well 1: 7.0 Well 2: 7.0

Final control pH: Well 1: 6.9 Well 2: 6.9

Light intensity (lux): 3820 Date measured: Sept 15/17

Thermometer: 4 Light meter: 1 pH meter/probe: 1, 1

Sample Description: light yellow, clear, odourless, no particulates

Comments: _____

Reviewed: MLG Date reviewed: Oct 5, 2017

***Pseudokirchneriella subcapitata* Algal Counts**

Client: ALS/Minto
 WO#: 170990
 Sample ID: L1990955-1 W3

Start Date/Time: 15-Sep-17 @ 0805h
 Termination Date/Time: 18-Sep-17 @ 0805h

Initial Cell Density: 10227 cell/mL
 225000
 0.22
 0.01
 10227.27

| Concentration %(v/v) | Rep | Count 1 (x 10 ⁴) | Count 2 (x 10 ⁴) | Count 3 (x 10 ⁴) | Count 4 (x 10 ⁴) | Mean (x 10 ⁴) | Cell Yield (x 10 ⁴) cell/mL | | |
|-------------------------|-----|---------------------------------|---------------------------------|---------------------------------|---------------------------------|------------------------------|---|------|----------|
| Control | A | 28 | | | | 28 | 27.0 | mean | 29.7 |
| | B | 30 | | | | 30 | 29.0 | SD | 2.37547 |
| | C | 31 | | | | 31 | 30.0 | CV | 7.990877 |
| | D | 28 | | | | 28 | 27.0 | | |
| | E | 33 | | | | 33 | 32.0 | | |
| | F | 34 | | | | 34 | 33.0 | | |
| | G | 29 | | | | 29 | 28.0 | | |
| | H | 33 | | | | 33 | 32.0 | | |
| 1.5 | A | 36 | | | | 36 | 35.0 | | |
| | B | 29 | | | | 29 | 28.0 | | |
| | C | 31 | | | | 31 | 30.0 | | |
| | D | 35 | | | | 35 | 34.0 | | |
| 3 | A | 33 | | | | 33 | 32.0 | | |
| | B | 31 | | | | 31 | 30.0 | | |
| | C | 34 | | | | 34 | 33.0 | | |
| | D | 33 | | | | 33 | 32.0 | | |
| 6 | A | 42 | | | | 42 | 41.0 | | |
| | B | 40 | | | | 40 | 39.0 | | |
| | C | 38 | | | | 38 | 37.0 | | |
| | D | 45 | | | | 45 | 44.0 | | |
| 11.9 | A | 83 | | | | 83 | 82.0 | | |
| | B | 79 | | | | 79 | 78.0 | | |
| | C | 80 | | | | 80 | 79.0 | | |
| | D | 89 | | | | 89 | 88.0 | | |
| 23.8 | A | 140 | | | | 140 | 139.0 | | |
| | B | 142 | | | | 142 | 141.0 | | |
| | C | 133 | | | | 133 | 132.0 | | |
| | D | 130 | | | | 130 | 129.0 | | |
| 47.6 | A | 133 | | | | 133 | 132.0 | | |
| | B | 131 | | | | 131 | 130.0 | | |
| | C | 148 | | | | 148 | 147.0 | | |
| | D | 144 | | | | 144 | 143.0 | | |
| 95.2 | A | 131 | | | | 131 | 130.0 | | |
| | B | 130 | | | | 130 | 129.0 | | |
| | C | 127 | | | | 127 | 126.0 | | |
| | D | 124 | | | | 124 | 123.0 | | |

Reviewed by: 

Date reviewed: Oct 5, 2017

Pseudokirchneriella subcapitata Toxicity Test Data Sheet
72-h Algal Cell Counts

Client: ALS/minto Start Date/Time: Sept 15/17 @ 0805h
 Work Order #: 170990 Termination Date: Sept 18/17 @ 0805h
 Sample ID: L1990955-1 WB Test set up by: MLT
 % (v/v)

| Concentration | Rep | Count 1 | Count 2 | Count 3 | Count 4 | Comments | Initials |
|---------------|-----|---------|---------|---------|---------|----------|----------|
| Control | A | 28 | | | | | MLT |
| | B | 30 | | | | | |
| | C | 31 | | | | | |
| | D | 28 | | | | | |
| | E | 33 | | | | | |
| | F | 34 | | | | | |
| | G | 29 | | | | | |
| | H | 33 | | | | | |
| 1.5 | A | 36 | | | | | |
| | B | 29 | | | | | |
| | C | 31 | | | | | |
| | D | 35 | | | | | |
| 3.0 | A | 33 | | | | | |
| | B | 31 | | | | | |
| | C | 34 | | | | | |
| | D | 33 | | | | | |
| 6.0 | A | 42 | | | | | |
| | B | 40 | | | | | |
| | C | 38 | | | | | |
| | D | 45 | | | | | |
| 11.9 | A | 83 | | | | | |
| | B | 79 | | | | | |
| | C | 80 | | | | | |
| | D | 89 | | | | | |
| 23.8 | A | 140 | | | | | |
| | B | 142 | | | | | |
| | C | 133 | | | | | |
| | D | 120 | | | | | |
| 47.6 | A | 133 | | | | | |
| | B | 131 | | | | | |
| | C | 148 | | | | | |
| | D | 144 | | | | | |
| 95.2 | A | 131 | | | | | |
| | B | 130 | | | | | |
| | C | 127 | | | | | |
| | D | 124 | | | | | |

Comments: _____

Reviewed by:  Date Reviewed: Oct. 5, 2017

CETIS Analytical Report

Report Date: 27 Sep-17 18:27 (p 1 of 2)
 Test Code: 170990 | 10-6566-6095

EC Alga Growth Inhibition Test

Nautilus Environmental

| | | |
|--------------------------------------|---|---|
| Analysis ID: 08-5835-5179 | Endpoint: Cell Yield | CETIS Version: CETISv1.8.7 |
| Analyzed: 27 Sep-17 18:27 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 14-9564-1824 | Test Type: Cell Growth | Analyst: Mimi Tran |
| Start Date: 15 Sep-17 08:05 | Protocol: EC/EPS 1/RM/25 | Diluent: Deionized Water + nutrients |
| Ending Date: 18 Sep-17 08:05 | Species: Pseudokirchneriella subcapitata | Brine: |
| Duration: 72h | Source: In-House Culture | Age: 7d |
| Sample ID: 13-9188-2167 | Code: 52F66FB7 | Client: ALS |
| Sample Date: 12 Sep-17 08:40 | Material: Water Sample | Project: |
| Receive Date: 14 Sep-17 15:55 | Source: ALS | |
| Sample Age: 71h (9.5 °C) | Station: L1990955-1 W3 | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|---------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 1155823 | 200 | Yes | Two-Point Interpolation |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|--------------------|-----------|----------|---------|-----------------------------------|
| Control Trend | Mann-Kendall Trend | | | 0.2821 | Non-significant Trend in Controls |

Point Estimates

| Level | % | 95% LCL | 95% UCL | TU | 95% LCL | 95% UCL |
|-------|-------|---------|---------|-------|---------|---------|
| IC5 | >95.2 | N/A | N/A | <1.05 | NA | NA |
| IC10 | >95.2 | N/A | N/A | <1.05 | NA | NA |
| IC15 | >95.2 | N/A | N/A | <1.05 | NA | NA |
| IC20 | >95.2 | N/A | N/A | <1.05 | NA | NA |
| IC25 | >95.2 | N/A | N/A | <1.05 | NA | NA |
| IC40 | >95.2 | N/A | N/A | <1.05 | NA | NA |
| IC50 | >95.2 | N/A | N/A | <1.05 | NA | NA |

Cell Yield Summary

| C-% | Control Type | Count | Calculated Variate | | | | | | |
|------|------------------|-------|--------------------|-----|-----|---------|---------|--------|---------|
| | | | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
| 0 | Negative Control | 8 | 29.75 | 27 | 33 | 0.8399 | 2.375 | 7.99% | 0.0% |
| 1.5 | | 4 | 31.75 | 28 | 35 | 1.652 | 3.304 | 10.41% | -6.72% |
| 3 | | 4 | 31.75 | 30 | 33 | 0.6292 | 1.258 | 3.96% | -6.72% |
| 6 | | 4 | 40.25 | 37 | 44 | 1.493 | 2.986 | 7.42% | -35.29% |
| 11.9 | | 4 | 81.75 | 78 | 88 | 2.25 | 4.5 | 5.51% | -174.8% |
| 23.8 | | 4 | 135.3 | 129 | 141 | 2.839 | 5.679 | 4.2% | -354.6% |
| 47.6 | | 4 | 138 | 130 | 147 | 4.143 | 8.287 | 6.01% | -363.9% |
| 95.2 | | 4 | 127 | 123 | 130 | 1.581 | 3.162 | 2.49% | -326.9% |

Cell Yield Detail

| C-% | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|------|------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | Negative Control | 27 | 29 | 30 | 27 | 32 | 33 | 28 | 32 |
| 1.5 | | 35 | 28 | 30 | 34 | | | | |
| 3 | | 32 | 30 | 33 | 32 | | | | |
| 6 | | 41 | 39 | 37 | 44 | | | | |
| 11.9 | | 82 | 78 | 79 | 88 | | | | |
| 23.8 | | 139 | 141 | 132 | 129 | | | | |
| 47.6 | | 132 | 130 | 147 | 143 | | | | |
| 95.2 | | 130 | 129 | 126 | 123 | | | | |

CETIS Analytical Report

Report Date: 27 Sep-17 18:27 (p 2 of 2)
Test Code: 170990 | 10-6566-6095

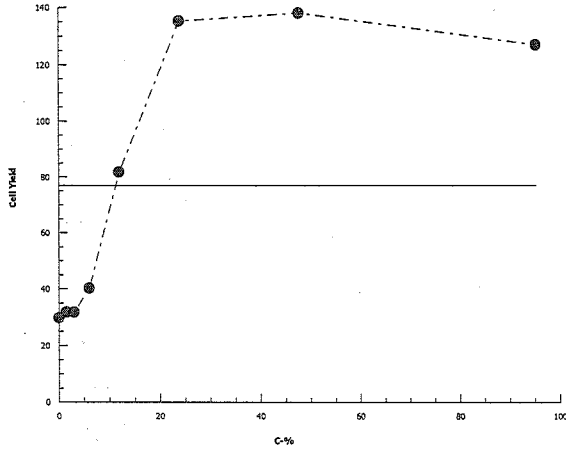
EC Alga Growth Inhibition Test

Nautilus Environmental

Analysis ID: 08-5835-5179 Endpoint: Cell Yield
Analyzed: 27 Sep-17 18:27 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



[Handwritten signature]
000-517

CETIS Analytical Report

Report Date: 06 Oct-17 11:44 (p 1 of 2)
 Test Code: 170990 | 10-6566-6095

EC Alga Growth Inhibition Test

Nautilus Environmental

| | | |
|--------------------------------------|---|---|
| Analysis ID: 08-8844-2486 | Endpoint: Cell Yield | CETIS Version: CETISv1.8.7 |
| Analyzed: 27 Sep-17 18:26 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 14-9564-1824 | Test Type: Cell Growth | Analyst: Mimi Tran |
| Start Date: 15 Sep-17 08:05 | Protocol: EC/EPS 1/RM/25 | Diluent: Deionized Water + nutrients |
| Ending Date: 18 Sep-17 08:05 | Species: Pseudokirchneriella subcapitata | Brine: |
| Duration: 72h | Source: In-House Culture | Age: 7d |
| Sample ID: 13-9188-2167 | Code: 52F66FB7 | Client: ALS |
| Sample Date: 12 Sep-17 08:40 | Material: Water Sample | Project: |
| Receive Date: 14 Sep-17 15:55 | Source: ALS | |
| Sample Age: 71h (9.5 °C) | Station: L1990955-1 W3 | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | PMSD | NOEL | LOEL | TOEL | TU |
|----------------|------|---------|--------|------|-------|------|------|-------|-------|
| Untransformed | NA | C < T | NA | NA | 21.9% | 3 | 6 | 4.243 | 33.33 |

Dunnett Multiple Comparison Test

| Control | vs | C-% | Test Stat | Critical | MSD | DF | P-Value | P-Type | Decision(α:5%) |
|------------------|----|-------|-----------|----------|-------|----|---------|--------|------------------------|
| Negative Control | | 1.5 | 0.775 | 2.526 | 6.519 | 10 | 0.6628 | CDF | Non-Significant Effect |
| | | 3 | 0.775 | 2.526 | 6.519 | 10 | 0.6628 | CDF | Non-Significant Effect |
| | | 6* | 4.069 | 2.526 | 6.519 | 10 | 0.0012 | CDF | Significant Effect |
| | | 11.9* | 20.15 | 2.526 | 6.519 | 10 | <0.0001 | CDF | Significant Effect |
| | | 23.8* | 40.88 | 2.526 | 6.519 | 10 | <0.0001 | CDF | Significant Effect |
| | | 47.6* | 41.95 | 2.526 | 6.519 | 10 | <0.0001 | CDF | Significant Effect |
| | | 95.2* | 37.68 | 2.526 | 6.519 | 10 | <0.0001 | CDF | Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|--------------------|-----------|----------|---------|-----------------------------------|
| Control Trend | Mann-Kendall Trend | | | 0.2821 | Non-significant Trend in Controls |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 77176.39 | 11025.2 | 7 | 620.8 | <0.0001 | Significant Effect |
| Error | 497.25 | 17.75893 | 28 | | | |
| Total | 77673.64 | | 35 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|-------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance | 12.8 | 18.48 | 0.0772 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality | 0.9901 | 0.9166 | 0.9831 | Normal Distribution |

Cell Yield Summary

| C-% | Control Type | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|------|------------------|-------|-------|---------|---------|--------|-----|-----|---------|--------|---------|
| 0 | Negative Control | 8 | 29.75 | 27.76 | 31.74 | 29.5 | 27 | 33 | 0.8399 | 7.99% | 0.0% |
| 1.5 | | 4 | 31.75 | 26.49 | 37.01 | 32 | 28 | 35 | 1.652 | 10.41% | -6.72% |
| 3 | | 4 | 31.75 | 29.75 | 33.75 | 32 | 30 | 33 | 0.6292 | 3.96% | -6.72% |
| 6 | | 4 | 40.25 | 35.5 | 45 | 40 | 37 | 44 | 1.493 | 7.42% | -35.29% |
| 11.9 | | 4 | 81.75 | 74.59 | 88.91 | 80.5 | 78 | 88 | 2.25 | 5.51% | -174.8% |
| 23.8 | | 4 | 135.3 | 126.2 | 144.3 | 135.5 | 129 | 141 | 2.839 | 4.2% | -354.6% |
| 47.6 | | 4 | 138 | 124.8 | 151.2 | 137.5 | 130 | 147 | 4.143 | 6.01% | -363.9% |
| 95.2 | | 4 | 127 | 122 | 132 | 127.5 | 123 | 130 | 1.581 | 2.49% | -326.9% |

CETIS Analytical Report

Report Date: 06 Oct-17 11:44 (p 2 of 2)
 Test Code: 170990 | 10-6566-6095

EC Alga Growth Inhibition Test

Nautilus Environmental

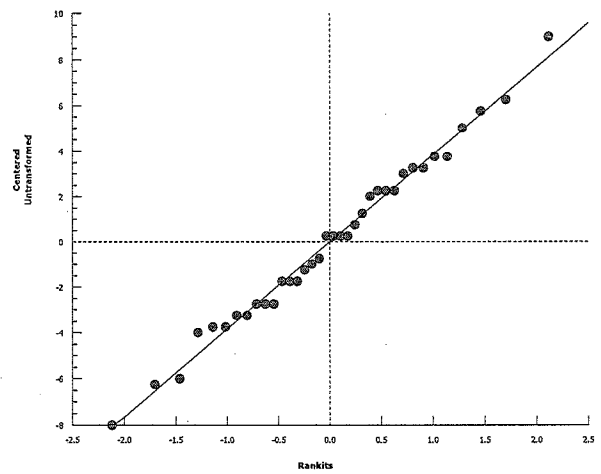
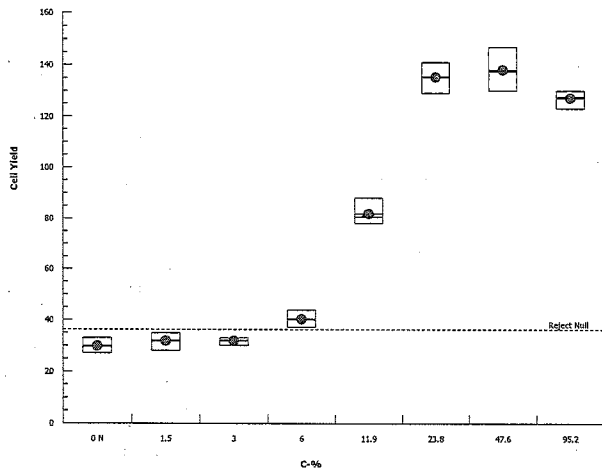
Analysis ID: 08-8844-2486 Endpoint: Cell Yield
 Analyzed: 27 Sep-17 18:26 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.8.7
 Official Results: Yes

Cell Yield Detail

| C-% | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|------|------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | Negative Control | 27 | 29 | 30 | 27 | 32 | 33 | 28 | 32 |
| 1.5 | | 35 | 28 | 30 | 34 | | | | |
| 3 | | 32 | 30 | 33 | 32 | | | | |
| 6 | | 41 | 39 | 37 | 44 | | | | |
| 11.9 | | 82 | 78 | 79 | 88 | | | | |
| 23.8 | | 139 | 141 | 132 | 129 | | | | |
| 47.6 | | 132 | 130 | 147 | 143 | | | | |
| 95.2 | | 130 | 129 | 126 | 123 | | | | |

Graphics



APPENDIX C – Chain-of-Custody Forms



Subcontract Request Form

Subcontract To:

WO#: 170989

Sub lethal

7 day Daphna

NAUTILUS ENVIRONMENTAL

170990

Sub lethal

72hr Algae

8664 COMMERCE COURT
BURNABY, BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# L1990955
ALS requires QC data to be provided with your final results.

Please see enclosed 1 sample(s) in 8 Container(s)

SAMPLE NUMBER

ANALYTICAL REQUIRED

DATE SAMPLED

DUE DATE

Priority Flag

L1990955-1 W3

Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)

9/12/2017

9/22/2017

Subcontract Info Contact:

Walter Lin (604) 253-4188

Analysis and reporting info contact:

Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9

Phone: (604) 253-4188

Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to:

Shane.Stack@alsglobal.com

Shipped By:

Date Shipped:

Received By:

Date Received:

Sept 14/17 @ 1555

Verified By:

Date Verified:

Temperature:

9.5

Sample Integrity Issues:

8 x 1 L (bottle)

sample description: light yellow, clear, odourless, no particulates.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1990955-COFC

COC Number: 2017-09-13 B

Page 1 of 1

www.alsglobal.com

| | | | | | | | | | | | | | | | |
|--|---|--|----------------------|------------------|---|-------------------------------------|---|--|--|--------------------------------------|----------------------|---------------------|--------------------|-----------------------------|------------------------|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | 09-14-17 09:00 AM | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Analysis Request | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Related Fields (client use) | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | PC#: | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | Routing Code: | | | | | | | | | | | | |
| PO / AFE: | 224159 (MMER) | Requisitioner: | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | |
| ALS Lab Work Order #: (lab use only) | | ALS Contact: | Shane Stack | Sampler: | CR | | | | | | Number of Containers | | | | |
| ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | 99hr - LC50 Rainbow Trout | 48hr - LC50 Daphnia | 7day - Rainbow Trout Embryo Toxicity | | 7day - Ceriodaphnia | 7day - Lemna minor | Alga 72-h Growth Inhibition | 7day - Flathead Minnow |
| | W3 | | | | 12-Sep-17 | 8:40 | Water | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> | | Ice Cubes <input type="checkbox"/> | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | FINAL COOLER TEMPERATURES °C | | | | | | | | |
| | | | | | 5.0C | | 9.5 | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | |
| Released by: Collin Prentice | Date: 2017-09-13 | Time: | Received by: | Date: Sept 13/17 | Time: 15:01 | Received by: Andy Ip | Date: Sept 14/17 | Time: 15:55h | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION... Failure to complete all portions of this form may delay analysis...


END OF REPORT



L1990955-COFC

COC Number: 2017-09-13 B

Page 1 of 1

| Report To <small>Contact and company name below will appear on the final report</small> | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|---------------------|--|--|--|--|--|--|--------------------------|---|--------------------------|--|------------------------------|-----------------------|--------------------------|------------|--------------------------|--|--|----------------------|---|--|--|--|--|--|--|--|---------------------------|---------------------|--------------------------------------|---------------------|--------------------|------------------------------|-----------------------|--|--|--|--|--|--|--|--|--|---|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | Priority (Business Days) <table border="1" style="display: inline-table; margin-left: 10px;"> <tr> <td>4 day [P4]</td><td><input type="checkbox"/></td> </tr> <tr> <td>3 day [P3]</td><td><input type="checkbox"/></td> </tr> <tr> <td>2 day [P2]</td><td><input type="checkbox"/></td> </tr> </table> | | | | 4 day [P4] | <input type="checkbox"/> | 3 day [P3] | <input type="checkbox"/> | 2 day [P2] | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 day [P4] | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 day [P3] | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 day [P2] | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | Emergency <table border="1" style="display: inline-table; margin-left: 10px;"> <tr> <td>1 Business day [E1]</td><td><input type="checkbox"/></td> </tr> <tr> <td>Same Day, Weekend or Statutory holiday [E0]</td><td><input type="checkbox"/></td> </tr> </table> | | | | 1 Business day [E1] | <input type="checkbox"/> | Same Day, Weekend or Statutory holiday [E0] | <input type="checkbox"/> | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Business day [E1] | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Same Day, Weekend or Statutory holiday [E0] | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: <small>For tests that can not be performed according to the service level selected, you will be contacted.</small> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <small>Company address below will appear on the final report</small> Street: 2100-510 West Georgia St. City/Province: Vancouver, British Columbia Postal Code: V6B 0M3 | | Email 1 or Fax minto_environment@mintomine.com | | | <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="8">Analysis Request</th> <th rowspan="3">Number of Containers</th> </tr> <tr> <th colspan="8">Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below</th> </tr> <tr> <th>96hr - LC50 Rainbow Trout</th> <th>48hr - LC50 Daphnia</th> <th>7day - Rainbow Trout Embryo Toxicity</th> <th>7day - Ceriodaphnia</th> <th>7day - Lemna minor</th> <th>Algae 72-h Growth Inhibition</th> <th>7day - Fathead Minnow</th> <th></th> </tr> </thead> <tbody> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>8</td> </tr> </tbody> </table> | | | | | | | | Analysis Request | | | | | | | | Number of Containers | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below | | | | | | | | 96hr - LC50 Rainbow Trout | 48hr - LC50 Daphnia | 7day - Rainbow Trout Embryo Toxicity | 7day - Ceriodaphnia | 7day - Lemna minor | Algae 72-h Growth Inhibition | 7day - Fathead Minnow | | | | | | | | | | 8 |
| Analysis Request | | | | | | | | | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 96hr - LC50 Rainbow Trout | 48hr - LC50 Daphnia | 7day - Rainbow Trout Embryo Toxicity | 7day - Ceriodaphnia | 7day - Lemna minor | | | | | | | | | | Algae 72-h Growth Inhibition | 7day - Fathead Minnow | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax ap@mintomine.com Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. Contact: Ruth Cayetano | | Oil and Gas Required Fields (client use) AFE/Cost Center: _____ PO# _____ Major/Minor Code: _____ Routing Code: _____ Requisitioner: _____ Location: _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information ALS Account # / Quote #: _____ Job #: _____ PO / AFE: 224159 (MMER) LSD: _____ | | ALS Contact: Shane Stack Sampler: CR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | ALS Sample # (lab use only) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Sample Identification and/or Coordinates (This description will appear on the report) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | W3 | | | 12-Sep-17 | 8:40 | Water | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | INITIAL COOLER TEMPERATURES °C: 5.0°C. FINAL COOLER TEMPERATURES °C: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: Colln Prentice | | Date: 2017-09-13 | | Received by:  | | Date: Sept 13/17. | | Received by: _____ | | Date: _____ | | Time: _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 13-SEP-17
Report Date: 25-SEP-17 14:01 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1990965
Project P.O. #: 226973 (WUL)
Job Reference:
C of C Numbers: 2017-09-13 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1990965-1 | L1990965-2 | L1990965-3 | L1990965-4 | L1990965-5 |
|-----------------------------------|---|--------------|--------------|-----------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 11-SEP-17 | 08:05 | W16 | 11-SEP-17 | 08:40 | 11-SEP-17 | 12-SEP-17 | 12-SEP-17 |
| | | | | | W16 | W17 | W8A | W3 | MC1 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 446 | 470 | 1050 | 518 | 330 | | | |
| | Hardness (as CaCO3) (mg/L) | 215 | 226 | 529 | 255 | 161 | | | |
| | pH (pH) | 8.41 | 8.44 | 8.36 | 8.50 | 8.42 | | | |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | 20.0 | <3.0 | <3.0 | | | |
| | TDS (Calculated) (mg/L) | 272 | 278 | 727 | 307 | 187 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 171 | 198 | 324 | 236 | 170 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 171 | 198 | 324 | 236 | 170 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0429 | <0.0050 | 0.0362 | 0.0051 | <0.0050 | | | |
| | Chloride (Cl) (mg/L) | 6.69 | 6.17 | 7.8 | 4.43 | 1.38 | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 1.86 | 0.172 | 6.20 | 0.167 | 0.0327 | | | |
| | Nitrate (as N) (mg/L) | 1.85 | 0.172 | 6.17 | 0.167 | 0.0327 | | | |
| | Nitrite (as N) (mg/L) | 0.0141 | <0.0010 | 0.0289 | <0.0010 | <0.0010 | | | |
| | Sulfate (SO4) (mg/L) | 62.5 | 54.6 | 266 | 54.9 | 17.8 | | | |
| | Anion Sum (meq/L) | 5.03 | 5.28 | 12.7 | 5.99 | 3.80 | | | |
| | Cation Sum (meq/L) | 4.99 | 5.27 | 12.4 | 5.98 | 3.67 | | | |
| | Cation - Anion Balance (%) | -0.5 | -0.2 | -1.1 | -0.1 | -1.7 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 13.5 | 8.78 | 17.0 | 5.76 | 9.45 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0282 | 0.0030 | 0.335 | 0.0071 | 0.0588 | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00011 | 0.00013 | 0.00040 | <0.00010 | 0.00011 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00042 | 0.00037 | 0.00077 | 0.00025 | 0.00058 | | | |
| | Barium (Ba)-Total (mg/L) | 0.0752 | 0.0717 | 0.118 | 0.0691 | 0.0614 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | 0.000021 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | 0.028 | 0.032 | 0.026 | 0.026 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000070 | <0.0000050 | 0.000135 | <0.0000050 | <0.0000050 | | | |
| | Calcium (Ca)-Total (mg/L) | 55.5 | 58.9 | 144 | 53.1 | 39.4 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00017 | 0.00011 | 0.00164 | 0.00015 | 0.00036 | | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | <0.00010 | 0.00059 | <0.00010 | 0.00010 | | | |
| | Copper (Cu)-Total (mg/L) | 0.0268 | 0.00698 | 0.150 | 0.00316 | 0.00183 | | | |
| | Iron (Fe)-Total (mg/L) | 0.087 | <0.010 | 1.04 | 0.028 | 0.199 | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | 0.000265 | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0013 | 0.0013 | 0.0032 | 0.0029 | 0.0014 | | | |
| | Magnesium (Mg)-Total (mg/L) | 17.9 | 18.9 | 40.0 | 30.2 | 16.0 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0420 | 0.00223 | 0.802 | 0.0497 | 0.0220 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1990965-6 Water 12-SEP-17 15:23 W2 | L1990965-7 Water 12-SEP-17 DUP | | |
|-----------------------------|---|---|---|------|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 336 | 330 | | |
| | Hardness (as CaCO3) (mg/L) | 167 | 163 | | |
| | pH (pH) | 8.42 | 8.43 | | |
| | Total Suspended Solids (mg/L) | <3.0 | 5.3 | | |
| | TDS (Calculated) (mg/L) | 191 | 188 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 167 | 169 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 167 | 169 | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | <0.0050 | | |
| | Chloride (Cl) (mg/L) | 1.63 | 1.38 | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.0249 | 0.0291 | | |
| | Nitrate (as N) (mg/L) | 0.0249 | 0.0291 | | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | | |
| | Sulfate (SO4) (mg/L) | 19.7 | 17.9 | | |
| | Anion Sum (meq/L) | 3.80 | 3.79 | | |
| | Cation Sum (meq/L) | 3.81 | 3.73 | | |
| | Cation - Anion Balance (%) | 0.1 | -0.9 | | |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 8.76 | 9.26 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0187 | 0.0501 | | |
| | Antimony (Sb)-Total (mg/L) | 0.00011 | 0.00013 | | |
| | Arsenic (As)-Total (mg/L) | 0.00048 | 0.00057 | | |
| | Barium (Ba)-Total (mg/L) | 0.0602 | 0.0624 | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Total (mg/L) | <0.010 | <0.010 | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | <0.0000050 | | |
| | Calcium (Ca)-Total (mg/L) | 40.2 | 39.4 | | |
| | Chromium (Cr)-Total (mg/L) | 0.00023 | 0.00033 | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00010 | | |
| | Copper (Cu)-Total (mg/L) | 0.00179 | 0.00183 | | |
| | Iron (Fe)-Total (mg/L) | 0.083 | 0.186 | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Total (mg/L) | 0.0015 | 0.0014 | | |
| | Magnesium (Mg)-Total (mg/L) | 15.9 | 16.1 | | |
| | Manganese (Mn)-Total (mg/L) | 0.00957 | 0.0217 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1990965-1 Water 11-SEP-17 08:05 W16 | L1990965-2 Water 11-SEP-17 08:40 W17 | L1990965-3 Water 11-SEP-17 10:15 W8A | L1990965-4 Water 12-SEP-17 08:40 W3 | L1990965-5 Water 12-SEP-17 14:44 MC1 |
|---|---------------------------------------|--|--|--|---|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | 0.0000057 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00290 | 0.00533 | 0.0137 | 0.00449 | 0.00153 |
| | Nickel (Ni)-Total (mg/L) | 0.00081 | 0.00065 | 0.00129 | 0.00102 | 0.00130 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | 0.069 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.83 | 3.63 | 6.07 | 2.39 | 1.32 |
| | Selenium (Se)-Total (mg/L) | 0.000754 | 0.000384 | 0.00972 | 0.000317 | 0.000118 |
| | Silicon (Si)-Total (mg/L) | 3.39 | 5.18 | 8.21 | 6.33 | 6.39 |
| | Silver (Ag)-Total (mg/L) | 0.000092 | <0.000010 | 0.000044 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 13.4 | 14.5 | 36.1 | 18.4 | 9.56 |
| | Strontium (Sr)-Total (mg/L) | 0.544 | 0.620 | 1.67 | 0.700 | 0.393 |
| | Sulfur (S)-Total (mg/L) | 21.2 | 18.7 | 97.3 | 19.2 | 6.25 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.0012 ^{DLM} | <0.00030 | 0.0177 | <0.00030 | 0.00253 |
| | Uranium (U)-Total (mg/L) | 0.00127 | 0.00194 | 0.00255 | 0.00268 | 0.00148 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | <0.00050 | 0.00226 | <0.00050 | 0.00097 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | 0.460 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0040 | 0.0074 | 0.0075 | 0.0112 | 0.0062 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00014 | <0.00010 | 0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00042 | 0.00037 | 0.00061 | 0.00023 | 0.00051 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0761 | 0.0739 | 0.111 | 0.0693 | 0.0599 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.029 | 0.032 | 0.025 | 0.025 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000075 | <0.0000050 | 0.000116 | 0.0000056 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 58.1 | 61.3 | 151 | 56.4 | 41.9 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00011 | 0.00011 | 0.00065 | 0.00015 | 0.00023 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00038 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0244 | 0.00736 | 0.0747 | 0.00480 ^{DTC} | 0.00167 |
| | Iron (Fe)-Dissolved (mg/L) | 0.040 | 0.011 | 0.147 | 0.037 | 0.088 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0011 | 0.0013 | 0.0034 | 0.0032 | 0.0011 |
| | Magnesium (Mg)-Dissolved (mg/L) | 17.1 | 17.8 | 36.9 | 27.7 | 13.7 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0286 | 0.00678 ^{DTC} | 0.811 | 0.0478 | 0.0135 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1990965-6 Water 12-SEP-17 15:23 W2 | L1990965-7 Water 12-SEP-17 DUP | | |
|-------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00143 | 0.00161 | | |
| | Nickel (Ni)-Total (mg/L) | 0.00119 | 0.00122 | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Total (mg/L) | 1.46 | 1.31 | | |
| | Selenium (Se)-Total (mg/L) | 0.000108 | 0.000128 | | |
| | Silicon (Si)-Total (mg/L) | 6.13 | 6.36 | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Total (mg/L) | 9.71 | 9.60 | | |
| | Strontium (Sr)-Total (mg/L) | 0.416 | 0.405 | | |
| | Sulfur (S)-Total (mg/L) | 6.91 | 6.81 | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Total (mg/L) | 0.00087 | 0.00254 | | |
| | Uranium (U)-Total (mg/L) | 0.00176 | 0.00152 | | |
| | Vanadium (V)-Total (mg/L) | 0.00074 | 0.00091 | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0039 | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0049 | 0.0060 | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00048 | 0.00052 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0607 | 0.0605 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 43.0 | 41.3 | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00019 | 0.00022 | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00165 | 0.00159 | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.052 | 0.094 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0016 | 0.0013 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 14.5 | 14.6 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00785 | 0.0146 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1990965-1 Water 11-SEP-17 08:05 W16 | L1990965-2 Water 11-SEP-17 08:40 W17 | L1990965-3 Water 11-SEP-17 10:15 W8A | L1990965-4 Water 12-SEP-17 08:40 W3 | L1990965-5 Water 12-SEP-17 14:44 MC1 |
|---|----------------------------------|--|--|--|---|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00290 | 0.00549 | 0.0140 | 0.00464 | 0.00153 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00075 | 0.00062 | 0.00099 | 0.00097 | 0.00097 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 2.92 | 3.65 | 6.02 | 2.40 | 1.29 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000771 | 0.000458 | 0.0102 | 0.000320 | 0.000095 |
| | Silicon (Si)-Dissolved (mg/L) | 3.38 | 5.07 | 7.38 | 6.14 | 5.87 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000011 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 13.9 | 14.9 | 37.0 | 18.8 | 9.42 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.565 | 0.656 | 1.79 | 0.743 | 0.431 |
| | Sulfur (S)-Dissolved (mg/L) | 22.6 | 19.1 | 97.9 | 19.5 | 6.08 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00038 | <0.00060 ^{DLM} | <0.00060 ^{DLM} | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | 0.00119 | 0.00184 | 0.00242 | 0.00256 | 0.00141 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00081 | <0.00050 | 0.00065 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0010 | 0.0011 | 0.178 | <0.0010 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1990965-6 Water 12-SEP-17 15:23 W2 | L1990965-7 Water 12-SEP-17 DUP | | |
|-------------------------|--|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00149 | 0.00155 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00096 | 0.00106 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 1.46 | 1.32 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000144 | 0.000111 | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.14 | 6.34 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 9.79 | 9.77 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.440 | 0.418 | | |
| | Sulfur (S)-Dissolved (mg/L) | 7.08 | 6.39 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00060 ^{DLM} | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00168 | 0.00143 | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00064 | 0.00069 | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|------------------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Copper (Cu)-Total | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Uranium (U)-Total | MS-B | L1990965-1, -2, -3, -4, -5, -6, -7 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|---|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

Reference Information

WR ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2017-09-13 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



COC Number: 2017-09-13 A

Canada Toll Free: 1 800 668 9878

L1990965-COFC

www.alsglobal.com

| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | |
|---|---|--|-----------------|---|--|-------------------------------------|------------------------------|---|--|--|--|---------------------------|--------------------------------|----------------------|--------------|--------------------|--|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: CR/CP | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | | | |
| W16 | | 11-Sep-17 | 8:05 | Water | R | R | R | R | R | R | R | R | R | | 7 | | | |
| W17 | | 11-Sep-17 | 8:40 | Water | R | R | R | R | R | R | R | R | R | | 7 | | | |
| W8A | | 11-Sep-17 | 10:15 | Water | R | R | R | R | R | R | R | R | R | | 7 | | | |
| W3 | | 12-Sep-17 | 8:40 | Water | R | R | R | R | R | R | R | R | R | | 7 | | | |
| W3 | | 12-Sep-17 | 8:40 | Water | R | R | R | R | R | R | R | R | R | | 7 | | | |
| MC1 | | 12-Sep-17 | 14:44 | Water | R | R | R | R | R | R | R | R | R | | 7 | | | |
| W2 | | 12-Sep-17 | 15:23 | Water | R | R | R | R | R | R | R | R | R | | 7 | | | |
| DUP | | 12-Sep-17 | | Water | R | R | R | R | R | R | R | R | R | | 7 | | | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | | | | | | | 7.5 avg | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | |
| Released by: Colin Prentice | | Date: 2017-09-13 | | Time: | | Received by: | | Date: | | Time: | | Received by: <i>Cade</i> | | Date: <i>Sep 14</i> | | Time: <i>13:30</i> | | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 20-SEP-17
Report Date: 02-OCT-17 18:54 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1994568
Project P.O. #: 226973
Job Reference:
C of C Numbers: 2017-09-20 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1994568-1 | L1994568-2 | L1994568-3 |
|-----------------------------|---|---------------------------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 19-SEP-17 | 19-SEP-17 | 19-SEP-17 |
| | | Sampled Time | 14:45 | 16:40 | |
| | | Client ID | W3 | MC1 | DUP |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 510 | 344 | 343 |
| | Hardness (as CaCO3) (mg/L) | | 252 | 169 | 174 |
| | pH (pH) | | 8.30 | 8.30 | 8.31 |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | 5.4 |
| | TDS (Calculated) (mg/L) | | 310 | 200 | 200 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 239 | 177 | 174 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | 4.0 | 3.6 | 4.4 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 243 | 181 | 178 |
| | Ammonia, Total (as N) (mg/L) | | 0.0057 | <0.0050 | <0.0050 |
| | Chloride (Cl) (mg/L) | | 4.42 | 1.57 | 1.58 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.153 | 0.0288 | 0.0275 |
| | Nitrate (as N) (mg/L) | | 0.153 | 0.0288 | 0.0275 |
| | Nitrite (as N) (mg/L) | | <0.0010 | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 55.2 | 20.3 | 20.3 |
| | Anion Sum (meq/L) | | 6.15 | 4.08 | 4.03 |
| | Cation Sum (meq/L) | | 5.90 | 3.86 | 3.95 |
| | Cation - Anion Balance (%) | | -2.1 | -2.8 | -1.1 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 5.66 | 8.85 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0083 | 0.0144 | 0.0234 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00027 | 0.00053 | 0.00051 |
| | Barium (Ba)-Total (mg/L) | | 0.0680 | 0.0609 | 0.0600 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.026 | <0.010 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Total (mg/L) | | 53.2 | 41.3 | 40.6 |
| | Chromium (Cr)-Total (mg/L) | | 0.00016 | 0.00027 | 0.00025 |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | | 0.00294 | 0.00173 | 0.00169 |
| | Iron (Fe)-Total (mg/L) | | 0.031 | 0.107 | 0.118 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | 0.0036 | 0.0017 | 0.0017 |
| | Magnesium (Mg)-Total (mg/L) | | 27.7 | 15.3 | 15.2 |
| | Manganese (Mn)-Total (mg/L) | | 0.0465 | 0.0131 | 0.0141 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1994568-1 Water 19-SEP-17 14:45 W3 | L1994568-2 Water 19-SEP-17 16:40 MC1 | L1994568-3 Water 19-SEP-17 DUP | |
|-------------------------|---|---|--|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00485 | 0.00169 | 0.00169 | |
| | Nickel (Ni)-Total (mg/L) | 0.00092 | 0.00100 | 0.00102 | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | |
| | Potassium (K)-Total (mg/L) | 2.26 | 1.31 | 1.29 | |
| | Selenium (Se)-Total (mg/L) | 0.000298 | 0.000136 | 0.000099 | |
| | Silicon (Si)-Total (mg/L) | 6.08 | 6.08 | 6.05 | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Sodium (Na)-Total (mg/L) | 18.5 | 10.1 | 10.0 | |
| | Strontium (Sr)-Total (mg/L) | 0.757 | 0.452 | 0.446 | |
| | Sulfur (S)-Total (mg/L) | 19.1 | 6.96 | 6.87 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Total (mg/L) | 0.00070 | <0.0012 ^{DLM} | 0.00100 | |
| | Uranium (U)-Total (mg/L) | 0.00289 | 0.00166 | 0.00161 | |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00077 | 0.00076 | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0030 | 0.0054 | 0.0045 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00024 | 0.00048 | 0.00047 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0683 | 0.0636 | 0.0625 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | 0.025 | <0.010 | <0.010 | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Calcium (Ca)-Dissolved (mg/L) | 56.6 | 42.9 | 44.5 | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00018 | 0.00016 | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00337 | 0.00145 | 0.00141 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.024 | 0.075 | 0.075 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0034 | 0.0015 | 0.0015 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 26.9 | 15.1 | 15.2 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0433 | 0.0106 | 0.0103 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1994568-1 | L1994568-2 | L1994568-3 | | |
|-------------------------|----------------------------------|--------------|--------------|------------|------------|------------|------------|--|--|
| | | | | | Water | Water | Water | | |
| | | 19-SEP-17 | 14:45 | | 19-SEP-17 | 19-SEP-17 | 19-SEP-17 | | |
| | | | | | W3 | MC1 | DUP | | |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00449 | 0.00157 | 0.00158 | | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00075 | 0.00082 | 0.00081 | | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | | | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.27 | 1.35 | 1.36 | | | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000383 | 0.000091 | 0.000092 | | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.16 | 6.27 | 6.15 | | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 18.3 | 9.96 | 9.99 | | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.750 | 0.437 | 0.443 | | | | | |
| | Sulfur (S)-Dissolved (mg/L) | 19.1 | 7.07 | 6.98 | | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00261 | 0.00147 | 0.00150 | | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00059 | 0.00060 | | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | 0.0023 | <0.0010 | | | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1994568-1, -2, -3 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1994568-1, -2, -3 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1994568-1, -2, -3 |
| Matrix Spike | Chloride (Cl) | MS-B | L1994568-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1994568-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1994568-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1994568-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1994568-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1994568-1, -2, -3 |
| Matrix Spike | Nitrate (as N) | MS-B | L1994568-1, -2, -3 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1994568-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) | | | |

Reference Information

should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

| | |
|----|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |
|----|---|

Chain of Custody Numbers:

2017-09-20 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1994568-COFC

COC Number: 2017-09-20 A

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www.alsglobal.com

| Report To | | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | |
|---|---|------------|--|------------------|--------------|--|-------------------------------------|------------------------------|-----------------------------|--|-------------------------|--|---------------------------|--------------------------------|----------------------|----------------|---|---|---|--|--|--|---|--|--|--|--|
| Contact and company name below will appear on the final report | | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | |
| Phone: | 1-604-759-4659 | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | dd-mmm-yy hh:mm | | | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | | Email 3 | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | P F/P P F/P P F/P | | | | | | | | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TW), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | | Email 3 | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | AFE/Cost Center: | | | | | | | | | | | | | PO# | | | | | | | | | | | |
| Job #: | | | Major/Minor Code: | | | | | | | | | | | | | Routing Code: | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | | Location: | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | ALS Contact: Shane Stack | | | | | | | | | | | | | Sampler: SR/CH | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | | | | | | | | | | | Sample Type | | | | | | | | | | | |
| | W3 | | | 19-Sep-17 | 14:45 | Water | R | R | R | R | R | R | R | R | R | R | R | R | R | | | | 7 | | | | |
| | MC1 | | | 19-Sep-17 | 16:40 | Water | R | R | R | R | R | R | R | R | R | R | R | R | R | | | | 7 | | | | |
| | DUP | | | 19-Sep-17 | | Water | R | R | R | R | R | R | R | R | R | R | R | R | R | | | | 7 | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | |
| | | | | | | 5°C | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | |
| Released by: Shaun Roberts | Date: 2017-09-19 | Time: 9:00 | Received by: | Date: Sept 20/17 | Time: 14:07 | Received by: | Date: | Time: | Received by: | Date: | Time: | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-SEP-17
Report Date: 08-NOV-17 15:43 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1998015
Project P.O. #: 224159 (MMER)
Job Reference:
C of C Numbers: 2017-09-26 C
Legal Site Desc:

Comments: Please note, the Nautilus report for 7-d Lemna minor growth inhibition can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | | | | |
|---|---------|--|--|--|--|
| Grouping | Analyte | | | | |
| | | | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|------------------|--------------------|
|---------------|--------|------------------|--------------------|

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

Chain of Custody Numbers:

2017-09-26 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Toxicity Testing on L1998015-1 W3

Sample collected on September 26, 2017

Final Report

November 7, 2017

Submitted to: **ALS Environmental**
Burnaby, BC

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APPENDIX A – *Lemna minor* Toxicity Test Data

APPENDIX B – Chain-of-Custody Form

SIGNATURE PAGE

Report By:
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Laboratory Biologist



Reviewed By:
Armando Tang, R.P.Bio
Laboratory Manager

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

SUMMARY

Sample Information and Test Type

| | |
|----------------------------|--|
| Sample ID | L1998015-1 W3 |
| Sample collection date | September 26, 2017 |
| Sample receipt date | September 28 2017 |
| Sample receipt temperature | 11°C |
| Test types | 7-d <i>Lemna minor</i> growth inhibition |

Summary of Results

| Endpoint | % v/v |
|--------------------|-------|
| <i>Lemna minor</i> | |
| Fronnd count IC25 | >97 |
| Fronnd count IC50 | >97 |
| Dry weight IC25 | >97 |
| Dry weight IC50 | >97 |

IC = Inhibition Concentration

1.0 INTRODUCTION

Nautilus Environmental Company Inc. conducted a *Lemna minor* growth inhibition toxicity test for Minto Explorations Ltd. as part of their requirements under the Metal Mining Effluent Regulations (MMER) and Environmental Effects Monitoring (EEM) program. Sample L1998015-1 W3 was collected on September 26, 2017 and delivered to the Nautilus Environmental laboratory in Burnaby, BC on September 28, 2017. Testing was initiated on September 28, 2017. The sample was transported in two 1-L plastic containers and was received at a temperature of 11°C. The sample was stored in the dark at $4 \pm 2^\circ\text{C}$ prior to testing.

This report describes the results of the *L. minor* toxicity test. Copies of raw laboratory data sheets and statistical analyses are provided in Appendix A. The chain-of-custody form is provided in Appendix B.

2.0 METHODS

Methods for the toxicity tests are summarized in Table 1. Testing was conducted according to procedures described by Environment Canada (2007). Statistical analyses for the test were performed using CETIS (Tidepool Scientific Software, 2013).

Table 1. Summary of test conditions: *Lemna minor* growth inhibition test.

| | |
|---|--|
| Test species | <i>Lemna minor</i> , strain CPCC# 490 |
| Organism source | In-house axenic culture, obtained from Canadian Phycological Culture Centre, and originally isolated from Wainfleet, Stinking Barn, Niagara Peninsula, Ontario, Canada |
| Organism age | 7- to 10-day old culture |
| Test type | Static |
| Test duration | 7 days |
| Test vessel | 250-mL glass container |
| Test volume | 100 mL |
| Test solution depth | 4 cm |
| Test concentrations | Seven concentrations, plus laboratory control |
| Test replicates | 4 per treatment |
| Number of organisms | Two 3-frond plants per replicate |
| Control/dilution water | Modified APHA media (deionized water plus 1% of each APHA stock solution A, B and C) |
| Test solution renewal | None |
| Test temperature | 25 ± 2°C |
| Feeding | None |
| Light intensity | 4000 to 5600 lux |
| Photoperiod | 24 hours light |
| Aeration | None |
| Test measurements | Test area temperature measured daily; temperature, pH and conductivity measured in all concentrations at test initiation; dissolved oxygen of highest concentration measured at test initiation; temperature and pH measured at test termination |
| Test protocol | Environment Canada (2007), EPS 1/RM/37 |
| Statistical software | CETIS Version 1.8.7 |
| Test endpoints | Number of fronds and dry weight |
| Test acceptability criterion for controls | ≥ 8-fold increase in number of fronds |
| Reference toxicant | Potassium chloride (KCl) |

3.0 RESULTS

Results of the toxicity test conducted on sample L1998015-1 W3 are provided in Table 2. There were no adverse effects on frond growth or dry weight, resulting in IC25 and IC50 values of >97% (v/v) for both endpoints. Significant stimulation on dry weight were observed in test concentrations 48.5 and 97% (v/v); percent stimulation ranged between 30.4 and 33.2%.

Table 2. Results: *Lemna minor* growth inhibition test.

| Concentration (% v/v) | Frond Growth (No. of Fronds) (Mean ± SD) | Stimulation (%) | Dry Weight (mg) (Mean ± SD) | Stimulation (%) |
|------------------------------|--|--------------------|-----------------------------------|--------------------|
| Laboratory Control | 110.3 ± 9.5 | -- | 9.3 ± 0.7 | -- |
| 1.5 | 107.3 ± 13.4 | -- | 8.6 ± 1.0 | -- |
| 3.0 | 105.3 ± 22.7 | -- | 8.6 ± 1.6 | -- |
| 6.1 | 111.5 ± 7.0 | 1.1 | 9.2 ± 0.9 | -- |
| 12.1 | 118.8 ± 8.2 | 7.7 | 9.3 ± 0.6 | 0.65 |
| 24.2 | 121.5 ± 18.6 | 10.2 | 10.8 ± 1.7 | 17.0 |
| 48.5 | 129.3 ± 3.6 | 17.2 | 12.1 ± 0.9* | 30.4 |
| 97 | 120.0 ± 17.1 | 8.8 | 12.3 ± 1.8* | 33.2 |
| Test Endpoint (% v/v) | | | | |
| IC25 | >97 | | >97 | |
| IC50 | >97 | | >97 | |

SD = Standard Deviation, IC = Inhibition Concentration

* = Indicates dry weight that were significantly greater than the control

4.0 QA/QC

The health history of the test organisms used in the exposure was acceptable and met the requirements of the Environment Canada protocol. The test met all control acceptability criteria and water quality parameters remained within ranges specified in the protocol throughout the test. There were no deviations from the test methodology. Uncertainty associated with the test is best described by the standard deviation around the mean and/or the confidence intervals around the point estimates.

Results of the reference toxicant test conducted during the testing program are summarized in Table 3. Results for this test fell within the range for organism performance of the mean and two standard deviations, based on historical results obtained by the laboratory with this test. Thus, the sensitivity of the organisms used in this test was appropriate. The reference toxicant test was performed under the same conditions as those used for the sample.

Table 3. Reference toxicant test results.

| Test Species | Endpoint | Historical Mean (2 SD Range) | CV (%) | Test Date |
|---------------------|--------------------------------|---|-------------------|--------------------|
| <i>L. minor</i> | No. Fronds (IC50): 3.8 g/L KCl | 3.7 (3.0 – 4.6) | 11 | September 29, 2017 |

SD = Standard Deviation, CV = Coefficient of Variation, IC = Inhibition Concentration,

5.0 REFERENCES

Environment Canada. 2007. Biological test method: tests for measuring the inhibition of growth using the freshwater macrophyte, *Lemna minor*. Environmental Protection Series, Report EPS 1/RM/37. Second Edition. January 2007. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 112 pp.

Tidepool Scientific Software. 2013. CETIS comprehensive environmental toxicity information system, version 1.8.7.16 Tidepool Scientific Software, McKinleyville, CA. 275 pp.

APPENDIX A – *Lemna minor* Toxicity Test Data

Lemna minor Summary Sheet

Client: ALS / Minto
Work Order No.: 171055

Start Date: Sept 28 / 17
Set up by: JW

Sample Information:

Sample ID: L1998015 - 1 W3
Sample Date: Sept 26 / 17
Date Received: Sept 28 / 17
Sample Volume: 2 x 1L

Test Organism Information:

Culture Date: 092117
Age of culture (Day 0): 7 days
>8X growth in APHA?: Y (34 fronds)

KCI Reference Toxicant Results:

Reference Toxicant ID: 151 LM 155 JW
Date Initiated: Sept 29 / 17

7-d No. of Fronds IC50 (95% CL): 3.8 (2.8 - 4.6) g/L KCI

7-d No. Fronds IC50 Reference Toxicant Mean (2 SD Range): 3.7 (3.0 - 4.6) CV (%): 11
g/L KCI

| | Number of Fronds | Dry Weight |
|------------------------------------|------------------|------------|
| Test Results: IC25 %(v/v) (95% CL) | 797 | 797 |
| IC50 %(v/v) (95% CL) | 797 | 797 |

Reviewed by: JOH

Date reviewed: Oct-20/17

Plant Growth Inhibition Toxicity Test Water Quality Measurements

Client: ALS / Minto Setup by: JW
 Sample ID: W3 (L1998015-1) Test Date: Sept 28/17
 Work Order No.: 171055 CER #: 4
 Culture Source: CPCC # 490 Test Species: Lemna minor
 Test Culture Age: 7 days > 8X Growth? (Y/N): Y^{JW} (~~Sept 28/17~~) (34 fronds)
 Light Intensity Range: 4100 - 5000 lux Date Measured: Sept 28/17

| Day | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-----------------|------|------|------|------|------|------|------|------|
| Shelf Temp (°C) | 24.5 | 24.5 | 24.5 | 24.5 | 24.5 | 24.5 | 24.5 | 24.5 |
| Initials | JW | JW | JW | Emm | JW | JW | JW | JW |

| | | | |
|-------------------------|-----------------------|--|------------------------|
| Sample Characteristics: | Initial Water Quality | | Adjusted Water Quality |
| Temperature (°C) | <u>25.0</u> | Aeration?: <u>20 min</u> | <u>25.0</u> |
| DO (mg/L) | <u>8.7</u> | Nutrients added? ¹ : <u>Y</u> | <u>8.4</u> |
| pH | <u>7.8</u> | | <u>8.1</u> |
| Conductivity (µS) | <u>560</u> | | <u>1358</u> |

¹ 10 mL of each APHA stock (A,B and C) added to 970 mL sample.

| Concentration % (V/V) | Temperature (°C) | | pH | | Conductivity (µS) 0 h |
|--------------------------|------------------|-------|--------------------------|-------|--------------------------|
| | Day 0 | Day 7 | Day 0 | Day 7 | |
| Control | 24.0 | 24.5 | <u>8.23^{JW}</u> | 8.3 | 872 |
| 1.5 | 24.0 | 24.5 | 8.2 | 8.5 | 886 |
| 3 | 24.0 | 24.5 | 8.2 | 8.7 | 894 |
| 6.1 | 24.0 | 24.5 | 8.2 | 8.7 | 910 |
| 12.1 | 24.0 | 24.5 | 8.2 | 8.8 | 941 |
| 24.2 | 24.0 | 24.5 | 8.2 | 8.8 | 1001 |
| 48.5 | 24.0 | 24.5 | 8.2 | 9.0 | 1124 |
| 97 | 25.0 | 24.5 | 8.1 | 9.1 | 1358 |
| Initials | JW | JW | JW | MLT | JW |

Thermometer: 4 Light meter: 1 pH meter/probe: 1 / 1 DO meter/probe: 1 / 1 Conductivity meter/probe: 1 / 1

Sample Description: Clear, light yellow, odorless, some particulates.

Comments: _____

Reviewed: Joh

Date Reviewed: Oct-20/17

Lemna minor Toxicity Test Data Sheet - 7-d Frond Counts

Client: ALS
 Sample ID: W3 (L1998015-1)
 Work Order #: 171055

Start Date: Sept 28 / 17
 Termination Date: Oct 5 / 17
 Test set up by: JW

| Concentration g % (v/v) | Rep | No. of fronds | | Chlorosis | Necrosis | Yellow | Abnormal size | Gibbosity | Single fronds | Root destruction | Loss of buoyancy | Comments | Initials |
|----------------------------|-----|---------------|-------|-----------|----------|--------|------------------|-----------|------------------|---------------------|---------------------|----------|----------|
| | | Day 0 | Day 7 | | | | | | | | | | |
| control | A | 6 | 109 | | | | | | | | | | JW |
| | B | 6 | 130 | | | | | | | | | | |
| | C | 6 | 111 | | | | | | | | | | |
| | D | 6 | 115 | | | | | | | | | | |
| 1.5 | A | 6 | 122 | | | | | | | | | | |
| | B | 6 | 127 | | | | | | | | | | |
| | C | 6 | 105 | | | | | | | | | | |
| | D | 6 | 99 | | | | | | | | | | |
| 3 | A | 6 | 80 | | | | | | | | | | |
| | B | 6 | 109 | | | | | | | | | | |
| | C | 6 | 126 | | | | | | | | | | |
| | D | 6 | 130 | | | | | | | | | | |
| 6.1 | A | 6 | 117 | | | | | | | | | | |
| | B | 6 | 108 | | | | | | | | | | |
| | C | 6 | 121 | | | | | | | | | | |
| | D | 6 | 124 | | | | | | | | | | |
| 12.1 | A | 6 | 116 | | | | | | | | | | |
| | B | 6 | 134 | | | | | | | | | | |
| | C | 6 | 129 | | | | | | | | | | |
| | D | 6 | 120 | | | | | | | | | | |
| 24.2 | A | 6 | 152 | | | | | | | | | | |
| | B | 6 | 108 | | | | | | | | | | |
| | C | 6 | 130 | | | | | | | | | | |
| | D | 6 | 120 | | | | | | | | | | ✓ |

Comments: _____

Reviewed by: JW

Date Reviewed: Oct-13/17

Lemna minor Toxicity Test Data Sheet - 7-d Frond Counts

Client: ALS
 Sample ID: W3 (L1998015 - 1)
 Work Order #: 171055

Start Date: Sept 28 / 17
 Termination Date: Oct 5 / 17
 Test set up by: JW

| Concentration % (v/v) | Rep | No. of fronds | | Chlorosis | Necrosis | Yellow | Abnormal size | Gibbosity | Single fronds | Root destruction | Loss of buoyancy | Comments | Initials |
|--------------------------|-----|---------------|-------|-----------|----------|--------|------------------|-----------|------------------|---------------------|---------------------|----------|----------|
| | | Day 0 | Day 7 | | | | | | | | | | |
| 48.5 | A | 6 | 136 | | | | | | | | | | JW |
| | B | 6 | 133 | | | | | | | | | | |
| | C | 6 | 132 | | | | | | | | | | |
| | D | 6 | 140 | | | | | | | | | | |
| 97 | A | 6 | 145 | | | | | | | | | | |
| | B | 6 | 105 | | | | | | | | | | |
| | C | 6 | 121 | | | | | | | | | | |
| | D | 6 | 133 | | | | | | | | | | ↓ |
| | A | | | | | | | | | | | | |
| | B | | | | | | | | | | | | |
| | C | | | | | | | | | | | | |
| | D | | | | | | | | | | | | |
| | A | | | | | | | | | | | | |
| | B | | | | | | | | | | | | |
| | C | | | | | | | | | | | | |
| | D | | | | | | | | | | | | |
| | A | | | | | | | | | | | | |
| | B | | | | | | | | | | | | |
| | C | | | | | | | | | | | | |
| | D | | | | | | | | | | | | |

Comments: _____

Reviewed by: JGh

Date Reviewed: Oct. 13 / 17

7-d Lemna minor Weight Data Sheet

Client: ALS / Minto
 Sample ID: W3 (L1998015 -1)
 WO #: 171055 JW

Start Date: sept 28 / 17
 Termination Date: oct 5 / 17
 Balance ID: Bal - 1

W3 Blue Black

| Concentration | Rep | Pan No. | Pan weight (mg) | Pan + plant (mg) | Initials |
|------------------------|-----|---------|-----------------|------------------|----------|
| % (v/v) control | A | 1 | 1280.08 | 1288.91 | JW |
| | B | 2 | 1279.25 | 1289.51 | |
| | C | 3 | 1280.97 | 1290.23 | |
| | D | 4 | 1279.49 | 1288.19 | |
| 1.5 | A | 5 | 1274.71 | 1283.57 | |
| | B | 6 | 1280.99 | 1290.60 | |
| | C | 7 | 1274.16 | 1282.82 | |
| | D | 8 | 1276.72 | 1283.96 | |
| 3 | A | 9 | 1277.35 | 1283.60 | |
| | B | 10 | 1279.33 | 1288.07 | |
| | C | 11 | 1275.33 | 1284.81 | |
| | D | 12 | 1275.52 | 1285.43 | |
| 6.1 | A | 13 | 1274.72 | 1283.63 | |
| | B | 14 | 1280.09 | 1288.07 | |
| | C | 15 | 1281.78 | 1291.59 | |
| | D | 16 | 1279.43 | 1289.49 | |
| 12.1 | A | 17 | 1276.10 | 1284.95 | |
| | B | 18 | 1277.56 | 1287.60 | |
| | C | 19 | 1282.95 | 1292.51 | |
| | D | 20 | 1282.01 | 1290.85 | |
| 24.2 | A | 21 | 1283.99 | 1297.21 | |
| | B | 22 | 1279.15 | 1288.29 | |
| | C | 23 | 1282.85 | 1293.16 | |
| | D | 24 | 1279.11 | 1289.77 | |
| 48.5 | A | 25 | 1273.68 | 1286.11 | |
| | B | 26 | 1272.35 | 1284.54 | |
| | C | 27 | 1278.33 | 1289.12 | |
| | D | 28 | 1277.53 | 1290.43 | ↓ |

Comments: 10 % Reweigh = # 1: 1288.75 mg # 27: 1289.02 mg
(mg) # 15: 1288.52 mg # 32: 1290.01 mg

Reviewed by: JGK Date Reviewed: Oct-13/17

7-d Lemna minor Weight Data Sheet

Client: ALS
 Sample ID: W3 (L1998015 -1)
 WO #: 171055 JW

Start Date: Sept 28 / 17
 Termination Date: Oct 5 / 17
 Balance ID: Bal - 1

W3 Blue - Black

| Concentration | Rep | Pan No. | Pan weight (mg) | Pan + plant (mg) | Initials |
|-------------------|-----|---------|-----------------|------------------|----------|
| % (v/v) 97 | A | 29 | 1277.26 | 1290.90 | JW |
| | B | 30 | 1271.74 | 1282.17 | |
| | C | 31 | 1275.41 | 1286.68 | |
| | D | 32 | 1276.04 | 1290.06 | ↓ |
| | A | | | | |
| | B | | | | |
| | C | | | | |
| | D | | | | |
| | A | | | | |
| | B | | | | |
| | C | | | | |
| | D | | | | |
| | A | | | | |
| | B | | | | |
| | C | | | | |
| | D | | | | |
| | A | | | | |
| | B | | | | |
| | C | | | | |
| | D | | | | |

Comments: _____

Reviewed by: JGh

Date Reviewed: Oct - 13 / 17

CETIS Analytical Report

Report Date: 09 Oct-17 17:50 (p 1 of 2)
 Test Code: 171055 | 20-4038-8962

Lemna Growth Inhibition Test Nautilus Environmental

| | | |
|-------------------------------|--|---|
| Analysis ID: 19-1163-4932 | Endpoint: Frond Count | CETIS Version: CETISv1.8.7 |
| Analyzed: 09 Oct-17 17:49 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 03-7269-1221 | Test Type: Lemna Growth | Analyst: JIN Jill Somes <i>Jeslin Wijaya</i> |
| Start Date: 28 Sep-17 | Protocol: EC/EPS 1/RM/37 | Diluent: Modified APHA |
| Ending Date: 05 Oct-17 | Species: Lemna minor | Brine: |
| Duration: 7d 0h | Source: CPCC#490 | Age: 7d |
| Sample ID: 13-1359-5064 | Code: 4E4BDEB8 | Client: ALS |
| Sample Date: 26 Sep-17 | Material: Water Sample | Project: |
| Receive Date: 28 Sep-17 13:30 | Source: ALS | |
| Sample Age: 48h (11 °C) | Station: L1998015-1 W3 | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 238844 | 200 | Yes | Two-Point Interpolation |

Point Estimates

| Level | % | 95% LCL | 95% UCL | TU | 95% LCL | 95% UCL |
|-------|-----|---------|---------|--------|---------|---------|
| IC5 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC10 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC15 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC20 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC25 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC40 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC50 | >97 | N/A | N/A | <1.031 | NA | NA |

Frond Count Summary

| C-% | Control Type | Count | Calculated Variate | | | | | | |
|------|------------------|-------|--------------------|-----|-----|---------|---------|--------|---------|
| | | | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
| 0 | Negative Control | 4 | 110.3 | 103 | 124 | 4.75 | 9.5 | 8.62% | 0.0% |
| 1.5 | | 4 | 107.3 | 93 | 121 | 6.688 | 13.38 | 12.47% | 2.72% |
| 3 | | 4 | 105.3 | 74 | 124 | 11.37 | 22.74 | 21.6% | 4.54% |
| 6.1 | | 4 | 111.5 | 102 | 118 | 3.476 | 6.952 | 6.24% | -1.13% |
| 12.1 | | 4 | 118.8 | 110 | 128 | 4.11 | 8.221 | 6.92% | -7.71% |
| 24.2 | | 4 | 121.5 | 102 | 146 | 9.323 | 18.65 | 15.35% | -10.2% |
| 48.5 | | 4 | 129.3 | 126 | 134 | 1.797 | 3.594 | 2.78% | -17.23% |
| 97 | | 4 | 120 | 99 | 139 | 8.544 | 17.09 | 14.24% | -8.84% |

Frond Count Detail

| C-% | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|------|------------------|-------|-------|-------|-------|
| 0 | Negative Control | 103 | 124 | 105 | 109 |
| 1.5 | | 116 | 121 | 99 | 93 |
| 3 | | 74 | 103 | 120 | 124 |
| 6.1 | | 111 | 102 | 115 | 118 |
| 12.1 | | 110 | 128 | 123 | 114 |
| 24.2 | | 146 | 102 | 124 | 114 |
| 48.5 | | 130 | 127 | 126 | 134 |
| 97 | | 139 | 99 | 115 | 127 |

CETIS Analytical Report

Report Date: 09 Oct-17 17:50 (p 2 of 2)

Test Code: 171055 | 20-4038-8962

Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 19-1163-4932

Endpoint: Frond Count

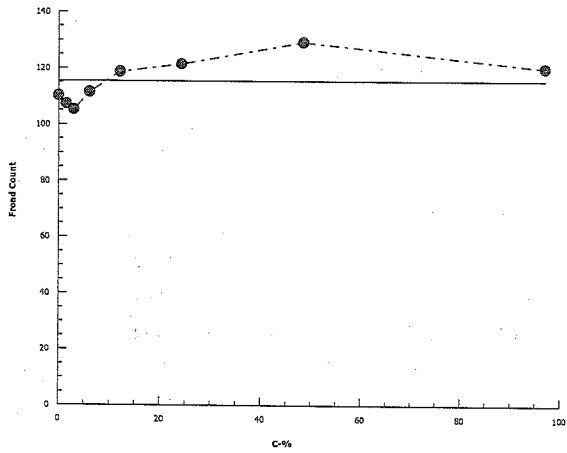
CETIS Version: CETISv1.8.7

Analyzed: 09 Oct-17 17:49

Analysis: Linear Interpolation (ICPIN)

Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 20 Oct-17 10:28 (p 1 of 2)
 Test Code: 171055 | 20-4038-8962

Lemna Growth Inhibition Test

Nautilus Environmental

| | | |
|-------------------------------|--|--------------------------------------|
| Analysis ID: 04-0616-3837 | Endpoint: Frond Count | CETIS Version: CETISv1.8.7 |
| Analyzed: 20 Oct-17 10:27 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 03-7269-1221 | Test Type: Lemna Growth | Analyst: JW Jill Sones-Jeslin Wijaya |
| Start Date: 28 Sep-17 | Protocol: EC/EPS 1/RM/37 | Diluent: Modified APHA |
| Ending Date: 05 Oct-17 | Species: Lemna minor | Brine: |
| Duration: 7d 0h | Source: CPMC#490 | Age: 7d |
| Sample ID: 13-1359-5064 | Code: 4E4BDEB8 | Client: ALS |
| Sample Date: 26 Sep-17 | Material: Water Sample | Project: |
| Receive Date: 28 Sep-17 13:30 | Source: ALS | |
| Sample Age: 48h (11 °C) | Station: L1998015-1 W3 | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | PMSD | NOEL | LOEL | TOEL | TU |
|----------------|------|---------|--------|------|-------|------|------|------|-------|
| Untransformed | NA | C < T | NA | NA | 22.2% | 97 | >97 | NA | 1.031 |

Dunnett Multiple Comparison Test

| Control | vs C-% | Test Stat | Critical | MSD | DF | P-Value | P-Type | Decision(α:5%) |
|------------------|--------|-----------|----------|-------|----|---------|--------|------------------------|
| Negative Control | 1.5 | -0.3044 | 2.482 | 24.46 | 6 | 0.9354 | CDF | Non-Significant Effect |
| | 3 | -0.5073 | 2.482 | 24.46 | 6 | 0.9607 | CDF | Non-Significant Effect |
| | 6.1 | 0.1268 | 2.482 | 24.46 | 6 | 0.8406 | CDF | Non-Significant Effect |
| | 12.1 | 0.8623 | 2.482 | 24.46 | 6 | 0.5453 | CDF | Non-Significant Effect |
| | 24.2 | 1.141 | 2.482 | 24.46 | 6 | 0.4160 | CDF | Non-Significant Effect |
| | 48.5 | 1.928 | 2.482 | 24.46 | 6 | 0.1395 | CDF | Non-Significant Effect |
| | 97 | 0.9891 | 2.482 | 24.46 | 6 | 0.4859 | CDF | Non-Significant Effect |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 1890.219 | 270.0313 | 7 | 1.39 | 0.2549 | Non-Significant Effect |
| Error | 4663.75 | 194.3229 | 24 | | | |
| Total | 6553.969 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|-------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance | 10.78 | 18.48 | 0.1487 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality | 0.985 | 0.9081 | 0.9248 | Normal Distribution |

Frond Count Summary

| C-% | Control Type | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|------|------------------|-------|-------|---------|---------|--------|-----|-----|---------|--------|---------|
| 0 | Negative Control | 4 | 110.3 | 95.13 | 125.4 | 107 | 103 | 124 | 4.75 | 8.62% | 0.0% |
| 1.5 | | 4 | 107.3 | 85.97 | 128.5 | 107.5 | 93 | 121 | 6.688 | 12.47% | 2.72% |
| 3 | | 4 | 105.3 | 69.07 | 141.4 | 111.5 | 74 | 124 | 11.37 | 21.6% | 4.54% |
| 6.1 | | 4 | 111.5 | 100.4 | 122.6 | 113 | 102 | 118 | 3.476 | 6.24% | -1.13% |
| 12.1 | | 4 | 118.8 | 105.7 | 131.8 | 118.5 | 110 | 128 | 4.11 | 6.92% | -7.71% |
| 24.2 | | 4 | 121.5 | 91.83 | 151.2 | 119 | 102 | 146 | 9.323 | 15.35% | -10.2% |
| 48.5 | | 4 | 129.3 | 123.5 | 135 | 128.5 | 126 | 134 | 1.797 | 2.78% | -17.23% |
| 97 | | 4 | 120 | 92.81 | 147.2 | 121 | 99 | 139 | 8.544 | 14.24% | -8.84% |

Frond Count Detail

| C-% | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|------|------------------|-------|-------|-------|-------|
| 0 | Negative Control | 103 | 124 | 105 | 109 |
| 1.5 | | 116 | 121 | 99 | 93 |
| 3 | | 74 | 103 | 120 | 124 |
| 6.1 | | 111 | 102 | 115 | 118 |
| 12.1 | | 110 | 128 | 123 | 114 |
| 24.2 | | 146 | 102 | 124 | 114 |
| 48.5 | | 130 | 127 | 126 | 134 |
| 97 | | 139 | 99 | 115 | 127 |

CETIS Analytical Report

Report Date: 20 Oct-17 10:28 (p 2 of 2)
Test Code: 171055 | 20-4038-8962

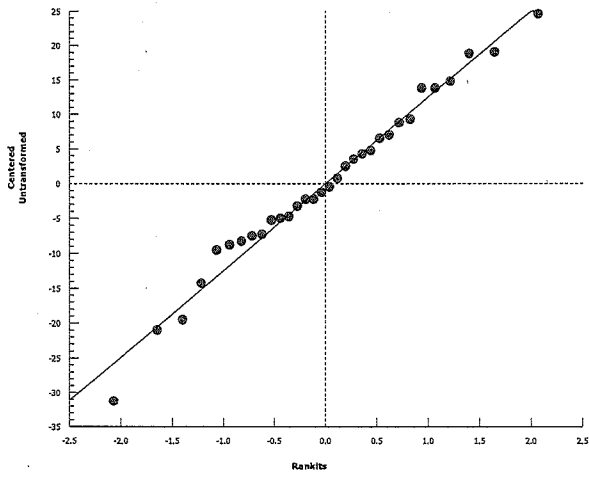
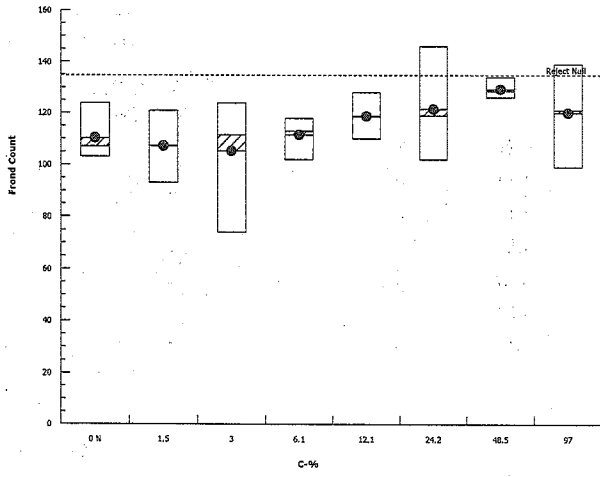
Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 04-0616-3837 Endpoint: Frond Count
Analyzed: 20 Oct-17 10:27 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 09 Oct-17 17:50 (p 1 of 2)
 Test Code: 171055 | 20-4038-8962

Lemna Growth Inhibition Test Nautilus Environmental

| | | |
|-------------------------------|--|--|
| Analysis ID: 19-5046-2732 | Endpoint: Total Dry Weight-mg | CETIS Version: CETISv1.8.7 |
| Analyzed: 09 Oct-17 17:50 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 03-7269-1221 | Test Type: Lemna Growth | Analyst: JW Jill Sones Jesin Wijaya |
| Start Date: 28 Sep-17 | Protocol: EC/EPS 1/RM/37 | Diluent: Modified APHA |
| Ending Date: 05 Oct-17 | Species: Lemna minor | Brine: |
| Duration: 7d 0h | Source: CPCC#490 | Age: 7d |
| Sample ID: 13-1359-5064 | Code: 4E4BDEB8 | Client: ALS |
| Sample Date: 26 Sep-17 | Material: Water Sample | Project: |
| Receive Date: 28 Sep-17 13:30 | Source: ALS | |
| Sample Age: 48h (11 °C) | Station: L1998015-1 W3 | |

| Linear Interpolation Options | | | | | |
|------------------------------|-------------|--------|-----------|------------|-------------------------|
| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
| Log(X+1) | Linear | 228634 | 200 | Yes | Two-Point Interpolation |

| Point Estimates | | | | | | |
|-----------------|-----|---------|---------|--------|---------|---------|
| Level | % | 95% LCL | 95% UCL | TU | 95% LCL | 95% UCL |
| IC5 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC10 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC15 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC20 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC25 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC40 | >97 | N/A | N/A | <1.031 | NA | NA |
| IC50 | >97 | N/A | N/A | <1.031 | NA | NA |

| Total Dry Weight-mg Summary | | | Calculated Variate | | | | | | |
|-----------------------------|------------------|-------|--------------------|-------|-------|---------|---------|--------|---------|
| C-% | Control Type | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
| 0 | Negative Control | 4 | 9.263 | 8.7 | 10.26 | 0.3534 | 0.7067 | 7.63% | 0.0% |
| 1.5 | | 4 | 8.592 | 7.24 | 9.61 | 0.495 | 0.9901 | 11.52% | 7.23% |
| 3 | | 4 | 8.595 | 6.25 | 9.91 | 0.8182 | 1.636 | 19.04% | 7.21% |
| 6.1 | | 4 | 9.19 | 7.98 | 10.06 | 0.4729 | 0.9458 | 10.29% | 0.78% |
| 12.1 | | 4 | 9.322 | 8.84 | 10.04 | 0.2926 | 0.5852 | 6.28% | -0.65% |
| 24.2 | | 4 | 10.83 | 9.14 | 13.22 | 0.8596 | 1.719 | 15.87% | -16.95% |
| 48.5 | | 4 | 12.08 | 10.79 | 12.9 | 0.4538 | 0.9076 | 7.51% | -30.39% |
| 97 | | 4 | 12.34 | 10.43 | 14.02 | 0.8806 | 1.761 | 14.27% | -33.23% |

| Total Dry Weight-mg Detail | | | | | |
|----------------------------|------------------|-------|-------|-------|-------|
| C-% | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
| 0 | Negative Control | 8.83 | 10.26 | 9.26 | 8.7 |
| 1.5 | | 8.86 | 9.61 | 8.66 | 7.24 |
| 3 | | 6.25 | 8.74 | 9.48 | 9.91 |
| 6.1 | | 8.91 | 7.98 | 9.81 | 10.06 |
| 12.1 | | 8.85 | 10.04 | 9.56 | 8.84 |
| 24.2 | | 13.22 | 9.14 | 10.31 | 10.66 |
| 48.5 | | 12.43 | 12.19 | 10.79 | 12.9 |
| 97 | | 13.64 | 10.43 | 11.27 | 14.02 |

CETIS Analytical Report

Report Date: 09 Oct-17 17:50 (p 2 of 2)
Test Code: 171055 | 20-4038-8962

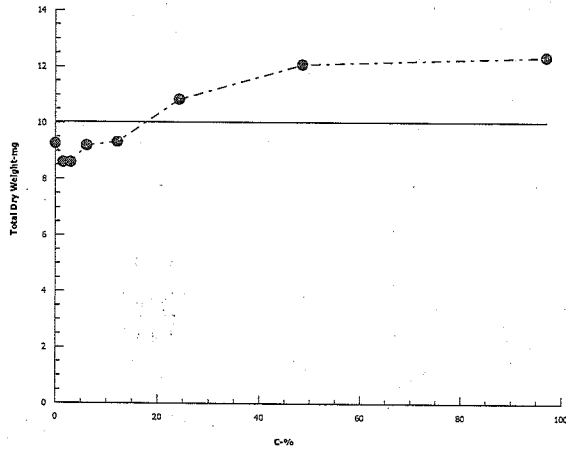
Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 19-5046-2732 Endpoint: Total Dry Weight-mg
Analyzed: 09 Oct-17 17:50 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 20 Oct-17 10:29 (p 1 of 2)
 Test Code: 171055 | 20-4038-8962

Lemna Growth Inhibition Test

Nautilus Environmental

| | | |
|-------------------------------|--|------------------------------------|
| Analysis ID: 10-4042-7087 | Endpoint: Total Dry Weight-mg | CETIS Version: CETISv1.8.7 |
| Analyzed: 20 Oct-17 10:27 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 03-7269-1221 | Test Type: Lemna Growth | Analyst: JW JH-Sones Jesu'n Nisaya |
| Start Date: 28 Sep-17 | Protocol: EC/EPS 1/RM/37 | Diluent: Modified APHA |
| Ending Date: 05 Oct-17 | Species: Lemna minor | Brine: |
| Duration: 7d 0h | Source: CPCC#490 | Age: 7d |
| Sample ID: 13-1359-5064 | Code: 4E4BDEB8 | Client: ALS |
| Sample Date: 26 Sep-17 | Material: Water Sample | Project: |
| Receive Date: 28 Sep-17 13:30 | Source: ALS | |
| Sample Age: 48h (11 °C) | Station: L1998015-1 W3 | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | PMSD | NOEL | LOEL | TOEL | TU |
|----------------|------|---------|--------|------|-------|------|------|-------|-------|
| Untransformed | NA | C < T | NA | NA | 23.5% | 24.2 | 48.5 | 34.26 | 4.132 |

Dunnnett Multiple Comparison Test

| Control | vs | C-% | Test Stat | Critical | MSD | DF | P-Value | P-Type | Decision(α:5%) |
|------------------|----|-------|-----------|----------|-------|----|---------|--------|------------------------|
| Negative Control | | 1.5 | -0.765 | 2.482 | 2.174 | 6 | 0.9804 | CDF | Non-Significant Effect |
| | | 3 | -0.762 | 2.482 | 2.174 | 6 | 0.9803 | CDF | Non-Significant Effect |
| | | 6.1 | -0.08282 | 2.482 | 2.174 | 6 | 0.8944 | CDF | Non-Significant Effect |
| | | 12.1 | 0.06846 | 2.482 | 2.174 | 6 | 0.8571 | CDF | Non-Significant Effect |
| | | 24.2 | 1.792 | 2.482 | 2.174 | 6 | 0.1739 | CDF | Non-Significant Effect |
| | | 48.5* | 3.214 | 2.482 | 2.174 | 6 | 0.0103 | CDF | Significant Effect |
| | | 97* | 3.514 | 2.482 | 2.174 | 6 | 0.0051 | CDF | Significant Effect |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 64.37354 | 9.19622 | 7 | 5.993 | 0.0004 | Significant Effect |
| Error | 36.82623 | 1.534426 | 24 | | | |
| Total | 101.1998 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|-------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance | 6.176 | 18.48 | 0.5194 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality | 0.9886 | 0.9081 | 0.9776 | Normal Distribution |

Total Dry Weight-mg Summary

| C-% | Control Type | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|------|------------------|-------|-------|---------|---------|--------|-------|-------|---------|--------|---------|
| 0 | Negative Control | 4 | 9.263 | 8.138 | 10.39 | 9.045 | 8.7 | 10.26 | 0.3534 | 7.63% | 0.0% |
| 1.5 | | 4 | 8.592 | 7.017 | 10.17 | 8.76 | 7.24 | 9.61 | 0.495 | 11.52% | 7.23% |
| 3 | | 4 | 8.595 | 5.991 | 11.2 | 9.11 | 6.25 | 9.91 | 0.8182 | 19.04% | 7.21% |
| 6.1 | | 4 | 9.19 | 7.685 | 10.69 | 9.36 | 7.98 | 10.06 | 0.4729 | 10.29% | 0.78% |
| 12.1 | | 4 | 9.322 | 8.391 | 10.25 | 9.205 | 8.84 | 10.04 | 0.2926 | 6.28% | -0.65% |
| 24.2 | | 4 | 10.83 | 8.097 | 13.57 | 10.49 | 9.14 | 13.22 | 0.8596 | 15.87% | -16.95% |
| 48.5 | | 4 | 12.08 | 10.63 | 13.52 | 12.31 | 10.79 | 12.9 | 0.4538 | 7.51% | -30.39% |
| 97 | | 4 | 12.34 | 9.538 | 15.14 | 12.46 | 10.43 | 14.02 | 0.8806 | 14.27% | -33.23% |

Total Dry Weight-mg Detail

| C-% | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|------|------------------|-------|-------|-------|-------|
| 0 | Negative Control | 8.83 | 10.26 | 9.26 | 8.7 |
| 1.5 | | 8.86 | 9.61 | 8.66 | 7.24 |
| 3 | | 6.25 | 8.74 | 9.48 | 9.91 |
| 6.1 | | 8.91 | 7.98 | 9.81 | 10.06 |
| 12.1 | | 8.85 | 10.04 | 9.56 | 8.84 |
| 24.2 | | 13.22 | 9.14 | 10.31 | 10.66 |
| 48.5 | | 12.43 | 12.19 | 10.79 | 12.9 |
| 97 | | 13.64 | 10.43 | 11.27 | 14.02 |

CETIS Analytical Report

Report Date: 20 Oct-17 10:29 (p 2 of 2)
Test Code: 171055 | 20-4038-8962

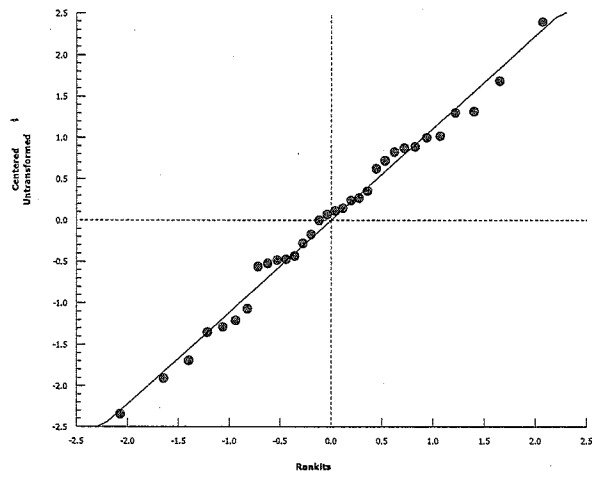
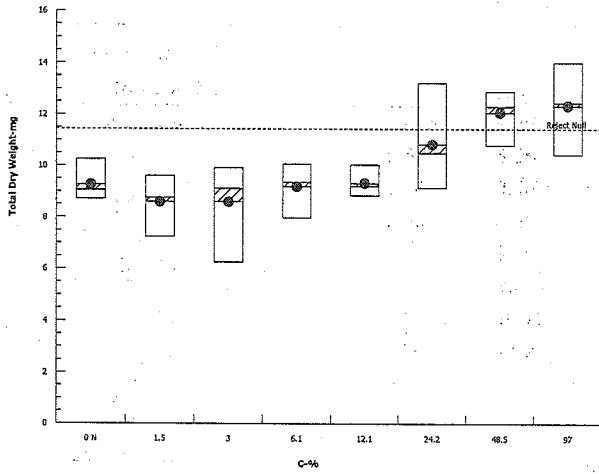
Lemna Growth Inhibition Test

Nautilus Environmental

Analysis ID: 10-4042-7087 Endpoint: Total Dry Weight-mg
Analyzed: 20 Oct-17 10:27 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



APPENDIX B – Chain-of-Custody Form



Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL

8664 COMMERCE COURT
BURNABY, BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# L1998015 w
ALS requires QC data to be provided with your final results.

Please see enclosed **2** sample(s) in **Z** Container(s)

| SAMPLE NUMBER | ANALYTICAL REQUIRED | DATE SAMPLED | PRIORITY FLAG |
|--------------------------------------|---|------------------------|---------------------------------|
| | | DUE DATE | |
| L1998015-1 W3 2x1L | Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14) | 9/26/2017 10/6/2017 | WO # 171055 Lemna 11°C |
| L1998015-2 W3 See Krysta 5x20L | Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14) | 9/26/2017 10/6/2017 | 11°C |

disposed
Testing
postponed

MINTO

Subcontract Info Contact: Walter Lin (604) 253-4188
Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9
Phone: (604) 253-4188 Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to: **Shane.Stack@alsglobal.com**

Shipped By: _____ Date Shipped: _____
Received By: Nau Yamamoto - NY Date Received: Sept 28/17 @ 13:30
Verified By: Nautilus Date Verified: _____
Temperature: _____
Sample Integrity Issues: NA

sample description = clear, light yellow, odorless, some particulates.

END OF REPORT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-SEP-17
Report Date: 16-OCT-17 18:11 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1998026
Project P.O. #: 226973 (WUL)
Job Reference:
C of C Numbers: 2017-09-26 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1998026-1 | L1998026-2 | L1998026-3 | L1998026-4 | L1998026-5 |
|---|---|---------------------------------|------------|------------|------------|------------|
| | | Water | Water | Water | Water | Water |
| | | 25-SEP-17 | 25-SEP-17 | 25-SEP-17 | 26-SEP-17 | 26-SEP-17 |
| | | 10:10 | 10:25 | 11:11 | 08:25 | 09:45 |
| | | W17 | W16 | W8A | W3 | W2 |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 483 | 471 | 1100 | 527 | 348 |
| | Hardness (as CaCO3) (mg/L) | 231 | 228 | 569 | 264 | 174 |
| | pH (pH) | 8.26 | 8.28 | 7.97 | 8.32 | 8.29 |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | 35.8 | <3.0 | 5.0 |
| | TDS (Calculated) (mg/L) | 285 | 285 | 758 | 314 | 200 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 204 | 176 | 369 | 237 | 173 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | 4.8 | 2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 204 | 176 | 369 | 242 | 175 |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.0424 | 0.120 | 0.0058 | <0.0050 |
| | Chloride (Cl) (mg/L) | 6.36 | 6.79 | 9.1 | 4.43 | 1.83 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.219 | 1.94 | 5.76 | 0.177 | 0.0120 |
| | Nitrate (as N) (mg/L) | 0.219 | 1.92 | 5.62 | 0.177 | 0.0120 |
| | Nitrite (as N) (mg/L) | <0.0010 | 0.0117 | 0.140 | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | 55.6 | 66.5 | 254 | 55.3 | 21.6 |
| | Anion Sum (meq/L) | 5.43 | 5.23 | 13.3 | 6.11 | 4.00 |
| | Cation Sum (meq/L) | 5.41 | 5.33 | 13.4 | 6.17 | 4.00 |
| | Cation - Anion Balance (%) | -0.2 | 0.9 | 0.2 | 0.5 | 0.0 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 8.59 | 13.3 | 17.1 | 6.39 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0040 | 0.121 | 0.323 | 0.0051 | 0.0119 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00041 | 0.00048 | 0.00079 | 0.00025 | 0.00040 |
| | Barium (Ba)-Total (mg/L) | 0.0736 | 0.0849 | 0.127 | 0.0727 | 0.0632 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | 0.000031 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.032 | 0.029 | 0.029 | 0.028 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000053 | 0.0000105 | 0.000296 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Total (mg/L) | 64.1 | 64.0 | 163 | 61.0 | 47.5 |
| | Chromium (Cr)-Total (mg/L) | 0.00011 | 0.00026 | 0.00073 | 0.00010 | 0.00021 |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00012 | 0.00103 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | 0.00725 | 0.0291 | 0.219 | 0.00263 | 0.00170 |
| | Iron (Fe)-Total (mg/L) | <0.010 | 0.242 | 2.91 | 0.026 | 0.063 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | 0.000162 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0012 | 0.0011 | 0.0040 | 0.0037 | 0.0020 |
| | Magnesium (Mg)-Total (mg/L) | 19.5 | 19.4 | 44.6 | 29.6 | 14.9 |
| | Manganese (Mn)-Total (mg/L) | 0.0135 | 0.0826 | 1.99 | 0.0525 | 0.0121 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1998026-6 Water 26-SEP-17 DUP | L1998026-7 Water 26-SEP-17 09:45 F-BL | | |
|-----------------------------|---|---|---|-------|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 524 | <2.0 | | |
| | Hardness (as CaCO3) (mg/L) | 261 | <0.50 | | |
| | pH (pH) | 8.34 | 5.42 | | |
| | Total Suspended Solids (mg/L) | <3.0 | <3.0 | | |
| | TDS (Calculated) (mg/L) | 314 | <1.0 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 235 | <1.0 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 6.6 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 242 | <1.0 | | |
| | Ammonia, Total (as N) (mg/L) | 0.0065 | <0.0050 | | |
| | Chloride (Cl) (mg/L) | 4.43 | <0.50 | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.174 | <0.0051 | | |
| | Nitrate (as N) (mg/L) | 0.174 | <0.0050 | | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | | |
| | Sulfate (SO4) (mg/L) | 55.3 | <5.0 | | |
| | Anion Sum (meq/L) | 6.12 | <0.10 | | |
| | Cation Sum (meq/L) | 6.11 | <0.10 | | |
| | Cation - Anion Balance (%) | 0.0 | 0.0 | | |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 5.81 | <0.50 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0200 | <0.0030 | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Total (mg/L) | 0.00025 | <0.00010 | | |
| | Barium (Ba)-Total (mg/L) | 0.0694 | <0.000050 | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Total (mg/L) | 0.028 | <0.010 | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | <0.0000050 | | |
| | Calcium (Ca)-Total (mg/L) | 61.9 | <0.050 | | |
| | Chromium (Cr)-Total (mg/L) | 0.00014 | <0.00010 | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Total (mg/L) | 0.00492 | <0.00050 | | |
| | Iron (Fe)-Total (mg/L) | 0.052 | <0.010 | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Total (mg/L) | 0.0038 | <0.0010 | | |
| | Magnesium (Mg)-Total (mg/L) | 27.4 | <0.10 | | |
| | Manganese (Mn)-Total (mg/L) | 0.0500 | 0.00017 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1998026-1 Water 25-SEP-17 10:10 W17 | L1998026-2 Water 25-SEP-17 10:25 W16 | L1998026-3 Water 25-SEP-17 11:11 W8A | L1998026-4 Water 26-SEP-17 08:25 W3 | L1998026-5 Water 26-SEP-17 09:45 W2 |
|---|---------------------------------------|--|--|--|---|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.000025 ^{DLM} | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00592 | 0.00308 | 0.0121 | 0.00522 | 0.00154 |
| | Nickel (Ni)-Total (mg/L) | 0.00063 | 0.00083 | 0.00153 | 0.00101 | 0.00095 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | 0.100 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 3.79 | 3.14 | 6.83 | 2.54 | 1.61 |
| | Selenium (Se)-Total (mg/L) | 0.000437 | 0.000688 | 0.00678 | 0.000283 | 0.000081 |
| | Silicon (Si)-Total (mg/L) | 5.22 | 3.78 | 8.01 | 6.75 | 6.37 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000065 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 15.6 | 14.9 | 38.7 | 19.9 | 10.2 |
| | Strontium (Sr)-Total (mg/L) | 0.697 | 0.635 | 2.16 | 0.769 | 0.463 |
| | Sulfur (S)-Total (mg/L) | 20.3 | 25.2 | 98.2 | 20.3 | 7.74 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.00030 | 0.00570 | 0.0177 | <0.00030 | 0.00055 |
| | Uranium (U)-Total (mg/L) | 0.00205 | 0.00145 | 0.00282 | 0.00276 | 0.00182 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00083 | 0.00283 | <0.00050 | 0.00062 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0099 | 0.261 | <0.0030 | 0.0032 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | 0.00039 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0015 | 0.0327 | 0.0110 | 0.0030 | 0.0040 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00039 | 0.00043 | 0.00055 | 0.00023 | 0.00041 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0812 | 0.0873 | 0.129 | 0.0723 | 0.0705 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.031 | 0.028 | 0.028 | 0.025 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | 0.000275 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 60.7 | 59.8 | 154 | 58.7 | 42.6 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00012 | 0.00038 | <0.00010 | 0.00020 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00087 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00681 | 0.0272 | 0.106 | 0.00300 | 0.00188 |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | 0.093 | 0.439 | 0.021 | 0.050 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0014 | 0.0011 | 0.0039 | 0.0036 | 0.0016 |
| | Magnesium (Mg)-Dissolved (mg/L) | 19.3 | 19.2 | 44.9 | 28.4 | 16.4 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00275 | 0.0640 | 1.86 | 0.0493 | 0.0135 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1998026-6 Water 26-SEP-17 DUP | L1998026-7 Water 26-SEP-17 09:45 F-BL | | |
|-------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00490 | <0.000050 | | |
| | Nickel (Ni)-Total (mg/L) | 0.00095 | <0.00050 | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Total (mg/L) | 2.35 | <0.10 | | |
| | Selenium (Se)-Total (mg/L) | 0.000276 | <0.000050 | | |
| | Silicon (Si)-Total (mg/L) | 6.69 | <0.10 | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Total (mg/L) | 18.7 | <0.050 | | |
| | Strontium (Sr)-Total (mg/L) | 0.773 | <0.00020 | | |
| | Sulfur (S)-Total (mg/L) | 20.0 | <0.50 | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Total (mg/L) | 0.00132 | <0.00030 | | |
| | Uranium (U)-Total (mg/L) | 0.00274 | <0.000010 | | |
| | Vanadium (V)-Total (mg/L) | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0036 | <0.0010 | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00021 | <0.00010 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0714 | <0.000050 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | 0.025 | <0.010 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 58.8 | <0.050 | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00236 | 0.00022 ^{RRV} | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.019 | <0.010 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0037 | <0.0010 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 27.8 | <0.10 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0477 | <0.00010 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1998026-1 | L1998026-2 | L1998026-3 | L1998026-4 | L1998026-5 |
|-------------------------|----------------------------------|--------------|--------------|-------------------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 25-SEP-17 | 10:10 | W17 | 25-SEP-17 | 25-SEP-17 | 25-SEP-17 | 26-SEP-17 | 26-SEP-17 |
| | | | | | 10:10 | 10:25 | 11:11 | 08:25 | 09:45 |
| | | | | | W17 | W16 | W8A | W3 | W2 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00557 | 0.00276 | 0.0111 | 0.00450 | 0.00136 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00068 | 0.00081 | 0.00164 | 0.00094 | 0.00106 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 3.98 | 3.22 | 7.05 | 2.50 | 1.78 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000511 | 0.000787 | 0.00737 | 0.000282 | 0.000116 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.30 | 3.73 | 7.50 | 6.55 | 6.25 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000015 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 16.1 | 15.4 | 39.9 | 19.3 | 10.9 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.660 | 0.582 | 2.02 | 0.751 | 0.434 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 18.4 | 22.5 | 89.5 | 19.6 | 7.40 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00151 | <0.00060 ^{DLM} | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00195 | 0.00129 | 0.00266 | 0.00252 | 0.00176 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00113 | <0.00050 | 0.00051 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0024 | 0.0043 | 0.296 | <0.0010 | 0.0052 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00037 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1998026-6 Water 26-SEP-17 DUP | L1998026-7 Water 26-SEP-17 09:45 F-BL | | |
|-------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00452 | <0.000050 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00091 | <0.00050 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 2.46 | <0.10 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000289 | <0.000050 | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.48 | <0.050 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 19.0 | <0.050 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.763 | <0.00020 | | |
| | Sulfur (S)-Dissolved (mg/L) | 19.4 | <0.50 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00259 | <0.000010 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------------|--------------------------|-----------|------------------------------------|
| Laboratory Control Sample | Manganese (Mn)-Total | MES | L1998026-1, -2, -3, -7 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1998026-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1998026-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1998026-1, -2, -3, -5, -7 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1998026-1, -2, -3, -5, -7 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1998026-1, -2, -3, -5, -7 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1998026-1, -2, -3, -5, -7 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1998026-1, -2, -3, -5, -7 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1998026-1, -2, -3, -7 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1998026-1, -2, -3, -7 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1998026-1, -2, -3, -7 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1998026-1, -2, -3, -7 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1998026-1, -2, -3, -7 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MES | Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |
| RRV | Reported Result Verified By Repeat Analysis |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-09-26 B

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 04-OCT-17
Report Date: 19-OCT-17 18:24 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2002445
Project P.O. #: 226973 (WUL)
Job Reference:
C of C Numbers: 2017-10-03 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2002445-1 WATER 03-OCT-17 08:55 W3 | L2002445-2 WATER 03-OCT-17 09:35 W35 | L2002445-3 WATER 03-OCT-17 10:00 W15 | L2002445-4 WATER 03-OCT-17 10:30 W30 | L2002445-5 WATER 03-OCT-17 13:15 BC | |
|---|---|--|--|--|---|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 541 | 312 | 706 | 478 | 220 |
| | Hardness (as CaCO3) (mg/L) | 261 | 149 | 352 | 212 | 101 |
| | pH (pH) | 8.29 | 7.99 | 8.21 | 8.27 | 8.14 |
| | Total Suspended Solids (mg/L) | <3.0 | 52.6 | 3.2 | 13.5 | 3.3 |
| | TDS (Calculated) (mg/L) | 311 | 178 | 447 | 280 | 123 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 239 | 125 | 216 | 146 | 106 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 2.8 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 242 | 125 | 216 | 146 | 106 |
| | Ammonia, Total (as N) (mg/L) | 0.0053 | 0.0148 | 0.0095 | 0.0239 | <0.0050 |
| | Chloride (Cl) (mg/L) | 4.36 | 0.89 | 2.77 | 2.78 | 0.59 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.180 | 6.57 | 7.99 | 0.213 | 0.0517 |
| | Nitrate (as N) (mg/L) | 0.180 | 6.56 | 7.98 | 0.210 | 0.0517 |
| | Nitrite (as N) (mg/L) | <0.0010 | 0.0098 | 0.0055 | 0.0032 | <0.0010 |
| | Sulfate (SO4) (mg/L) | 54.3 | 14.8 | 140 | 101 | 16.0 |
| | Anion Sum (meq/L) | 6.09 | 3.29 | 7.88 | 5.11 | 2.46 |
| | Cation Sum (meq/L) | 6.10 | 3.30 | 7.71 | 4.91 | 2.37 |
| | Cation - Anion Balance (%) | 0.1 | 0.1 | -1.1 | -2.1 | -1.8 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 5.80 | 20.0 | 15.1 | 9.22 | 8.02 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0051 | 1.60 | 0.0317 | 0.357 | 0.0378 |
| | Antimony (Sb)-Total (mg/L) | 0.00017 | 0.00022 | 0.00021 | 0.00021 | 0.00026 |
| | Arsenic (As)-Total (mg/L) | 0.00022 | 0.00068 | 0.00036 | 0.00067 | 0.00068 |
| | Barium (Ba)-Total (mg/L) | 0.0684 | 0.0920 | 0.0835 | 0.0980 | 0.0662 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | 0.000074 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.032 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | 0.0000279 | <0.0000050 | 0.0000131 | 0.0000086 |
| | Calcium (Ca)-Total (mg/L) | 56.1 | 39.7 | 99.2 | 51.5 | 24.3 |
| | Chromium (Cr)-Total (mg/L) | 0.00012 | 0.00120 | 0.00027 | 0.00031 | 0.00026 |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00098 | 0.00013 | 0.00025 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | 0.00257 | 0.156 | 0.00874 | 0.0445 | 0.00203 |
| | Iron (Fe)-Total (mg/L) | 0.026 | 2.69 | 0.234 | 0.627 | 0.091 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.000616 | <0.000050 | 0.000246 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0030 | 0.0013 | <0.0010 | 0.0018 | 0.0012 |
| | Magnesium (Mg)-Total (mg/L) | 29.4 | 14.4 | 27.8 | 23.6 | 10.2 |
| | Manganese (Mn)-Total (mg/L) | 0.0494 | 0.100 | 0.0377 | 0.119 | 0.0173 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2002445-6 WATER 03-OCT-17 13:40 W2 | L2002445-7 WATER 03-OCT-17 14:30 W7 | | |
|-----------------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 358 | 288 | | |
| | Hardness (as CaCO3) (mg/L) | 174 | 139 | | |
| | pH (pH) | 8.15 | 8.28 | | |
| | Total Suspended Solids (mg/L) | 23.9 | 4.9 | | |
| | TDS (Calculated) (mg/L) | 199 | 157 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 174 | 150 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 174 | 150 | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.0148 | | |
| | Chloride (Cl) (mg/L) | 1.90 | <0.50 | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.0162 | 0.118 | | |
| | Nitrate (as N) (mg/L) | 0.0162 | 0.118 | | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | | |
| | Sulfate (SO4) (mg/L) | 22.0 | 10.1 | | |
| | Anion Sum (meq/L) | 3.98 | 3.21 | | |
| | Cation Sum (meq/L) | 3.95 | 3.16 | | |
| | Cation - Anion Balance (%) | -0.4 | -0.9 | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 8.91 | 8.44 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0098 | 0.741 | | |
| | Antimony (Sb)-Total (mg/L) | 0.00017 | 0.00018 | | |
| | Arsenic (As)-Total (mg/L) | 0.00038 | 0.00075 | | |
| | Barium (Ba)-Total (mg/L) | 0.0666 | 0.0931 | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | 0.000033 | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Total (mg/L) | <0.010 | <0.010 | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000068 | 0.0000139 | | |
| | Calcium (Ca)-Total (mg/L) | 45.2 | 35.5 | | |
| | Chromium (Cr)-Total (mg/L) | 0.00018 | 0.00161 | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00074 | | |
| | Copper (Cu)-Total (mg/L) | 0.00171 | 0.00230 | | |
| | Iron (Fe)-Total (mg/L) | 0.078 | 1.36 | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.000385 | | |
| | Lithium (Li)-Total (mg/L) | 0.0015 | 0.0013 | | |
| | Magnesium (Mg)-Total (mg/L) | 15.8 | 13.8 | | |
| | Manganese (Mn)-Total (mg/L) | 0.0197 | 0.0994 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2002445-1 WATER 03-OCT-17 08:55 W3 | L2002445-2 WATER 03-OCT-17 09:35 W35 | L2002445-3 WATER 03-OCT-17 10:00 W15 | L2002445-4 WATER 03-OCT-17 10:30 W30 | L2002445-5 WATER 03-OCT-17 13:15 BC | |
|---|---|--|--|--|---|-------------------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00471 | 0.000864 | 0.00227 | 0.00145 | 0.00125 |
| | Nickel (Ni)-Total (mg/L) | 0.00097 | 0.00196 | 0.00086 | 0.00068 | 0.00114 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.083 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.31 | 1.02 | 2.78 | 3.74 | 0.82 |
| | Selenium (Se)-Total (mg/L) | 0.000369 | 0.000145 | 0.00184 | 0.000707 | 0.000056 |
| | Silicon (Si)-Total (mg/L) | 6.60 | 8.86 | 5.47 | 1.33 | 6.37 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000058 | <0.000010 | 0.000016 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 18.7 | 7.17 | 13.9 | 13.9 | 7.74 |
| | Strontium (Sr)-Total (mg/L) | 0.763 | 0.236 | 0.793 | 0.525 | 0.271 |
| | Sulfur (S)-Total (mg/L) | 18.8 | 5.27 | 50.9 | 36.0 | 5.71 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | 0.000017 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.00030 | 0.0657 | 0.00161 | 0.0165 | <0.00090 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.00299 | 0.000181 | 0.00233 | 0.000532 | 0.00321 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00573 | 0.00059 | 0.00141 | 0.00087 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0165 | 0.0050 | 0.0066 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | 0.00041 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0025 | 0.0157 | 0.0088 | 0.0031 | 0.0135 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00010 | <0.00010 | 0.00014 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00023 | 0.00029 | 0.00031 | 0.00055 | 0.00058 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0693 | 0.0724 | 0.0808 | 0.0864 | 0.0649 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.028 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000050 | 0.0000085 | <0.0000050 | <0.0000050 | 0.0000069 |
| | Calcium (Ca)-Dissolved (mg/L) | 55.5 | 38.1 | 95.4 | 48.8 | 23.9 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00034 | 0.00019 | <0.00010 | 0.00021 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00278 | 0.0194 | 0.00719 | 0.00987 | 0.00186 |
| | Iron (Fe)-Dissolved (mg/L) | 0.021 | 0.045 | 0.100 | 0.026 | 0.047 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0029 | <0.0010 | <0.0010 | 0.0016 | 0.0011 |
| | Magnesium (Mg)-Dissolved (mg/L) | 29.8 | 13.1 | 27.6 | 21.9 | 10.0 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0472 | 0.0343 | 0.0296 | 0.00672 | 0.0150 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2002445-6 WATER 03-OCT-17 13:40 W2 | L2002445-7 WATER 03-OCT-17 14:30 W7 | | |
|-------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00141 | 0.00128 | | |
| | Nickel (Ni)-Total (mg/L) | 0.00104 | 0.00278 | | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.108 | | |
| | Potassium (K)-Total (mg/L) | 1.58 | 1.16 | | |
| | Selenium (Se)-Total (mg/L) | 0.000085 | 0.000108 | | |
| | Silicon (Si)-Total (mg/L) | 6.46 | 7.85 | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Total (mg/L) | 10.3 | 8.19 | | |
| | Strontium (Sr)-Total (mg/L) | 0.475 | 0.386 | | |
| | Sulfur (S)-Total (mg/L) | 7.82 | 3.59 | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Total (mg/L) | 0.00045 | 0.0302 | | |
| | Uranium (U)-Total (mg/L) | 0.00225 | 0.00153 | | |
| | Vanadium (V)-Total (mg/L) | 0.00058 | 0.00318 | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0055 | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0045 | 0.0053 | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00036 | 0.00042 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0685 | 0.0702 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000051 | <0.0000050 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 43.9 | 34.5 | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00013 | 0.00017 | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00170 | 0.00091 | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.060 | 0.102 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0015 | <0.0010 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 15.5 | 12.8 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0184 | 0.0405 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L2002445-1 | L2002445-2 | L2002445-3 | L2002445-4 | L2002445-5 |
|-------------------------|----------------------------------|--------------|--------------|------------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 03-OCT-17 | 08:55 | W3 | 03-OCT-17 | 03-OCT-17 | 03-OCT-17 | 03-OCT-17 | 03-OCT-17 |
| | | | | | 08:55 | 09:35 | 10:00 | 10:30 | 13:15 |
| | | | | | W3 | W35 | W15 | W30 | BC |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00456 | 0.000767 | 0.00219 | 0.00137 | 0.00119 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00095 | 0.00123 | 0.00080 | <0.00050 | 0.00107 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.31 | 0.62 | 2.68 | 3.36 | 0.81 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000334 | 0.000112 | 0.00194 | 0.000665 | 0.000070 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.56 | 5.68 | 5.40 | 0.560 | 6.31 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 18.8 | 6.86 | 13.7 | 13.2 | 7.56 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.736 | 0.225 | 0.804 | 0.512 | 0.264 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 19.1 | 5.05 | 49.6 | 33.6 | 5.37 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00087 | 0.00050 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00292 | 0.000136 | 0.00234 | 0.000466 | 0.00305 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00066 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0013 | 0.0028 | <0.0010 | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2002445-6 WATER 03-OCT-17 13:40 W2 | L2002445-7 WATER 03-OCT-17 14:30 W7 | | | |
|---|---|---|------------|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00130 | 0.00137 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00103 | 0.00083 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 1.56 | 1.02 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000074 | 0.000154 | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.28 | 6.32 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 10.1 | 7.95 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.465 | 0.377 | | |
| | Sulfur (S)-Dissolved (mg/L) | 7.43 | 3.36 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00212 | 0.00146 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00057 | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0016 | <0.0010 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|------------------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2002445-3 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2002445-3 |
| Matrix Spike | Copper (Cu)-Total | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2002445-3 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2002445-3 |
| Matrix Spike | Molybdenum (Mo)-Total | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Potassium (K)-Total | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2002445-3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2002445-3 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L2002445-3 |
| Matrix Spike | Uranium (U)-Total | MS-B | L2002445-1, -2, -3, -4, -5, -6, -7 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |

Reference Information

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

| | |
|----|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |
|----|---|

Chain of Custody Numbers:

2017-10-03 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 12-OCT-17
Report Date: 23-OCT-17 19:17 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2006096
Project P.O. #: 226973 (WUL)
Job Reference:
C of C Numbers: 2017-10-11 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2006096-1 Water 07-OCT-17 14:45 C4 | L2006096-2 Water 07-OCT-17 15:30 W46 | L2006096-3 Water 07-OCT-17 15:55 W6 | L2006096-4 Water 09-OCT-17 10:10 W17 | L2006096-5 Water 09-OCT-17 10:30 W16 |
|-----------------------------------|---|---|--|---|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 306 | 337 | 224 | 498 | 489 |
| | Hardness (as CaCO3) (mg/L) | 158 | 168 | 113 | 238 | 235 |
| | pH (pH) | 8.31 | 8.35 | 8.21 | 8.36 | 8.35 |
| | Total Suspended Solids (mg/L) | <3.0 | 4.5 | <3.0 | <3.0 | 63.5 |
| | TDS (Calculated) (mg/L) | 174 | 197 | 122 | 290 | 299 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 160 | 171 | 121 | 202 | 184 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | 3.2 | 7.4 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 160 | 171 | 121 | 205 | 191 |
| | Ammonia, Total (as N) (mg/L) | 0.0089 | 0.0108 | <0.0050 | <0.0050 | 0.0726 |
| | Chloride (Cl) (mg/L) | 0.88 | 1.86 | 0.97 | 6.56 | 7.04 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.0269 | 0.113 | <0.0051 | 0.284 | 1.89 |
| | Nitrate (as N) (mg/L) | 0.0269 | 0.113 | <0.0050 | 0.284 | 1.88 |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0085 |
| | Sulfate (SO4) (mg/L) | 13.4 | 22.5 | 2.57 | 57.8 | 69.6 |
| | Anion Sum (meq/L) | 3.51 | 3.96 | 2.51 | 5.52 | 5.61 |
| | Cation Sum (meq/L) | 3.51 | 3.86 | 2.49 | 5.49 | 5.42 |
| | Cation - Anion Balance (%) | 0.0 | -1.3 | -0.4 | -0.3 | -1.8 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 11.3 | 7.65 | 9.73 | 8.78 | 12.7 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0103 | 0.0247 | 0.0067 | 0.0041 | 1.65 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00070 | 0.00048 | 0.00048 | 0.00038 | 0.00085 |
| | Barium (Ba)-Total (mg/L) | 0.0660 | 0.0701 | 0.0507 | 0.0728 | 0.102 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | 0.000080 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | <0.010 | <0.010 | <0.010 | 0.030 | 0.028 |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000182 |
| | Calcium (Ca)-Total (mg/L) | 40.7 | 41.3 | 34.0 | 64.7 | 65.9 |
| | Chromium (Cr)-Total (mg/L) | 0.00032 | 0.00024 | 0.00025 | 0.00015 | 0.00139 |
| | Cobalt (Co)-Total (mg/L) | 0.00020 | 0.00011 | <0.00010 | <0.00010 | 0.00118 |
| | Copper (Cu)-Total (mg/L) | 0.00150 | 0.00148 | 0.00095 | 0.00648 | 0.0638 |
| | Iron (Fe)-Total (mg/L) | 0.444 | 0.178 | 0.098 | <0.010 | 2.73 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.000563 |
| | Lithium (Li)-Total (mg/L) | 0.0015 | 0.0016 | <0.0010 | 0.0016 | 0.0027 |
| | Magnesium (Mg)-Total (mg/L) | 13.3 | 16.7 | 8.52 | 19.5 | 19.9 |
| | Manganese (Mn)-Total (mg/L) | 0.105 | 0.0577 | 0.0362 | 0.0140 | 0.305 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

23-OCT-17 19:17 (MT)

Version: FINAL

| | Sample ID Description Sampled Date Sampled Time Client ID | L2006096-6 Water 09-OCT-17 11:00 W8A | L2006096-7 Water 09-OCT-17 15:00 MN | L2006096-8 Water 10-OCT-17 08:50 W3 | L2006096-9 Water 10-OCT-17 11:10 BC | L2006096-10 Water 10-OCT-17 13:50 MC1 |
|-----------------------------------|---|--|---|---|---|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 1060 | 556 | 533 | 226 | 357 |
| | Hardness (as CaCO3) (mg/L) | 591 | 203 | 267 | 106 | 181 |
| | pH (pH) | 8.24 | 8.05 | 8.42 | 8.20 | 8.37 |
| | Total Suspended Solids (mg/L) | 36.3 | 29.7 | <3.0 | <3.0 | 3.5 |
| | TDS (Calculated) (mg/L) | 758 | 362 | 317 | 127 | 206 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 362 | 80.3 | 237 | 107 | 174 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | 7.2 | <1.0 | 7.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 362 | 80.3 | 244 | 107 | 181 |
| | Ammonia, Total (as N) (mg/L) | 0.108 | 0.612 | <0.0050 | <0.0050 | 0.0053 |
| | Chloride (Cl) (mg/L) | 9.0 | 1.81 | 4.45 | 0.64 | 1.62 |
| | Nitrate and Nitrite (as N) (mg/L) | 6.41 | 26.0 | 0.189 | 0.0764 | 0.0848 |
| | Nitrate (as N) (mg/L) | 6.31 | 25.9 | 0.189 | 0.0764 | 0.0848 |
| | Nitrite (as N) (mg/L) | 0.106 | 0.105 | <0.0010 | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | 248 | 89.7 | 55.8 | 17.2 | 21.2 |
| | Anion Sum (meq/L) | 13.1 | 5.47 | 6.21 | 2.53 | 4.14 |
| | Cation Sum (meq/L) | 13.8 | 5.35 | 6.22 | 2.49 | 4.12 |
| | Cation - Anion Balance (%) | 2.4 | -1.1 | 0.1 | -0.8 | -0.3 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | | 5.56 | 7.37 | 8.36 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.326 | 0.529 | 0.0067 | 0.0213 | 0.0665 |
| | Antimony (Sb)-Total (mg/L) | 0.00011 | 0.00035 | <0.00010 | 0.00021 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00070 | 0.00052 | 0.00025 | 0.00067 | 0.00055 |
| | Barium (Ba)-Total (mg/L) | 0.123 | 0.0407 | 0.0684 | 0.0698 | 0.0618 |
| | Beryllium (Be)-Total (mg/L) | 0.000029 | 0.000022 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.029 | 0.114 | 0.027 | <0.010 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | 0.000356 | 0.0000891 | <0.000050 | 0.0000056 | <0.0000050 |
| | Calcium (Ca)-Total (mg/L) | 167 | 67.6 | 59.5 | 26.3 | 45.8 |
| | Chromium (Cr)-Total (mg/L) | 0.00075 | 0.00288 | 0.00012 | 0.00024 | 0.00034 |
| | Cobalt (Co)-Total (mg/L) | 0.00090 | 0.00032 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | 0.197 | 0.0793 | 0.00241 | 0.00189 | 0.00164 |
| | Iron (Fe)-Total (mg/L) | 2.37 | 0.726 | 0.028 | 0.064 | 0.191 |
| | Lead (Pb)-Total (mg/L) | 0.000195 | 0.000338 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0042 | 0.0057 | 0.0036 | 0.0016 | 0.0017 |
| | Magnesium (Mg)-Total (mg/L) | 46.3 | 9.71 | 29.6 | 10.5 | 16.7 |
| | Manganese (Mn)-Total (mg/L) | 2.00 | 0.0618 | 0.0517 | 0.0184 | 0.0175 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2006096-1 | L2006096-2 | L2006096-3 | L2006096-4 | L2006096-5 |
|-------------------------|---------------------------------------|--------------|-------------------------|------------|------------|------------|--------------------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 07-OCT-17 | 07-OCT-17 | 07-OCT-17 | 09-OCT-17 | 09-OCT-17 |
| | | Sampled Time | 14:45 | 15:30 | 15:55 | 10:10 | 10:30 |
| | | Client ID | C4 | W46 | W6 | W17 | W16 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.000025 ^{DLM} |
| | Molybdenum (Mo)-Total (mg/L) | | 0.000852 | 0.00206 | 0.000642 | 0.00594 | 0.00304 |
| | Nickel (Ni)-Total (mg/L) | | 0.00168 | 0.00111 | 0.00146 | 0.00078 | 0.00200 |
| | Phosphorus (P)-Total (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 | 0.130 |
| | Potassium (K)-Total (mg/L) | | 1.10 | 1.36 | 0.49 | 3.59 | 3.30 |
| | Selenium (Se)-Total (mg/L) | | 0.000092 | 0.000154 | <0.000050 | 0.000420 | 0.000645 |
| | Silicon (Si)-Total (mg/L) | | 6.45 | 6.50 | 7.79 | 5.52 | 7.60 |
| | Silver (Ag)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000020 |
| | Sodium (Na)-Total (mg/L) | | 7.07 | 10.9 | 4.80 | 15.4 | 14.5 |
| | Strontium (Sr)-Total (mg/L) | | 0.277 | 0.461 | 0.151 | 0.688 | 0.640 |
| | Sulfur (S)-Total (mg/L) | | 4.94 | 8.33 | 1.12 | 20.8 | 25.3 |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000013 |
| | Tin (Sn)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | | <0.00090 ^{DLM} | 0.00168 | 0.00031 | <0.00030 | 0.0885 |
| | Uranium (U)-Total (mg/L) | | 0.000787 | 0.00145 | 0.000195 | 0.00198 | 0.00142 |
| | Vanadium (V)-Total (mg/L) | | <0.00050 | 0.00076 | 0.00052 | <0.00050 | 0.00640 |
| | Zinc (Zn)-Total (mg/L) | | <0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0108 |
| | Zirconium (Zr)-Total (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | 0.00049 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0048 | 0.0066 | 0.0047 | 0.0037 | 0.0034 |
| | Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00070 | 0.00045 | 0.00050 | 0.00036 | 0.00044 |
| | Barium (Ba)-Dissolved (mg/L) | | 0.0660 | 0.0695 | 0.0505 | 0.0736 | 0.0845 |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | <0.010 | <0.010 | <0.010 | 0.029 | 0.025 |
| | Cadmium (Cd)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000075 |
| | Calcium (Ca)-Dissolved (mg/L) | | 41.8 | 40.7 | 31.6 | 64.1 | 63.0 |
| | Chromium (Cr)-Dissolved (mg/L) | | 0.00023 | 0.00011 | 0.00019 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | | 0.00021 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00087 | 0.00140 | 0.00092 | 0.00604 | 0.0217 |
| | Iron (Fe)-Dissolved (mg/L) | | 0.354 | 0.132 | 0.083 | <0.010 | 0.048 |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | | 0.0013 | 0.0014 | <0.0010 | 0.0014 | 0.0012 |
| | Magnesium (Mg)-Dissolved (mg/L) | | 13.0 | 16.2 | 8.40 | 18.9 | 19.0 |
| | Manganese (Mn)-Dissolved (mg/L) | | 0.102 | 0.0546 | 0.0357 | 0.00269 | 0.202 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2006096-6 Water 09-OCT-17 11:00 W8A | L2006096-7 Water 09-OCT-17 15:00 MN | L2006096-8 Water 10-OCT-17 08:50 W3 | L2006096-9 Water 10-OCT-17 11:10 BC | L2006096-10 Water 10-OCT-17 13:50 MC1 |
|---|---------------------------------------|--|---|---|---|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.0116 | 0.0253 | 0.00502 | 0.00145 | 0.00178 |
| | Nickel (Ni)-Total (mg/L) | 0.00149 | <0.00050 | 0.00105 | 0.00113 | 0.00119 |
| | Phosphorus (P)-Total (mg/L) | 0.103 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 6.84 | 3.96 | 2.36 | 0.87 | 1.38 |
| | Selenium (Se)-Total (mg/L) | 0.00687 | 0.0181 | 0.000282 | 0.000070 | 0.000135 |
| | Silicon (Si)-Total (mg/L) | 8.37 | 3.90 | 6.72 | 6.17 | 6.80 |
| | Silver (Ag)-Total (mg/L) | 0.000038 | 0.000027 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 39.1 | 26.2 | 19.1 | 8.08 | 10.7 |
| | Strontium (Sr)-Total (mg/L) | 2.21 | 1.76 | 0.778 | 0.288 | 0.458 |
| | Sulfur (S)-Total (mg/L) | 102 | 32.9 | 20.5 | 6.16 | 7.89 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.000010 | 0.00041 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | 0.0186 | 0.0176 | 0.00045 | 0.00067 | <0.0030 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.00277 | 0.000950 | 0.00269 | 0.00300 | 0.00156 |
| | Vanadium (V)-Total (mg/L) | 0.00291 | 0.00208 | <0.00050 | 0.00078 | 0.00083 |
| | Zinc (Zn)-Total (mg/L) | 0.180 | 0.0082 | <0.0030 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | 0.00038 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0100 | 0.0031 | 0.0019 | 0.0109 | 0.0036 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00024 | <0.00010 | 0.00015 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00057 | 0.00043 | 0.00023 | 0.00065 | 0.00051 |
| | Barium (Ba)-Dissolved (mg/L) | 0.115 | 0.0349 | 0.0683 | 0.0675 | 0.0602 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.026 | 0.103 | 0.024 | <0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000300 | 0.0000733 | 0.0000054 | 0.0000081 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 163 | 65.7 | 57.9 | 25.4 | 45.7 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00042 | 0.00047 | <0.00010 | 0.00017 | 0.00017 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00070 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.104 | 0.0314 | 0.00228 | 0.00178 | 0.00135 |
| | Iron (Fe)-Dissolved (mg/L) | 0.374 | <0.010 | 0.020 | 0.041 | 0.070 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | 0.000110 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0037 | 0.0050 | 0.0034 | 0.0013 | 0.0016 |
| | Magnesium (Mg)-Dissolved (mg/L) | 44.9 | 9.56 | 29.6 | 10.4 | 16.3 |
| | Manganese (Mn)-Dissolved (mg/L) | 1.78 | 0.0351 | 0.0471 | 0.0166 | 0.00785 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2006096-1 | L2006096-2 | L2006096-3 | L2006096-4 | L2006096-5 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 07-OCT-17 | 07-OCT-17 | 07-OCT-17 | 09-OCT-17 | 09-OCT-17 |
| | | Sampled Time | 14:45 | 15:30 | 15:55 | 10:10 | 10:30 |
| | | Client ID | C4 | W46 | W6 | W17 | W16 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.000729 | 0.00182 | 0.000413 | 0.00532 | 0.00271 |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00151 | 0.00095 | 0.00128 | 0.00062 | 0.00077 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 1.10 | 1.34 | 0.49 | 3.61 | 2.96 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000088 | 0.000167 | 0.000061 | 0.000473 | 0.000767 |
| | Silicon (Si)-Dissolved (mg/L) | | 6.05 | 6.19 | 7.53 | 5.36 | 3.91 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 6.94 | 10.5 | 4.79 | 14.9 | 14.3 |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.287 | 0.457 | 0.140 | 0.687 | 0.611 |
| | Sulfur (S)-Dissolved (mg/L) | | 4.63 | 7.77 | 0.94 | 20.3 | 24.9 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.000818 | 0.00142 | 0.000171 | 0.00192 | 0.00130 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | 0.00055 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | <0.0010 | 0.0012 | <0.0010 | <0.0010 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L2006096-6 | L2006096-7 | L2006096-8 | L2006096-9 | L2006096-10 |
|-------------------------|----------------------------------|-------------------------|--------------|------------|------------|------------|------------|------------|-------------|
| | | | | | Water | Water | Water | Water | Water |
| | | 09-OCT-17 | 11:00 | W8A | 09-OCT-17 | 09-OCT-17 | 10-OCT-17 | 10-OCT-17 | 10-OCT-17 |
| | | | | | 11:00 | 15:00 | 08:50 | 11:10 | 13:50 |
| | | | | | W8A | MN | W3 | BC | MC1 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0112 | 0.0228 | 0.00442 | 0.00118 | 0.00154 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00131 | <0.00050 | 0.00092 | 0.00116 | 0.00091 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 6.63 | 3.82 | 2.36 | 0.86 | 1.36 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00758 | 0.0199 | 0.000352 | <0.000050 | 0.000117 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 7.56 | 2.67 | 6.56 | 5.84 | 6.42 | | | |
| | Silver (Ag)-Dissolved (mg/L) | 0.000013 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 38.6 | 26.3 | 19.2 | 7.99 | 10.5 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 2.12 | 1.68 | 0.762 | 0.274 | 0.454 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 96.8 | 31.7 | 20.6 | 5.85 | 7.54 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | 0.00012 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLM} | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00250 | 0.000882 | 0.00255 | 0.00287 | 0.00150 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00122 | <0.00050 | <0.00050 | 0.00064 | 0.00051 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.110 | 0.0027 | <0.0010 | 0.0034 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | 0.00047 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

| Qualifier | Description |
|-----------|---|
| WSMT | Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low. |

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|---|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2006096-1, -10, -2, -3, -4, -5, -8, -9 |
| Matrix Spike | Nitrate (as N) | MS-B | L2006096-7 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2006096-1, -2, -3, -4, -5, -6 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are

Reference Information

included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-10-11 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

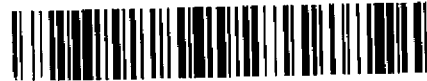
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2006096-COFC

COC Number: 2017-10-11 A

Page of

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| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
|--|---|--|------------------------|---|--|--------------|-------------------------------------|---|-------------------------------------|-------|--|----|---------|-----------|-----|------------|--|
| Contact and company name below will appear on the final report | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | EMERGENCY | | | | | | |
| Company: | Minto Explorations Ltd. | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | | | | | |
| Contact: | Minto Environment - Coordinator | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | Date and Time Required for all E&P TATs: | | | | | | dd-mmm-yy hh:mm | | | | | | |
| Phone: | 1-604-759-4659 | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Analysis Request | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | pH / Conductivity / Alkalinity / Anions | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Total Suspended Solids (TSS) | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | Total Dissolved Solids (TDS) | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Total Metals (TM), Hardness | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | Dissolved Metals (DM) (filtered and preserved) | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | Total Mercury, Hardness | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | Dissolved Mercury (1) (Filtered + preserved) | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: PO# | | | Total Nutrients (Ammonia) | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: Routing Code: | | | Dissolved Organic Carbon (DOC) | | | | | | | | | | | | |
| PO / AFE: | 226973 (WUL) | Requisitioner: | | | Number of Containers | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Shane Stack | Sampler: | SRVCH | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH | Conductivity | Alkalinity | Anions | TSS | TDS | TM | DM | Mercury | Nutrients | DOC | Containers | |
| C4 | | 7-Oct-17 | 14:45 | Water | R | R | R | R | R | R | R | R | R | R | R | 7 | |
| W46 | | 7-Oct-17 | 15:30 | Water | R | R | R | R | R | R | R | R | R | R | R | 7 | |
| W6 | | 7-Oct-17 | 15:55 | Water | R | R | R | R | R | R | R | R | R | R | R | 7 | |
| W17 | | 9-Oct-17 | 10:10 | Water | R | R | R | R | R | R | R | R | R | R | R | 7 | |
| W16 | | 9-Oct-17 | 10:30 | Water | R | R | R | R | R | R | R | R | R | R | R | 7 | |
| W8A | | 9-Oct-17 | 11:00 | Water | R | R | R | R | R | R | R | R | R | R | R | 6 | |
| MN | | 9-Oct-17 | 15:00 | Water | R | R | R | R | R | R | R | R | R | R | R | 6 | |
| W3 | | 10-Oct-17 | 8:50 | Water | R | R | R | R | R | R | R | R | R | R | R | 7 | |
| BC | | 10-Oct-17 | 11:10 | Water | R | R | R | R | R | R | R | R | R | R | R | 7 | |
| MC1 | | 10-Oct-17 | 13:50 | Water | R | R | R | R | R | R | R | R | R | R | R | 7 | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C: 10°C 2°C | | | | | | | | | | | | |
| | | | | | FINAL COOLER TEMPERATURES °C: | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Shaun Roberts | Date: 2017-10-11 | Time: 11:00 | Received by: <i>DR</i> | Date: OCT 12 / 17 | Time: 11:39 | Received by: | Date: | Time: | Received by: | Date: | Time: | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.
 OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 18-OCT-17
Report Date: 02-NOV-17 19:31 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2009424
Project P.O. #: 226973 (WUL)
Job Reference:
C of C Numbers: 2017-10-18A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2009424-1 | L2009424-2 | L2009424-3 | L2009424-4 | L2009424-5 |
|-----------------------------------|---|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 17-OCT-17 | 17-OCT-17 | 17-OCT-17 | 17-OCT-17 | 17-OCT-17 |
| | | Sampled Time | 09:35 | 10:00 | 14:20 | 14:45 | |
| | | Client ID | W3 | W8A | BC | W2 | DUP |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 524 | 1290 | 228 | 351 | 532 |
| | Hardness (as CaCO3) (mg/L) | | 250 | 633 | 107 | 182 | 257 |
| | pH (pH) | | 8.41 | 7.88 | 8.20 | 8.35 | 8.40 |
| | Total Suspended Solids (mg/L) | | <3.0 | 4.0 | <3.0 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | | 309 | 884 | 128 | 208 | 316 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 230 | 413 | 107 | 172 | 235 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | 11.0 | <1.0 | <1.0 | 5.4 | 11.4 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 241 | 413 | 107 | 178 | 246 |
| | Ammonia, Total (as N) (mg/L) | | 0.0054 | 0.149 | <0.0050 | <0.0050 | 0.0057 |
| | Chloride (Cl) (mg/L) | | 4.42 | 12.0 | 0.70 | 1.99 | 4.49 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.196 | 6.60 | 0.0865 | 0.126 | 0.200 |
| | Nitrate (as N) (mg/L) | | 0.196 | 6.36 | 0.0865 | 0.126 | 0.200 |
| | Nitrite (as N) (mg/L) | | <0.0010 | 0.246 | <0.0010 | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 55.6 | 319 | 17.6 | 23.7 | 56.3 |
| | Anion Sum (meq/L) | | 6.10 | 15.7 | 2.54 | 4.11 | 6.24 |
| | Cation Sum (meq/L) | | 5.88 | 14.9 | 2.52 | 4.14 | 6.04 |
| | Cation - Anion Balance (%) | | -1.9 | -2.8 | -0.5 | 0.5 | -1.6 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 5.35 | | 6.97 | 7.48 | 5.42 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0055 | 0.0666 | 0.0151 | 0.0183 | 0.0046 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | 0.00013 | 0.00015 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00025 | 0.00061 | 0.00062 | 0.00038 | 0.00023 |
| | Barium (Ba)-Total (mg/L) | | 0.0653 | 0.124 | 0.0610 | 0.0606 | 0.0619 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | 0.000024 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.029 | 0.039 | <0.010 | <0.010 | 0.029 |
| | Cadmium (Cd)-Total (mg/L) | | <0.0000050 | 0.000436 | 0.0000079 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Total (mg/L) | | 55.9 | 190 | 25.4 | 45.5 | 56.1 |
| | Chromium (Cr)-Total (mg/L) | | 0.00013 | 0.00058 | 0.00018 | 0.00015 | <0.00010 |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | 0.00096 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | | 0.00266 | 0.147 | 0.00235 | 0.00151 | 0.00217 |
| | Iron (Fe)-Total (mg/L) | | 0.025 | 1.01 | 0.045 | 0.063 | 0.025 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | 0.000076 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | 0.0042 | 0.0058 | 0.0018 | 0.0024 | 0.0043 |
| | Magnesium (Mg)-Total (mg/L) | | 29.4 | 52.1 | 10.0 | 15.1 | 28.6 |
| | Manganese (Mn)-Total (mg/L) | | 0.0524 | 2.50 | 0.0196 | 0.0123 | 0.0493 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2009424-1 Water 17-OCT-17 09:35 W3 | L2009424-2 Water 17-OCT-17 10:00 W8A | L2009424-3 Water 17-OCT-17 14:20 BC | L2009424-4 Water 17-OCT-17 14:45 W2 | L2009424-5 Water 17-OCT-17 DUP |
|---|---------------------------------------|---|--|---|---|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00479 | 0.0131 | 0.00135 | 0.00132 | 0.00478 |
| | Nickel (Ni)-Total (mg/L) | 0.00094 | 0.00121 | 0.00096 | 0.00086 | 0.00089 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.055 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.35 | 7.69 | 0.90 | 1.56 | 2.27 |
| | Selenium (Se)-Total (mg/L) | 0.000298 | 0.00790 | 0.000054 | 0.000078 | 0.000287 |
| | Silicon (Si)-Total (mg/L) | 6.26 | 7.60 | 5.49 | 6.24 | 6.19 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000038 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 19.6 | 45.9 | 8.08 | 10.8 | 19.8 |
| | Strontium (Sr)-Total (mg/L) | 0.773 | 2.56 | 0.280 | 0.454 | 0.769 |
| | Sulfur (S)-Total (mg/L) | 19.9 | 123 | 5.75 | 8.30 | 19.4 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | 0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.00030 | 0.00421 | 0.00044 | 0.00087 | <0.00030 |
| | Uranium (U)-Total (mg/L) | 0.00291 | 0.00342 | 0.00323 | 0.00213 | 0.00285 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00196 | 0.00064 | 0.00051 | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.109 | <0.0030 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | 0.00045 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0014 | 0.0087 | 0.0083 | 0.0029 | 0.0016 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00011 | 0.00013 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00023 | 0.00053 | 0.00061 | 0.00035 | 0.00023 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0628 | 0.126 | 0.0645 | 0.0600 | 0.0637 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.027 | 0.032 | <0.010 | <0.010 | 0.027 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.000242 | 0.0000072 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 54.3 | 174 | 25.9 | 47.6 | 56.9 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00044 | 0.00014 | 0.00012 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00069 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00214 | 0.0725 | 0.00166 | 0.00147 | 0.00218 |
| | Iron (Fe)-Dissolved (mg/L) | 0.019 | 0.460 | 0.031 | 0.036 | 0.019 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0037 | 0.0047 | 0.0018 | 0.0024 | 0.0041 |
| | Magnesium (Mg)-Dissolved (mg/L) | 27.8 | 48.1 | 10.3 | 15.3 | 28.0 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0481 | 2.08 | 0.0185 | 0.0105 | 0.0465 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2009424-1 Water 17-OCT-17 09:35 W3 | L2009424-2 Water 17-OCT-17 10:00 W8A | L2009424-3 Water 17-OCT-17 14:20 BC | L2009424-4 Water 17-OCT-17 14:45 W2 | L2009424-5 Water 17-OCT-17 DUP | |
|---|---|--|---|---|---|------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00456 | 0.0122 | 0.00120 | 0.00126 | 0.00438 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00087 | 0.00125 | 0.00094 | 0.00081 | 0.00087 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 2.33 | 7.25 | 0.87 | 1.58 | 2.33 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000293 | 0.00874 | <0.000050 | 0.000080 | 0.000303 |
| | Silicon (Si)-Dissolved (mg/L) | 6.13 | 7.54 | 5.54 | 6.07 | 6.20 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | 0.000013 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 18.9 | 43.5 | 8.14 | 10.7 | 19.2 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.782 | 2.59 | 0.284 | 0.491 | 0.767 |
| | Sulfur (S)-Dissolved (mg/L) | 18.6 | 115 | 5.74 | 7.89 | 19.3 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00063 | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | 0.00269 | 0.00331 | 0.00327 | 0.00208 | 0.00279 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00120 | 0.00058 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | 0.202 ^{DTC} | <0.0010 | 0.0012 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | 0.00048 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2009424-1, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2009424-1, -2, -3, -4, -5 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2009424-5 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| <p>This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.</p> | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| <p>Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.</p> | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| <p>Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.</p> | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| <p>Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.</p> | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| <p>This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.</p> | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| <p>This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.</p> | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| <p>Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.</p> | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| <p>Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.</p> | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| <p>Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.</p> | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |

Reference Information

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-10-18A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2009424-COFC

COC Number: 2017-10-18 A

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| | | | | | | | | | | | | | | | | |
|--|---|--|------------------|-------------------|---|------------------------------|-------------------------------------|-----------------------------|--|------------------------------|--|---------------------------|--------------------------------|----------------------|---|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EOD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | | 1 Business day [E1] <input type="checkbox"/> | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | Analysis Request | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | Requisitioner: | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: SR/CP | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM, Hardness) | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (I) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | |
| | W3 | 17-Oct-17 | 9:35 | Water | R | R | R | R | R | R | R | R | R | | 7 | |
| | W8A | 17-Oct-17 | 10:00 | Water | R | R | R | R | R | R | R | R | R | | 6 | |
| | BC | 17-Oct-17 | 14:20 | Water | R | R | R | R | R | R | R | R | R | | 7 | |
| | W2 | 17-Oct-17 | 14:45 | Water | R | R | R | R | R | R | R | R | R | | 7 | |
| | DUP | 17-Oct-17 | | Water | R | R | R | R | R | R | R | R | R | | 7 | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | |
| | | | | | 3.0 | | | | | 5 6 | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | |
| Released by: Shaun Roberts | Date: 2017-10-18 | Time: 9:00 | Received by: EHF | Date: 18 Oct 2017 | Time: 14:40 | Received by: C. HAYAN | Date: 1 Oct. 19 | Time: 14:25 | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 24-OCT-17
Report Date: 22-NOV-17 16:19 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2011956
Project P.O. #: 224159 (MMER)
Job Reference:
C of C Numbers: 2017.10.22A
Legal Site Desc:

Comments: Please note, this report contains only Nautilus Environmental reports (at the end of the attachment).

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | | | | |
|---|---------|--|--|--|--|
| Grouping | Analyte | | | | |
| | | | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|------------------|--------------------|
|---------------|--------|------------------|--------------------|

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

Chain of Custody Numbers:

2017.10.22A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Toxicity testing on L2011956-1 W3

Sample collected October 22, 2017

Final Report

November 20, 2017

Submitted to: **ALS Environmental**
Burnaby, BC

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APPENDIX B – Chain-of-Custody Forms

SIGNATURE PAGE

Report By:
Kania Lywe, B.Sc.
Laboratory Biologist



Reviewed By:
Armando Tang, R.P.Bio
Senior Reviewer

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

SUMMARY

Sample Information and Test Type

| | |
|-----------------------------|---|
| Sample ID | L2011956-1 W3 |
| Samples collection date | October 22, 2017 |
| Samples receipt date | October 24, 2017 |
| Samples receipt temperature | 8.0°C |
| Test type | 7-d rainbow trout (<i>Oncorhynchus mykiss</i>) embryo viability |

Summary of Results

| Endpoint | L2011956-1 W3 (% v/v) |
|----------------------------|--------------------------|
| <i>Oncorhynchus mykiss</i> | |
| Embryo viability EC25 | > 100 |
| Embryo viability EC50 | > 100 |

EC = Effective Concentration

1.0 INTRODUCTION

Nautilus Environmental Company Inc. conducted an early life stage embryo toxicity test on rainbow trout (*Oncorhynchus mykiss*) for ALS Environmental. Sample L2011956-1 W3 was collected on October 22, 2017 and delivered to the Nautilus Environmental laboratory in Burnaby, BC on October 24, 2017. The sample was transported in five 20-L plastic containers and was received at a temperature of 8.0°C. The sample was stored in the dark at $4 \pm 2^\circ\text{C}$ prior to testing.

This report describes the results of these toxicity tests. Copies of raw laboratory data sheets and statistical analysis for each species are provided in Appendix A. The chain-of-custody form is provided in Appendix B.

2.0 METHODS

Methods for the toxicity test using rainbow trout are summarized in Table 1. The rainbow trout embryo viability test followed procedures described by Environment Canada (1998) and modified by Canaria *et al.* (1999). Statistical analyses were performed using CETIS (Tidepool Scientific Software, 2013).

Table 1. Summary of test conditions: 7-d rainbow trout (*Oncorhynchus mykiss*) embryo viability test.

| | |
|---|--|
| Test species | <i>Oncorhynchus mykiss</i> |
| Organism source | Hatchery |
| Organism age | <30 minutes post fertilization, <24 hour old gametes |
| Test type | Static-renewal |
| Test duration | 7 days |
| Test vessel | 2-L plastic container |
| Test volume | 2 L |
| Test solution depth | 17 cm |
| Test concentrations | Five concentrations, plus laboratory control |
| Test replicates | 4 per treatment |
| Number of organisms | 30 per replicate |
| Control/dilution water | Dechlorinated Metro Vancouver municipal tapwater |
| Test solution renewal | Daily (80% renewal) |
| Test temperature | 14 ± 1°C |
| Feeding | None |
| Light intensity | Dark |
| Photoperiod | 24 hours dark |
| Aeration | Continuous gentle aeration |
| Test measurements | Temperature, dissolved oxygen, pH and conductivity measured daily; hardness and alkalinity of undiluted sample measured at test initiation; survival checked daily |
| Test protocol | Environment Canada (1998), EPS 1/RM/28; Canaria <i>et al.</i> (1999) |
| Statistical software | CETIS Version 1.8.7 |
| Test endpoint | Embryo viability |
| Test acceptability criterion for controls | Embryo viability ≥70% |
| Reference toxicant | Sodium dodecyl sulphate (SDS) |

3.0 RESULTS

Results of the toxicity test for sample L2011956-1 W3 are summarized in Table 2. Embryo viability in all test treatments was $\geq 90\%$ and there were no adverse effects observed on embryo viability.

Table 2. Results: 7-d rainbow trout (*Oncorhynchus mykiss*) embryo viability test.

| Concentration (% v/v) | Embryo Viability (%) (Mean \pm SD) |
|----------------------------------|--|
| Laboratory Control | 93.3 \pm 9.0 |
| 6.25 | 94.2 \pm 9.6 |
| 12.5 | 94.2 \pm 5.7 |
| 25 | 90.8 \pm 12.0 |
| 50 | 95.8 \pm 3.2 |
| 100 | 94.2 \pm 7.4 |
| Test Endpoint (% v/v) | |
| EC25 | >100 |
| EC50 | >100 |

SD = Standard Deviation, EC = Effective Concentration

4.0 QA/QC

The health history of the test organisms used in the exposure was acceptable and met the requirements of the Environment Canada protocol. The test met all control acceptability criteria and water quality parameters remained within ranges specified in the protocol throughout the test. Uncertainty associated with the test is best described by the standard deviation around the mean and/or the confidence intervals around the point estimates.

The eggs were exposed using a blocked design; eggs from each of the four female fish were used in each of replicates A, B, C and D. This approach deviated from the Environment Canada method, which specifies that all the eggs should be pooled for testing. However, this modification was used because the egg quality from each female varied considerably and blocking would minimize the effects of poor quality eggs from any one particular female fish. However, the results were not affected as the control criterion was still met at the end of the test.

Results of the reference toxicant tests conducted during the testing program are summarized in Table 3. Result for this test fell within the acceptable range for organism performance of mean and two standard deviations, based on historical results obtained by the laboratory with this test. Thus, the sensitivity of the organisms used in these tests was appropriate. The reference toxicant was performed under the same conditions as those used for the samples.

Table 3. Reference toxicant test results.

| Test Species | Endpoint | Historical Mean (2 SD Range) | CV (%) | Test Date |
|------------------|--------------------------------|------------------------------|--------|------------------|
| <i>O. mykiss</i> | Viability (EC50): 4.0 mg/L SDS | 4.3 (2.0 – 9.0) | 45 | October 24, 2017 |

SD = Standard Deviation, CV = Coefficient of Variation, EC = Effective Concentration

5.0 REFERENCES

Canaria, E.C., J.R. Elphick and H.C. Bailey. 1999. A simplified procedure for conducting small-scale short-term embryo toxicity tests with salmonids. *Environ. Toxicol.* 14:301-307.

Environment Canada. 1998. Biological test method: toxicity tests using early life stages of salmonid fish (rainbow trout). Environmental Protection Series EPS 1/RM/28. Second Edition, July 1998. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 102 pp.

Tidepool Scientific Software. 2013. CETIS comprehensive environmental toxicity information system, version 1.8.7.16 Tidepool Scientific Software, McKinleyville, CA. 222 pp.

APPENDIX A – *Oncorhynchus mykiss* Toxicity Test Data

Rainbow Trout Early Life Stage Summary Sheet

Client: ALS Start Date/Time: Oct 24/17 e1610h
 Work Order No.: 171215 Test Species: Oncorhynchus mykiss

Sample Information:

Sample ID: L201956-1 W3
 Sample Date: Oct 22/17
 Date Received: Oct 24/17
 Sample Volume: 5x10L

Dilution Water:

Type: Dechlorinated Tap Water
 Hardness (mg/L CaCO₃): 12
 Alkalinity (mg/L CaCO₃): 10

Test Organism Information:

Batch No.: 102417
 Source: Vancouver Island Trout Hatchery
 Loading Density: 0.90g/L

Number of male broodstock used: 3
 Number of female broodstock used: 4
 Sperm motility check: Verification of sperm motility using a compound microscope

SDS Reference Toxicant Results:

Reference Toxicant ID: RT1000^h
 Stock Solution ID: 17503 (1000mg/L SDS)
 Date Initiated: Oct 24/17
 7-d EC50 (95% CL): 4.0 (3.8-4.2) mg/L SDS

Reference Toxicant Mean and Range: 4.3 (2.0-9.0) mg/L SDS
 Reference Toxicant CV (%): 45

Test Results:

| | Sample ID | | |
|-----------------------|--------------|--|--|
| | L201956-1 W3 | | |
| EC25 % (v/v) (95% CL) | >100 | | |
| EC50 % (v/v) (95% CL) | >100 | | |

Reviewed by: Joh

Date reviewed: Nov. 14/17

7-d Chronic Freshwater Toxicity Test Initial and Final Water Quality Measurements

Client: ALS
 Sample ID: L201956-1 WS
 Work Order #: ATCS 17125

Start Date & Time: Oct 24/17 @ 16:0h
 Stop Date & Time: Oct 31/17 @ 11:00h
 CER #: 279
 Test Species: Oncorhynchus mykiss

| % (W) | Days | | | | | | | | | | | | | | |
|-----------------------|-------|------|------|------|------|------|------|------|------|------|------|------|------|-------|---|
| | 0 | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 |
| | init. | new | old | new | old | new | old | new | old | new | old | new | old | final | |
| Concentration Control | | | | | | | | | | | | | | | |
| Temperature (°C) | 14.0 | 14.0 | 14.0 | 14.5 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | |
| DO (mg/L) | 9.6 | 9.9 | 9.8 | 10.1 | 9.8 | 9.8 | 9.7 | 9.8 | 9.7 | 9.9 | 9.8 | 9.7 | 9.5 | 9.8 | |
| pH | 6.9 | 7.1 | 7.1 | 7.1 | 7.2 | 6.8 | 6.9 | 7.0 | 7.1 | 7.0 | 7.2 | 6.6 | 6.6 | 6.7 | |
| Cond. (µS/cm) | 32 | | 34 | | 34 | | 34 | | 34 | | 34 | | 36 | 38 | |
| Initials | K | | K | | K | | K | | A | | A | | K | K | |

| Concentration | Days | | | | | | | | | | | | | | |
|------------------|-------|------|------|------|------|------|------|------|------|------|------|------|------|-------|---|
| | 0 | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 |
| | init. | new | old | new | old | new | old | new | old | new | old | new | old | final | |
| 6.25 | | | | | | | | | | | | | | | |
| Temperature (°C) | 14.5 | 14.0 | 14.0 | 14.5 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | |
| DO (mg/L) | 9.4 | 9.8 | 9.8 | 9.6 | 9.8 | 9.8 | 9.7 | 9.7 | 9.8 | 9.8 | 9.8 | 9.5 | 9.4 | 9.8 | |
| pH | 7.2 | 7.2 | 7.4 | 7.5 | 7.5 | 7.0 | 7.4 | 7.3 | 7.4 | 7.4 | 7.6 | 7.2 | 7.2 | 7.4 | |
| Cond. (µS/cm) | 69 | | 65 | | 68 | | 64 | | 67 | | 65 | | 67 | 68 | |
| Initials | K | | K | | K | | K | | A | | A | | K | K | |

| Concentration | Days | | | | | | | | | | | | | | |
|------------------|-------|------|------|------|------|------|------|------|------|------|------|------|------|-------|---|
| | 0 | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 |
| | init. | new | old | new | old | new | old | new | old | new | old | new | old | final | |
| 25 | | | | | | | | | | | | | | | |
| Temperature (°C) | 15.0 | 14.0 | 14.0 | 14.5 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | |
| DO (mg/L) | 9.5 | 9.8 | 9.8 | 9.6 | 9.8 | 9.8 | 9.7 | 9.9 | 9.8 | 10.2 | 9.9 | 9.5 | 9.4 | 9.8 | |
| pH | 7.6 | 7.8 | 7.8 | 7.8 | 7.9 | 7.6 | 7.7 | 7.6 | 7.7 | 7.7 | 7.8 | 7.7 | 7.7 | 7.8 | |
| Cond. (µS/cm) | 175 | | 176 | | 172 | | 172 | | 174 | | 175 | | 176 | 176 | |
| Initials | K | | K | | K | | K | | A | | A | | K | K | |

| Concentration | Days | | | | | | | | | | | | | | |
|------------------|-------|------|------|------|------|------|------|------|------|------|------|------|------|-------|---|
| | 0 | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 |
| | init. | new | old | new | old | new | old | new | old | new | old | new | old | final | |
| 100 | | | | | | | | | | | | | | | |
| Temperature (°C) | 15.0 | 14.0 | 14.0 | 14.5 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | |
| DO (mg/L) | 9.8 | 9.7 | 9.8 | 9.6 | 9.8 | 9.8 | 9.7 | 9.5 | 9.8 | 9.9 | 9.8 | 9.5 | 9.4 | 9.8 | |
| pH | 7.9 | 8.0 | 8.5 | 8.1 | 8.5 | 8.0 | 8.4 | 8.1 | 8.3 | 8.0 | 8.1 | 8.0 | 8.5 | 8.5 | |
| Cond. (µS/cm) | 551 | | 543 | | 542 | | 541 | | 543 | | 542 | | 545 | 538 | |
| Initials | K | | K | | K | | K | | A | | A | | K | K | |

Thermometer: CER-9 DO meter/probe: 2/3 / 2/3 pH meter/probe: 3 / 3 Conductivity meter/probe: 2/3 / 2/3

| | Control | 100% |
|-------------|---------|------|
| Hardness* | 12 | 280 |
| Alkalinity* | 10 | 272 |

Analysts: AW, M

Reviewed by: JOU

Date reviewed: Nov. 14/17

* mg/L as CaCO3

Sample Description: Clear, slightly yellow, odourless, some particulates.

Comments:

Embryo Toxicity Test Daily Mortality

Client: ALS
 Sample ID: E201956-1 W3
 Work Order #: 171215

Start Date & Time: Oct 24/17 9:16am
 Stop Date & Time: Oct 31/17 11:00h
 Test Species: Oncorhynchus mykiss

| Concentration % (v/v) | Rep | Day of Test - No. of Mortalities | | | | | | | Total Dead Eggs | Total Undeveloped | Total No. Embryo | Total Exposed |
|--------------------------|-----|----------------------------------|---|---|---|---|---|---|-----------------------|----------------------|---------------------|------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | | |
| control | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 |
| | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 29 | 30 |
| | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 4 | 2 | 24 | 30 |
| | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 29 | 30 |
| 6.25 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 29 | 30 |
| | 3 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 2 | 24 | 30 |
| | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 |
| 12.5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 28 | 30 |
| | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 4 | 0 | 26 | 30 |
| | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 29 | 30 |
| 25 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 29 | 30 |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 28 | 30 |
| | 3 | 0 | 0 | 0 | 0 | 0 | 6 | 1 | 7 | 1 | 22 | 30 |
| | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 |
| 50 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 29 | 30 |
| | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 28 | 30 |
| | 4 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 28 | 30 |
| 100 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 29 | 30 |
| | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 25 | 30 |
| | 4 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 29 | 30 |
| | 1 | | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |
| | 1 | | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |
| Tech Initials | | k | k | k | a | n | k | k | k | u | k | k |

Comments:

Reviewed by: JGh

Date reviewed: Nov. 19/17

CETIS Analytical Report

Report Date: 31 Oct-17 18:54 (p 1 of 2)
 Test Code: 171215 | 14-5200-9738

Salmonid Embryo Survival and Development Test

Nautilus Environmental

| | | |
|-------------------------------|---|----------------------------------|
| Analysis ID: 16-7089-6539 | Endpoint: Proportion Normal | CETIS Version: CETISv1.8.7 |
| Analyzed: 31 Oct-17 18:54 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 13-1860-7194 | Test Type: Development | Analyst: Kania Lywe |
| Start Date: 24 Oct-17 16:10 | Protocol: EC/EPS 1/RM/28 | Diluent: Dechlorinated Tap Water |
| Ending Date: 31 Oct-17 11:00 | Species: Oncorhynchus mykiss | Brine: |
| Duration: 6d 19h | Source: Vancouver Island Trout Hatchery | Age: |
| Sample ID: 11-7501-0747 | Code: 46093DBB | Client: ALS |
| Sample Date: 22 Oct-17 | Material: Water Sample | Project: |
| Receive Date: 24 Oct-17 10:45 | Source: ALS | |
| Sample Age: 64h (8 °C) | Station: L2011956-1 W3 | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|---------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 1345287 | 200 | Yes | Two-Point Interpolation |

Point Estimates

| Level | % | 95% LCL | 95% UCL | TU | 95% LCL | 95% UCL |
|-------|------|---------|---------|----|---------|---------|
| EC5 | >100 | N/A | N/A | <1 | NA | NA |
| EC10 | >100 | N/A | N/A | <1 | NA | NA |
| EC15 | >100 | N/A | N/A | <1 | NA | NA |
| EC20 | >100 | N/A | N/A | <1 | NA | NA |
| EC25 | >100 | N/A | N/A | <1 | NA | NA |
| EC40 | >100 | N/A | N/A | <1 | NA | NA |
| EC50 | >100 | N/A | N/A | <1 | NA | NA |

Proportion Normal Summary

Calculated Variate(A/B)

| C-% | Control Type | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
|------|------------------|-------|--------|--------|-----|---------|---------|--------|---------|-----|-----|
| 0 | Negative Control | 4 | 0.9333 | 0.8 | 1 | 0.04513 | 0.09027 | 9.67% | 0.0% | 112 | 120 |
| 6.25 | | 4 | 0.9417 | 0.8 | 1 | 0.04787 | 0.09574 | 10.17% | -0.89% | 113 | 120 |
| 12.5 | | 4 | 0.9417 | 0.8667 | 1 | 0.02846 | 0.05693 | 6.05% | -0.89% | 113 | 120 |
| 25 | | 4 | 0.9083 | 0.7333 | 1 | 0.0599 | 0.1198 | 13.19% | 2.68% | 109 | 120 |
| 50 | | 4 | 0.9583 | 0.9333 | 1 | 0.01596 | 0.03191 | 3.33% | -2.68% | 115 | 120 |
| 100 | | 4 | 0.9417 | 0.8333 | 1 | 0.03696 | 0.07391 | 7.85% | -0.89% | 113 | 120 |

Proportion Normal Detail

| C-% | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|------|------------------|--------|--------|--------|--------|
| 0 | Negative Control | 1 | 0.9667 | 0.8 | 0.9667 |
| 6.25 | | 1 | 0.9667 | 0.8 | 1 |
| 12.5 | | 1 | 0.9333 | 0.8667 | 0.9667 |
| 25 | | 0.9667 | 0.9333 | 0.7333 | 1 |
| 50 | | 1 | 0.9667 | 0.9333 | 0.9333 |
| 100 | | 1 | 0.9667 | 0.8333 | 0.9667 |

Proportion Normal Binomials

| C-% | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|------|------------------|-------|-------|-------|-------|
| 0 | Negative Control | 30/30 | 29/30 | 24/30 | 29/30 |
| 6.25 | | 30/30 | 29/30 | 24/30 | 30/30 |
| 12.5 | | 30/30 | 28/30 | 26/30 | 29/30 |
| 25 | | 29/30 | 28/30 | 22/30 | 30/30 |
| 50 | | 30/30 | 29/30 | 28/30 | 28/30 |
| 100 | | 30/30 | 29/30 | 25/30 | 29/30 |

CETIS Analytical Report

Report Date: 31 Oct-17 18:54 (p 2 of 2)
Test Code: 171215 | 14-5200-9738

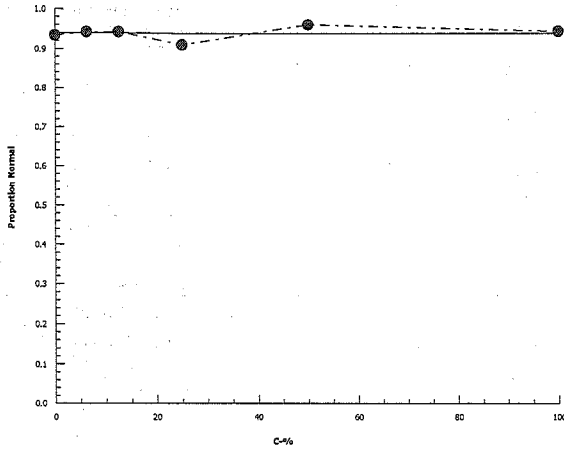
Salmonid Embryo Survival and Development Test

Nautilus Environmental

Analysis ID: 16-7089-6539 Endpoint: Proportion Normal
Analyzed: 31 Oct-17 18:54 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



Client: ACS

W.O.#: 171215

Hardness and Alkalinity Datasheet

| Sample ID | Alkalinity | | | | | | Hardness | | | Technician |
|---------------|----------------|---------------|--------------------|--|---|---|--------------------|--------------------------------|--|------------|
| | Subsample Date | Date Measured | Sample Volume (mL) | (mL) 0.02N HCL/H ₂ SO ₄ used to pH 4.5 | (mL) of 0.02N HCL/H ₂ SO ₄ used to pH 4.2 | Total Alkalinity (mg/LCaCO ₃) | Sample Volume (mL) | Volume of 0.01M EDTA Used (mL) | Total Hardness (mg/L CaCO ₃) | |
| L2011956-1 W3 | Oct 24/17 | Oct 24/17 | 50 | 13.7 | 13.8 | 272 | 50 | 14.0 | 280 | K |
| Dechlor | Oct 23/17 | Oct 23/17 | 100 | 1.1 | 1.2 | 10 | 100 | 1.2 | 12 | K |
| | | | | | | | | | | |
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Notes: _____

Reviewed by: Joh Date Reviewed: Nov. 14/17

APPENDIX B – Chain-of-Custody Forms



Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL

8664 COMMERCE COURT
BURNABY, BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# L2011956 wo# 171215
ALS requires QC data to be provided with your final results.
7 - day Rainbow Trout / Embryo Tox

Please see enclosed 1 sample(s) in 5 Container(s)

| SAMPLE NUMBER | ANALYTICAL REQUIRED | DATE SAMPLED | Priority Flag |
|---------------|---|--------------------------|---------------|
| L2011956-1 W3 | Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14) | 10/22/2017 11/15/2017 | |

Subcontract Info Contact: Walter Lin (604) 253-4188
Analysis and reporting info contact: Shane Stack
8081 LOUGHEED HWY
SUITE 100
BURNABY, BC V5A 1W9
Phone: (604) 253-4188 Email: Shane.Stack@alsglobal.com

Please email confirmation of receipt to: Shane.Stack@alsglobal.com

Shipped By: mel Date Shipped: Oct 24 2017
Received By: Nautilus Date Received: Oct 24/17 @ 10:45
Verified By: NY - Nari Yamamoto Date Verified: _____
Temperature: 8.0°C

Sample Integrity Issues: _____



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2011956-COFC

COC Number: 10/22/2017 2017.10.22A

Page 1 of 1

www.alsglobal.com

| | | | | | | | | | | | | | | |
|--|---|---|---------------------|-------------------------|--|---------------------|--|---------------------|---|---------------------|----------------------|-----------------------------|------------------------|---|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT (if received by 3 pm - business days - no surcharges apply) | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 2 day [P2] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Emergency | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax: minto_environment@mintonline.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Analysis Request | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax: ap@mintonline.com | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | Number of Containers | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | |
| PO / AFE: 224159 (MMER) | | Requisitioner: | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: CH/CR | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | |
| | W3 | | | 22-Oct-17 | 8:05 | Water | 96hr - LC50 Rainbow Trout | 48hr - LC50 Daphnia | 7day - Rainbow Trout Embryo Toxicity | 7day - Ceriodaphnia | 7day - Lemna minor | Alga 72-h Growth Inhibition | 7day - Flethead Minnow | 5 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic CDC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | | | | |
| | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Chris Harry | Date: 2017-10-22 10:00 | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

0010018 2/15/2011

END OF REPORT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 25-OCT-17
Report Date: 06-NOV-17 19:34 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2013198
Project P.O. #: 226973 (WUL)
Job Reference:
C of C Numbers: 2017-10-25 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2013198-1 WATER 24-OCT-17 08:50 W3 | L2013198-2 WATER 24-OCT-17 09:15 AMP-1B | L2013198-3 WATER 24-OCT-17 09:40 W2 | L2013198-4 WATER 24-OCT-17 10:40 MC1 | L2013198-5 WATER 24-OCT-17 DUP | |
|---|---|---|---|--|---|-----------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 522 | 472 | 365 | 367 | 246 |
| | Hardness (as CaCO3) (mg/L) | 289 | 255 | 200 | 201 | 128 |
| | pH (pH) | 8.20 | 8.09 | 8.17 | 8.22 | 8.18 |
| | Total Suspended Solids (mg/L) | <3.0 | 256 | 52.4 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | 327 | 295 | 220 | 219 | 145 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 243 | 214 | 180 | 186 | 117 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 243 | 214 | 180 | 186 | 117 |
| | Ammonia, Total (as N) (mg/L) | 0.0053 | <0.0050 | <0.0050 | 0.0054 | <0.0050 |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | 4.56 | 6.41 | 2.39 | 1.81 | 0.87 |
| | Fluoride (F) (mg/L) | 0.544 | 0.431 | 0.351 | 0.439 | 0.140 |
| | Nitrate (as N) (mg/L) | 0.208 | 0.0321 | 0.110 | 0.151 | 0.108 |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | <0.0010 | 0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | 57.6 | 51.9 | 27.1 | 23.8 | 20.0 |
| | Anion Sum (meq/L) | 6.23 | 5.57 | 4.24 | 4.29 | 2.79 |
| | Cation Sum (meq/L) | 6.73 | 5.85 | 4.52 | 4.54 | 2.98 |
| | Cation - Anion Balance (%) | 3.8 | 2.5 | 3.2 | 2.8 | 3.4 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 5.28 | 7.91 | 7.41 | 6.99 | 7.10 |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0280 | 3.05 | 1.06 | 0.0398 | 0.0178 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | 0.00016 | <0.00010 | 0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00026 | 0.00103 | 0.00094 | 0.00046 | 0.00063 |
| | Barium (Ba)-Total (mg/L) | 0.0618 | 0.0949 | 0.0849 | 0.0657 | 0.0691 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | 0.000119 | 0.000040 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.027 | 0.027 | 0.010 | <0.010 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | 0.0000193 | 0.0000371 | <0.0000050 | 0.0000076 |
| | Calcium (Ca)-Total (mg/L) | 62.1 | 70.4 | 54.9 | 49.4 | 29.6 |
| | Chromium (Cr)-Total (mg/L) | 0.00026 | 0.00221 | 0.00231 | 0.00031 | 0.00028 |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00140 | 0.00074 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | 0.00365 | 0.0351 | 0.0121 | 0.00173 | 0.00194 |
| | Iron (Fe)-Total (mg/L) | 0.058 | 4.35 | 1.65 | 0.112 | 0.052 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.000665 | 0.000434 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0041 | 0.0032 | 0.0025 | 0.0015 | 0.0013 |
| | Magnesium (Mg)-Total (mg/L) | 32.0 | 22.6 | 18.2 | 19.0 | 12.2 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2013198-1 WATER 24-OCT-17 08:50 W3 | L2013198-2 WATER 24-OCT-17 09:15 AMP-1B | L2013198-3 WATER 24-OCT-17 09:40 W2 | L2013198-4 WATER 24-OCT-17 10:40 MC1 | L2013198-5 WATER 24-OCT-17 DUP |
|---|---------------------------------------|---|---|---|--|---|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Manganese (Mn)-Total (mg/L) | 0.0769 | 0.239 | 0.120 | 0.0256 | 0.0318 |
| | Mercury (Hg)-Total (mg/L) | <0.000050 | <0.000050 ^{DLM} | <0.000025 ^{DLM} | <0.000050 | <0.000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00467 | 0.00498 | 0.00127 | 0.00150 | 0.00127 |
| | Nickel (Ni)-Total (mg/L) | 0.00100 | 0.00302 | 0.00325 | 0.00101 | 0.00115 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.095 | 0.065 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.28 | 3.31 | 1.89 | 1.42 | 0.90 |
| | Selenium (Se)-Total (mg/L) | 0.000378 | 0.000123 | 0.000170 | 0.000192 | <0.000050 |
| | Silicon (Si)-Total (mg/L) | 6.39 | 11.9 | 8.37 | 6.57 | 6.32 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000051 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 19.6 | 16.2 | 11.4 | 11.7 | 9.15 |
| | Strontium (Sr)-Total (mg/L) | 0.753 | 0.526 | 0.485 | 0.462 | 0.284 |
| | Sulfur (S)-Total (mg/L) | 19.1 | 17.6 | 9.15 | 7.77 | 6.79 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | 0.000019 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.00090 ^{DLM} | 0.133 | 0.0409 | 0.00198 | <0.00090 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.00260 | 0.00193 | 0.00218 | 0.00147 | 0.00292 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00855 | 0.00356 | 0.00062 | 0.00071 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0165 | 0.0146 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0024 | 0.0040 | 0.0046 | 0.0033 | 0.0080 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00024 | 0.00030 | 0.00035 | 0.00038 | 0.00066 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0641 | 0.0627 | 0.0687 | 0.0645 | 0.0724 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.025 | 0.023 | <0.010 | <0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000050 | 0.000057 | 0.0000134 | <0.000050 | 0.000056 |
| | Calcium (Ca)-Dissolved (mg/L) | 62.0 | 68.4 | 51.3 | 49.7 | 30.5 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00014 | 0.00019 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00236 | 0.00396 | 0.00263 | 0.00141 | 0.00175 |
| | Iron (Fe)-Dissolved (mg/L) | 0.019 | <0.010 | 0.033 | 0.052 | 0.029 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0036 | 0.0016 | 0.0024 | 0.0017 | 0.0016 |
| | Magnesium (Mg)-Dissolved (mg/L) | 32.5 | 20.5 | 17.4 | 18.8 | 12.5 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L2013198-1 | L2013198-2 | L2013198-3 | L2013198-4 | L2013198-5 |
|-------------------------|----------------------------------|--------------|--------------|------------|------------|------------|------------|------------|------------|
| | | | | | WATER | WATER | WATER | WATER | WATER |
| | | 24-OCT-17 | 08:50 | W3 | 24-OCT-17 | 24-OCT-17 | 24-OCT-17 | 24-OCT-17 | 24-OCT-17 |
| | | | | | | 09:15 | 09:40 | 10:40 | |
| | | | | | | AMP-1B | W2 | MC1 | DUP |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Manganese (Mn)-Dissolved (mg/L) | 0.0651 | 0.00280 | 0.0114 | 0.0206 | 0.0319 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00434 | 0.00436 | 0.00109 | 0.00141 | 0.00120 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00095 | 0.00108 | 0.00096 | 0.00081 | 0.00105 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.32 | 2.66 | 1.75 | 1.41 | 0.95 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000338 | 0.000106 | 0.000083 | 0.000140 | 0.000068 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.18 | 5.71 | 6.03 | 6.30 | 6.00 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 20.6 | 15.8 | 11.2 | 11.0 | 9.38 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.746 | 0.497 | 0.481 | 0.442 | 0.292 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 18.5 | 16.9 | 8.49 | 7.44 | 6.14 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00242 | 0.00171 | 0.00203 | 0.00135 | 0.00272 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00062 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | 0.0010 | 0.0058 | 0.0011 | 0.0011 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2013198-1, -2, -3, -4, -5 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2013198-1, -2, -3, -4, -5 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-VA | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| F-IC-N-VA | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-10-25 A

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



L2013198-COFC

COC Number: 2017-10-25 A

Page 1 of 1

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

| Report To | | | | Report Format / Distribution | | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Contact and company name below will appear on the final report | | | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | | PRIORITY (Business Days) | | | | EMERGENCY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | | | Email 1 or Fax minto_environment@mintomine.com | | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | | | Email 2 | | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | | | Email 3 | | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Invoice Distribution | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | | | AFE/Cost Center: | | | | Major/Minor Code: | | | | Requisitioner: | | | | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | | PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | | | ALS Contact: Shane Stack | | | | Sampler: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| ALS Lab Work Order # (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W3 | | | | 24-Oct-17 | 8:50 | Water | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AMP-1B | | | | 24-Oct-17 | 9:15 | Water | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W2 | | | | 24-Oct-17 | 9:40 | Water | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MC1 | | | | 24-Oct-17 | 10:40 | Water | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DUP | | | | 24-Oct-17 | | Water | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1"> <tr> <th colspan="4">Drinking Water (DW) Samples¹ (client use)</th> <th colspan="4">Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)</th> <th colspan="9">SAMPLE CONDITION AS RECEIVED (lab use only)</th> </tr> <tr> <td colspan="4">Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO</td> <td colspan="4" rowspan="2"></td> <td colspan="9">Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/></td> </tr> <tr> <td colspan="4">Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO</td> <td colspan="9">Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/></td> </tr> <tr> <td colspan="4"></td> <td colspan="4"></td> <td colspan="9">Cooling Initiated <input type="checkbox"/></td> </tr> <tr> <td colspan="4"></td> <td colspan="4"></td> <td colspan="9">INITIAL COOLER TEMPERATURES °C</td> </tr> <tr> <td colspan="4"></td> <td colspan="4"></td> <td colspan="9">FINAL COOLER TEMPERATURES °C</td> </tr> <tr> <td colspan="4"></td> <td colspan="4"></td> <td colspan="9">1 °C, 3 °C</td> </tr> <tr> <td colspan="4"></td> <td colspan="4"></td> <td colspan="9">2 3</td> </tr> </table> | | | | | | | | | | | | | | | | | Drinking Water (DW) Samples ¹ (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | 1 °C, 3 °C | | | | | | | | | | | | | | | | | 2 3 | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | 1 °C, 3 °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | 2 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: Corey Roberts | | Date: 2017-10-25 | | Time: | | Received by: | | Date: OCT 25 17 | | Time: 14:37 | | Received by: | | Date: OCT 26 2017 | | Time: 12 pm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 01-NOV-17
Report Date: 16-NOV-17 11:55 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2016822
Project P.O. #: 226973
Job Reference:
C of C Numbers: 2017-11-01 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2016822-1 | L2016822-2 | L2016822-3 | L2016822-4 |
|-----------------------------------|---|--------------|-------------------------|------------|-------------------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 30-OCT-17 | 30-OCT-17 | 31-OCT-17 | 31-OCT-17 |
| | | Sampled Time | 09:15 | 10:25 | 09:50 | 10:20 |
| | | Client ID | W17 | W8A | W3 | MC1 |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 486 | 1350 | 525 | 368 |
| | Hardness (as CaCO3) (mg/L) | | 238 | 706 | 254 | 185 |
| | pH (pH) | | 8.43 | 8.12 | 8.30 | 8.23 |
| | Total Suspended Solids (mg/L) | | <3.0 | 36.9 | <3.0 | 5.7 |
| | TDS (Calculated) (mg/L) | | 288 | 957 | 306 | 215 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 192 | 447 | 233 | 189 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | 9.6 | <1.0 | 3.8 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 202 | 447 | 237 | 189 |
| | Ammonia, Total (as N) (mg/L) | | 0.0061 | 0.225 | 0.0080 | 0.0090 |
| | Chloride (Cl) (mg/L) | | 6.70 | 13.4 | 4.45 | 1.84 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.281 | 7.25 | 0.203 | 0.187 |
| | Nitrate (as N) (mg/L) | | 0.281 | 7.01 | 0.203 | 0.187 |
| | Nitrite (as N) (mg/L) | | <0.0010 | 0.232 | <0.0010 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 58.6 | 337 | 56.0 | 24.1 |
| | Anion Sum (meq/L) | | 5.46 | 16.9 | 6.03 | 4.34 |
| | Cation Sum (meq/L) | | 5.48 | 16.5 | 5.87 | 4.19 |
| | Cation - Anion Balance (%) | | 0.2 | -1.1 | -1.4 | -1.7 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 10.1 | | 5.30 | 7.32 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0039 | 0.0815 | 0.0074 | 0.179 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | 0.00023 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00042 | 0.00077 | 0.00025 | 0.00054 |
| | Barium (Ba)-Total (mg/L) | | 0.0689 | 0.150 | 0.0652 | 0.0711 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | 0.000027 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.033 | 0.034 | 0.028 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | | <0.0000050 | 0.000220 | <0.0000050 | 0.0000067 |
| | Calcium (Ca)-Total (mg/L) | | 67.2 | 211 | 58.1 | 49.9 |
| | Chromium (Cr)-Total (mg/L) | | <0.00030 ^{DLB} | 0.00096 | <0.00030 ^{DLB} | 0.00087 |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | 0.00084 | <0.00010 | 0.00017 |
| | Copper (Cu)-Total (mg/L) | | 0.00630 | 0.106 | 0.00305 | 0.00271 |
| | Iron (Fe)-Total (mg/L) | | <0.010 | 3.04 | 0.027 | 0.363 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | 0.000137 | <0.000050 | 0.000077 |
| | Lithium (Li)-Total (mg/L) | | 0.0018 | 0.0043 | 0.0035 | 0.0021 |
| | Magnesium (Mg)-Total (mg/L) | | 20.4 | 57.0 | 30.7 | 18.7 |
| | Manganese (Mn)-Total (mg/L) | | 0.00971 | 2.42 | 0.0468 | 0.0445 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2016822-1 Water 30-OCT-17 09:15 W17 | L2016822-2 Water 30-OCT-17 10:25 W8A | L2016822-3 Water 31-OCT-17 09:50 W3 | L2016822-4 Water 31-OCT-17 10:20 MC1 |
|---|---------------------------------------|--|--|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 ^{DLM} |
| | Molybdenum (Mo)-Total (mg/L) | 0.00620 | 0.0134 | 0.00510 | 0.00161 |
| | Nickel (Ni)-Total (mg/L) | 0.00073 | 0.00214 | 0.00102 | 0.00144 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.079 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 3.67 | 7.26 | 2.23 | 1.45 |
| | Selenium (Se)-Total (mg/L) | 0.000358 | 0.00850 | 0.000304 | 0.000133 |
| | Silicon (Si)-Total (mg/L) | 5.29 | 8.10 | 6.42 | 7.24 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000031 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 15.5 | 47.5 | 19.4 | 11.2 |
| | Strontium (Sr)-Total (mg/L) | 0.723 | 2.61 | 0.797 | 0.490 |
| | Sulfur (S)-Total (mg/L) | 20.4 | 119 | 19.5 | 8.22 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.00030 | <0.005 | 0.00040 | 0.00828 |
| | Uranium (U)-Total (mg/L) | 0.00217 | 0.00378 | 0.00281 | 0.00167 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00271 | <0.00050 | 0.00120 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.415 | <0.0030 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | 0.00047 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0039 | 0.0068 | 0.0019 | 0.0029 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00013 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00035 | 0.00052 | 0.00024 | 0.00038 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0700 | 0.140 | 0.0618 | 0.0682 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.028 | 0.029 | 0.023 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.000185 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 62.7 | 193 | 55.3 | 45.8 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00010 | 0.00052 | <0.00010 | 0.00013 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00076 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00575 | 0.0494 | 0.00186 | 0.00127 |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | 0.522 | 0.016 | 0.049 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0013 | 0.0036 | 0.0029 | 0.0012 |
| | Magnesium (Mg)-Dissolved (mg/L) | 19.7 | 54.3 | 28.1 | 17.2 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00493 | 2.30 | 0.0432 | 0.0224 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L2016822-1 | L2016822-2 | L2016822-3 | L2016822-4 |
|-------------------------|----------------------------------|-------------------------|--------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water |
| | | 30-OCT-17 | 09:15 | W17 | 30-OCT-17 | 10:25 | 31-OCT-17 | 31-OCT-17 |
| | | | | | W17 | W8A | W3 | MC1 |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00550 | 0.0121 | 0.00468 | 0.00144 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00064 | 0.00177 | 0.00083 | 0.00083 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 3.55 | 7.38 | 2.12 | 1.35 | | | |
| | Selenium (Se)-Dissolved (mg/L) | <0.00040 ^{DLB} | 0.00927 | 0.000299 | 0.000122 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.06 | 7.53 | 5.89 | 6.26 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 14.6 | 47.3 | 17.0 | 10.5 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.702 | 2.57 | 0.767 | 0.491 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 18.5 | 111 | 17.4 | 7.12 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | 0.00051 | <0.00030 | <0.00030 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00195 | 0.00338 | 0.00262 | 0.00150 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00119 | <0.00050 | <0.00050 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | 0.342 | <0.0010 | <0.0010 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | 0.00043 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Duplicate | Aluminum (Al)-Dissolved | DUP-H | L2016822-1 |
| Method Blank | Barium (Ba)-Dissolved | MB-LOR | L2016822-1, -2, -3 |
| Method Blank | Calcium (Ca)-Dissolved | MB-LOR | L2016822-1, -2, -3 |
| Method Blank | Magnesium (Mg)-Dissolved | MB-LOR | L2016822-1, -2, -3 |
| Method Blank | Selenium (Se)-Dissolved | MB-LOR | L2016822-1, -2, -3 |
| Method Blank | Chromium (Cr)-Total | MB-LOR | L2016822-1, -2, -3, -4 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2016822-1, -3, -4 |
| Matrix Spike | Antimony (Sb)-Dissolved | MS-B | L2016822-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2016822-4 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2016822-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2016822-4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2016822-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Iron (Fe)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2016822-4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2016822-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2016822-4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2016822-4 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2016822-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2016822-4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2016822-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2016822-1 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L2016822-1, -2, -3 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L2016822-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLB | Detection Limit Raised. Analyte detected at comparable level in Method Blank. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| DUP-H | Duplicate results outside ALS DQO, due to sample heterogeneity. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|----------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |

Reference Information

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA Water Diss. Be (low) in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

BE-T-L-CCMS-VA Water Total Be (Low) in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

CARBONS-DOC-VA Water Dissolved organic carbon by combustion APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CL-IC-N-VA Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-11-01 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 08-NOV-17
Report Date: 15-DEC-17 19:13 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2020109
Project P.O. #: 226973
Job Reference:
C of C Numbers: 2017-11-08 A
Legal Site Desc:

Comments:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2020109-1 water 06-NOV-17 09:35 W17 | L2020109-2 water 06-NOV-17 10:45 W8A | L2020109-3 water 06-NOV-17 14:35 MC1 | L2020109-4 water 07-NOV-17 10:55 W10 | L2020109-5 water 07-NOV-17 11:10 W30 |
|---|---|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 504 | 1450 | 422 | 545 | 607 |
| | Hardness (as CaCO3) (mg/L) | 240 | 762 | 208 | 258 | 289 |
| | pH (pH) | 8.25 | 7.80 | 8.12 | 7.95 | 8.23 |
| | Total Suspended Solids (mg/L) | <3.0 | 4.7 | 8.7 | <3.0 | 12.0 |
| | TDS (Calculated) (mg/L) | 299 | 1050 | 244 | 336 | 384 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 215 | 484 | 215 | 213 | 206 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 215 | 484 | 215 | 213 | 206 |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.310 | 0.0166 | 0.0677 | 0.106 |
| | Chloride (Cl) (mg/L) | 6.83 | 14.1 | 2.23 | 0.66 | 3.88 |
| | Nitrate and Nitrite (as N) (mg/L) | 0.265 | 7.08 | 0.165 | 19.8 | 0.755 |
| | Nitrate (as N) (mg/L) | 0.265 | 6.60 | 0.165 | 19.8 | 0.738 |
| | Nitrite (as N) (mg/L) | <0.0010 | 0.477 | <0.0010 | 0.0158 | 0.0169 |
| | Sulfate (SO4) (mg/L) | 59.4 | 381 | 26.3 | 14.2 | 133 |
| | Anion Sum (meq/L) | 5.76 | 18.5 | 4.94 | 6.00 | 7.06 |
| | Cation Sum (meq/L) | 5.57 | 17.8 | 4.74 | 5.71 | 6.66 |
| | Cation - Anion Balance (%) | -1.7 | -2.1 | -2.0 | -2.6 | -2.9 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 9.20 | | 7.29 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0045 | 0.168 | 0.0189 | 0.0108 | 0.0567 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00013 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00041 | 0.00078 | 0.00039 | 0.00016 | 0.00071 |
| | Barium (Ba)-Total (mg/L) | 0.0701 | 0.165 | 0.0775 | 0.265 | 0.122 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | 0.000021 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | 0.028 | 0.030 | <0.010 | 0.017 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | 0.000208 | <0.0000050 | <0.0000050 | 0.0000132 |
| | Calcium (Ca)-Total (mg/L) | 63.7 | 209 | 53.7 | 77.4 | 66.0 |
| | Chromium (Cr)-Total (mg/L) | 0.00025 | 0.00092 | 0.00037 | 0.00018 | 0.00022 |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00103 | <0.00010 | 0.00023 | 0.00011 |
| | Copper (Cu)-Total (mg/L) | 0.00620 | 0.142 | 0.00211 | 0.00231 | 0.0176 |
| | Iron (Fe)-Total (mg/L) | <0.010 | 5.31 | 0.077 | 0.587 | 0.113 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.000120 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0013 | 0.0041 | 0.0016 | 0.0011 | 0.0020 |
| | Magnesium (Mg)-Total (mg/L) | 21.9 | 63.2 | 20.8 | 19.2 | 32.4 |
| | Manganese (Mn)-Total (mg/L) | 0.0168 | 2.92 | 0.0276 | 0.231 | 0.452 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2020109-6 | L2020109-7 | L2020109-8 | L2020109-9 |
|-----------------------------------|---|--------------|------------|------------|--------------------------|------------------------|
| | | Description | water | water | water | water |
| | | Sampled Date | 07-NOV-17 | 07-NOV-17 | 07-NOV-17 | 07-NOV-17 |
| | | Sampled Time | 12:00 | 12:20 | 12:25 | 14:05 |
| | | Client ID | W15 | W14 | W12 | W3 |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 968 | 3240 | 2460 | 558 |
| | Hardness (as CaCO3) (mg/L) | | 512 | 1610 | 1160 | 259 |
| | pH (pH) | | 8.12 | 8.18 | 8.12 | 8.22 |
| | Total Suspended Solids (mg/L) | | 4.0 | 18.0 | 14.0 | <3.0 |
| | TDS (Calculated) (mg/L) | | 660 | 3050 | 2140 | 907 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 325 | 133 | 209 | 256 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 325 | 133 | 209 | 256 |
| | Ammonia, Total (as N) (mg/L) | | 0.138 | 3.63 | 4.10 | 0.0093 |
| | Chloride (Cl) (mg/L) | | 4.40 | 51.4 | 36.0 | 4.43 ^{HTD} |
| | Nitrate and Nitrite (as N) (mg/L) | | 10.9 | 24.2 | 17.8 | |
| | Nitrate (as N) (mg/L) | | 10.8 | 18.9 | 12.5 | 0.212 ^{HTD} |
| | Nitrite (as N) (mg/L) | | 0.0195 | 5.23 | 5.35 | <0.0010 ^{HTD} |
| | Sulfate (SO4) (mg/L) | | 210 | 1950 | 1290 | 57.4 ^{HTD} |
| | Anion Sum (meq/L) | | 11.8 | 46.5 | 33.4 | 6.77 |
| | Cation Sum (meq/L) | | 11.2 | 42.8 | 30.5 | 6.10 |
| | Cation - Anion Balance (%) | | -2.4 | -4.1 | -4.5 | -5.2 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 18.1 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0499 | | 0.0275 | 0.0083 |
| | Antimony (Sb)-Total (mg/L) | | 0.00013 | | 0.00030 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00056 | | 0.00056 | 0.00028 |
| | Barium (Ba)-Total (mg/L) | | 0.128 | | 0.0958 | 0.0740 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | | <0.000040 ^{DLA} | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | | <0.00010 ^{DLA} | <0.000050 |
| | Boron (B)-Total (mg/L) | | <0.010 | | 0.250 | 0.025 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000086 | | 0.000188 | 0.0000056 |
| | Calcium (Ca)-Total (mg/L) | | 132 | | 363 ^{DLA} | 57.8 |
| | Chromium (Cr)-Total (mg/L) | | 0.00049 | | <0.00020 | 0.00024 |
| | Cobalt (Co)-Total (mg/L) | | 0.00033 | | 0.00132 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | | 0.0186 | | 0.0866 | 0.00255 |
| | Iron (Fe)-Total (mg/L) | | 1.06 | | 0.038 | 0.025 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | | <0.00010 ^{DLA} | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | <0.0010 | | 0.0192 | 0.0033 |
| | Magnesium (Mg)-Total (mg/L) | | 45.4 | | 75.8 | 33.0 |
| | Manganese (Mn)-Total (mg/L) | | 0.367 | | 1.29 | 0.0542 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2020109-1 water 06-NOV-17 09:35 W17 | L2020109-2 water 06-NOV-17 10:45 W8A | L2020109-3 water 06-NOV-17 14:35 MC1 | L2020109-4 water 07-NOV-17 10:55 W10 | L2020109-5 water 07-NOV-17 11:10 W30 |
|---|---------------------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | 0.0000111 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00624 | 0.0129 | 0.00158 | 0.00130 | 0.00163 |
| | Nickel (Ni)-Total (mg/L) | 0.00075 | 0.00235 | 0.00098 | <0.00050 | 0.00074 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.087 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | 3.61 | 7.49 | 1.46 | 1.92 | 4.52 |
| | Selenium (Se)-Total (mg/L) | 0.000326 | 0.00805 | 0.000139 | 0.000154 | 0.000806 |
| | Silicon (Si)-Total (mg/L) | 5.39 | 8.27 | 7.22 | 3.73 | 1.65 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000054 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 14.0 | 43.0 | 11.5 | 10.5 | 16.2 |
| | Strontium (Sr)-Total (mg/L) | 0.788 | 3.13 | 0.620 | 0.557 | 0.786 |
| | Sulfur (S)-Total (mg/L) | 20.6 | 118 | 9.06 | 5.14 | 47.2 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.00030 | 0.00967 | <0.00090 ^{DLM} | <0.00030 | <0.0018 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.00227 | 0.00370 | 0.00171 | 0.000384 | 0.000552 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00323 | 0.00056 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.501 | <0.0030 | 0.0037 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | 0.00059 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0018 | 0.0077 | 0.0031 | 0.0025 | 0.0014 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00035 | 0.00050 | 0.00034 | 0.00010 | 0.00064 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0725 | 0.153 | 0.0801 | 0.247 | 0.123 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.028 | 0.031 | <0.010 | 0.017 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.000339 ^{DTMF} | <0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 63.6 | 205 | 52.5 | 75.1 | 68.8 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00046 | 0.00010 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00114 | <0.00010 | 0.00021 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00564 | 0.0760 | 0.00135 | 0.00160 | 0.0115 |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | 0.425 | 0.045 | 0.324 | 0.018 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0017 | 0.0044 | 0.0020 | 0.0013 | 0.0023 |
| | Magnesium (Mg)-Dissolved (mg/L) | 19.8 | 60.7 | 18.8 | 17.1 | 28.6 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00602 | 3.16 | 0.0257 | 0.215 | 0.321 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | L2020109-6 | L2020109-7 | L2020109-8 | L2020109-9 |
|-------------------------|---------------------------------------|-------------------------|----------------------|--------------------------|------------|
| | | water | water | water | water |
| | | 07-NOV-17 | 07-NOV-17 | 07-NOV-17 | 07-NOV-17 |
| | | 12:00 | 12:20 | 12:25 | 14:05 |
| | | W15 | W14 | W12 | W3 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00267 | | 0.0843 | 0.00484 |
| | Nickel (Ni)-Total (mg/L) | 0.00126 | | 0.0039 | 0.00104 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | | <0.10 ^{DLA} | <0.050 |
| | Potassium (K)-Total (mg/L) | 3.87 | | 47.3 | 2.21 |
| | Selenium (Se)-Total (mg/L) | 0.00238 | | 0.0113 | 0.000306 |
| | Silicon (Si)-Total (mg/L) | 6.84 | | 4.41 | 6.59 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | 0.000023 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 19.2 | | 131 | 18.0 |
| | Strontium (Sr)-Total (mg/L) | 1.30 | | 8.29 | 0.921 |
| | Sulfur (S)-Total (mg/L) | 76.8 | | 444 | 20.5 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | <0.000020 ^{DLA} | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 ^{DLM} | | <0.00020 ^{DLA} | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.0021 | | <0.00090 ^{DLM} | <0.00030 |
| | Uranium (U)-Total (mg/L) | 0.00282 | | 0.00768 | 0.00278 |
| | Vanadium (V)-Total (mg/L) | 0.00063 | | <0.0010 ^{DLA} | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | | 0.0104 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0054 | 0.0233 | 0.0040 | 0.0016 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00033 | 0.00027 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00038 | 0.00036 | 0.00039 | 0.00021 |
| | Barium (Ba)-Dissolved (mg/L) | 0.125 | 0.204 | 0.0841 | 0.0693 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000040 ^{DLA} | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.204 ^{DLM} | 0.240 ^{DLM} | 0.025 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.00010 | <0.00020 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 137 | 508 | 358 | 54.3 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00011 | <0.00010 | <0.00020 ^{DLA} | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00028 | 0.00106 | 0.00121 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0140 | 0.00361 | 0.0675 | 0.00213 |
| | Iron (Fe)-Dissolved (mg/L) | 0.057 | <0.010 | <0.020 ^{DLA} | 0.015 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.00010 ^{DLA} | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0011 | 0.0233 | 0.0181 | 0.0035 |
| | Magnesium (Mg)-Dissolved (mg/L) | 41.3 | 82.3 | 64.1 | 30.0 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.323 | 1.08 | 1.14 | 0.0490 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2020109-1 water 06-NOV-17 09:35 W17 | L2020109-2 water 06-NOV-17 10:45 W8A | L2020109-3 water 06-NOV-17 14:35 MC1 | L2020109-4 water 07-NOV-17 10:55 W10 | L2020109-5 water 07-NOV-17 11:10 W30 |
|---|----------------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | 0.0000077 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00517 | 0.0114 | 0.00131 | 0.00110 | 0.00147 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00059 | 0.00148 | 0.00077 | <0.00050 | <0.00050 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 3.61 | 8.06 | 1.54 | 1.88 | 4.43 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000331 | 0.00828 | 0.000174 | 0.000136 | 0.000756 |
| | Silicon (Si)-Dissolved (mg/L) | 5.19 | 7.52 | 6.94 | 3.36 | 1.40 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | 0.000012 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 15.5 | 50.1 | 12.3 | 10.9 | 17.2 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.692 | 2.87 | 0.538 | 0.511 | 0.673 |
| | Sulfur (S)-Dissolved (mg/L) | 19.7 | 124 | 8.63 | 4.60 | 43.2 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00090 ^{DLM} | <0.00030 | <0.00030 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | 0.00195 | 0.00345 | 0.00152 | 0.000355 | 0.000455 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00137 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0047 | 0.174 | <0.0010 | 0.0016 | 0.0015 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | 0.00055 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2020109-6 water 07-NOV-17 12:00 W15 | L2020109-7 water 07-NOV-17 12:20 W14 | L2020109-8 water 07-NOV-17 12:25 W12 | L2020109-9 water 07-NOV-17 14:05 W3 |
|---|----------------------------------|--|--|--|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00225 | 0.120 | 0.0796 | 0.00431 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00098 | 0.00364 | 0.0034 | 0.00082 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.10 ^{DLA} | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 3.80 | 83.7 | 45.9 | 2.32 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00216 | 0.0182 | 0.0109 | 0.000357 |
| | Silicon (Si)-Dissolved (mg/L) | 6.19 | 2.39 | 3.99 | 6.20 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 20.3 | 191 | 136 | 19.8 |
| | Strontium (Sr)-Dissolved (mg/L) | 1.12 | 6.95 | 7.28 | 0.806 |
| | Sulfur (S)-Dissolved (mg/L) | 70.3 | 697 | 419 | 19.4 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000020 ^{DLA} | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00020 ^{DLA} | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00060 ^{DLM} | <0.00060 ^{DLA} | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | 0.00252 | 0.00841 | 0.00772 | 0.00250 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.0010 ^{DLA} | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0021 | <0.0010 | 0.0074 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--|
| Method Blank | Chromium (Cr)-Total | MB-LOR | L2020109-1, -2, -3, -4, -5, -6, -8, -9 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2020109-1, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2020109-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2020109-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L2020109-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2020109-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2020109-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L2020109-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2020109-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2020109-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L2020109-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2020109-1, -2, -3, -4, -5, -6, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2020109-1, -2, -3, -4, -5, -6, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2020109-1, -2, -3, -4, -5, -6, -8, -9 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2020109-1, -2, -3, -4, -5, -6, -8, -9 |
| Matrix Spike | Molybdenum (Mo)-Total | MS-B | L2020109-1, -2, -3, -4, -5, -6, -8, -9 |
| Matrix Spike | Silicon (Si)-Total | MS-B | L2020109-1, -2, -3, -4, -5, -6, -8, -9 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2020109-1, -2, -3, -4, -5, -6, -8, -9 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2020109-1, -2, -3, -4, -5, -6, -8, -9 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L2020109-1, -2, -3, -4, -5, -6, -8, -9 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2020109-1, -2, -3, -4, -5, -6, -7, -8 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLA | Detection Limit adjusted for required dilution |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| DTMF | Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants were likely introduced to dissolved sample during field filtration. |
| HTD | Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| BR-L-IC-N-WR | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |

Reference Information

| | | | |
|-------------------------|-------|--|---|
| CL-IC-N-VA | Water | Chloride in Water by IC Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | EPA 300.1 (mod) |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | EPA 300.1 (mod) |
| EC-PCT-VA | Water | Conductivity (Automated) This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | APHA 2510 Auto. Conduc. |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | APHA 2510 |
| F-IC-N-WR | Water | Fluoride in Water by IC Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | EPA 300.1 (mod) |
| HARDNESS-CALC-VA | Water | Hardness Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | APHA 2340B |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | APHA 3030B/EPA 1631E (mod) |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | EPA 1631E (mod) |
| IONBALANCE-VA | Water | Ion Balance Calculation Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | APHA 1030E |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | APHA 3030B/6020A (mod) |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | EPA 200.2/6020A (mod) |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | EPA 300.1 (mod) |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | EPA 300.1 (mod) |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | EPA 300.1 (mod) |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | EPA 300.1 (mod) |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-11-08 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

- mg/kg - milligrams per kilogram based on dry weight of sample.*
- mg/kg wwt - milligrams per kilogram based on wet weight of sample.*
- mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.*
- mg/L - milligrams per litre.*
- < - Less than.*

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

*Test results reported relate only to the samples as received by the laboratory.
 UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
 Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2020109-COFC

COC Number: 2017-11-08 A

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| | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|--|---------------------------------|---|--|------------------------------|------------------------------|--|-----------------------------|--|---------------------------|--------------------------------|----------------------|---|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | | | 1 Business day [E1] <input type="checkbox"/> | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | 3 day [P3] <input type="checkbox"/> | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: SR/CP | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | |
| ✓ W17 | | | | 6-Nov-17 | 9:35 | Water | R | R | R | R | R | R | R | R | R | | 7 |
| ✓ W8A | | | | 6-Nov-17 | 10:45 | Water | R | R | R | R | R | R | R | R | R | | 6 |
| ✓ MC1 | | | | 6-Nov-17 | 14:35 | Water | R | R | R | R | R | R | R | R | R | | 7 |
| ✓ W10 | | | | 7-Nov-17 | 10:55 | Water | R | R | R | R | R | R | R | R | R | | 6 |
| ✓ W30 | | | | 7-Nov-17 | 11:10 | Water | R | R | R | R | R | R | R | R | R | | 6 |
| ✓ W15 | | | | 7-Nov-17 | 12:00 | Water | R | R | R | R | R | R | R | R | R | | 7 |
| ✓ W14 | | | | 7-Nov-17 | 12:20 | Water | R | R | R | R | R | R | R | R | R | | 4 |
| ✓ W12 | | | | 7-Nov-17 | 12:25 | Water | R | R | R | R | R | R | R | R | R | | 6 |
| ✓ W3 | | | | 7-Nov-17 | 14:05 | Water | R | R | R | R | R | R | R | R | R | | 7 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | 4.0c | | | | | 3.7 | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-11-08 | | Time: 11:00 | | Received by: <i>(Signature)</i> | | Date: NOV 8/17 | | Time: 16:01 | | Received by: <i>Cade W.</i> | | Date: Nov 10 | | Time: 1105 | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.





Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-NOV-17
Report Date: 28-NOV-17 16:07 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2023151
Project P.O. #: 226973
Job Reference:
C of C Numbers: 2017-11-15 D
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2023151-1 | L2023151-2 | L2023151-3 |
|-----------------------------|---|---------------------------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 13-NOV-17 | 13-NOV-17 | 14-NOV-17 |
| | | Sampled Time | 11:15 | 15:10 | 09:00 |
| | | Client ID | W17 | W16 | W3 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 495 | 507 | 539 |
| | Hardness (as CaCO3) (mg/L) | | 264 | 262 | 280 |
| | pH (pH) | | 8.18 | 8.21 | 8.21 |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | | 303 | 319 | 328 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 207 | 202 | 252 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 207 | 202 | 252 |
| | Ammonia, Total (as N) (mg/L) | | <0.0050 | 0.0881 | 0.0099 |
| | Chloride (Cl) (mg/L) | | 6.88 | 7.41 | 4.54 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.232 | 1.89 | 0.199 |
| | Nitrate (as N) (mg/L) | | 0.232 | 1.89 | 0.199 |
| | Nitrite (as N) (mg/L) | | <0.0010 | 0.0080 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 59.5 | 71.2 | 57.9 |
| | Anion Sum (meq/L) | | 5.61 | 5.89 | 6.40 |
| | Cation Sum (meq/L) | | 6.03 | 5.99 | 6.48 |
| | Cation - Anion Balance (%) | | 3.6 | 0.9 | 0.6 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 8.69 | 12.4 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0090 | 0.0114 | 0.0211 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | 0.00012 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00039 | 0.00041 | 0.00026 |
| | Barium (Ba)-Total (mg/L) | | 0.0715 | 0.0879 | 0.0728 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.030 | 0.028 | 0.024 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000058 | 0.0000137 | 0.0000075 |
| | Calcium (Ca)-Total (mg/L) | | 69.7 | 73.7 | 62.9 |
| | Chromium (Cr)-Total (mg/L) | | 0.00024 | 0.00029 | 0.00014 |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | | 0.00711 | 0.0230 | 0.00281 |
| | Iron (Fe)-Total (mg/L) | | 0.014 | 0.086 | 0.060 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | 0.0014 | 0.0013 | 0.0030 |
| | Magnesium (Mg)-Total (mg/L) | | 23.0 | 23.2 | 34.5 |
| | Manganese (Mn)-Total (mg/L) | | 0.0614 | 0.354 | 0.0918 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2023151-1 Water 13-NOV-17 11:15 W17 | L2023151-2 Water 13-NOV-17 15:10 W16 | L2023151-3 Water 14-NOV-17 09:00 W3 | |
|-------------------------|---|--|--|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | 0.0000072 | <0.0000050 | 0.0000052 | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00581 | 0.00308 | 0.00419 | |
| | Nickel (Ni)-Total (mg/L) | 0.00075 | 0.00093 | 0.00095 | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | <0.050 | |
| | Potassium (K)-Total (mg/L) | 3.91 | 3.56 | 2.17 | |
| | Selenium (Se)-Total (mg/L) | 0.000408 | 0.000704 | 0.000355 | |
| | Silicon (Si)-Total (mg/L) | 5.81 | 5.01 | 6.83 | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Sodium (Na)-Total (mg/L) | 15.2 | 15.3 | 19.2 | |
| | Strontium (Sr)-Total (mg/L) | 0.700 | 0.653 | 0.747 | |
| | Sulfur (S)-Total (mg/L) | 20.9 | 25.0 | 20.3 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Titanium (Ti)-Total (mg/L) | 0.00034 | 0.00040 | 0.00097 | |
| | Uranium (U)-Total (mg/L) | 0.00210 | 0.00137 | 0.00257 | |
| | Vanadium (V)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0042 | <0.0030 | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0019 | 0.0037 | 0.0015 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00034 | 0.00041 | 0.00021 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0701 | 0.0859 | 0.0711 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | 0.028 | 0.027 | 0.023 | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | 0.0000096 | <0.0000050 | |
| | Calcium (Ca)-Dissolved (mg/L) | 71.0 | 69.9 | 61.6 | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00011 | <0.00010 | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00550 | 0.0207 | 0.00218 | |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | 0.068 | 0.027 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0015 | 0.0014 | 0.0028 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 21.0 | 21.3 | 30.5 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00836 | 0.263 | 0.0739 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2023151-1 Water 13-NOV-17 11:15 W17 | L2023151-2 Water 13-NOV-17 15:10 W16 | L2023151-3 Water 14-NOV-17 09:00 W3 | | |
|-------------------------|---|--|--|---|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00590 | 0.00317 | 0.00460 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00057 | 0.00071 | 0.00087 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | 3.57 | 3.20 | 2.30 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000391 | 0.000711 | 0.000307 | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.49 | 4.75 | 6.29 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 15.4 | 15.0 | 19.0 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.744 | 0.677 | 0.807 | | |
| | Sulfur (S)-Dissolved (mg/L) | 20.8 | 25.3 | 18.5 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00211 | 0.00144 | 0.00265 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0010 | 0.0024 | 0.0011 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Copper (Cu)-Total | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2023151-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L2023151-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------------------|--------|--|--|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. |
| BR-L-IC-N-WR | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. |
| F-IC-N-WR | Water | Fluoride in Water by IC | EPA 300.1 (mod) Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-11-15 D

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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analytical



L2023151-COFC

COC Number: 2017-11-15 D

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| | | | | | | | | | | | | | | | | | | | |
|--|---|---|--|--|--|---|------------------------------|--|--|------------------------------|--|----------------------------|--------------------------------|--|---|--|--|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: | <input checked="" type="checkbox"/> PDF | <input type="checkbox"/> EXCEL | <input checked="" type="checkbox"/> EDD (DIGITAL) | Regular [R] | | <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | EMERGENCY | | 1 Business day [E1] | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | 4 day [P4] | | <input type="checkbox"/> | | 3 day [P3] | | <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] | | | | | |
| Phone: | 1-804-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 2 day [P2] | | <input type="checkbox"/> | | 2 day [P2] | | <input type="checkbox"/> | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: | <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs | | | | | dd-mmm-yy hh:mm | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax | minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | | Analysis Request | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: | <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax | ap@mintomine.com | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | PO# | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | Routing Code: | | | | | | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Shane Stack | Sampler: | SR | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | PH / Conductivity / Alkalinity / Actions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (1) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | | | | |
| | W17 | 13-Nov-17 | 11:15 | Water | R | R | R | R | R | R | R | R | R | | 7 | | | | |
| | W16 | 13-Nov-17 | 15:10 | Water | R | R | R | R | R | R | R | R | R | | 7 | | | | |
| | W3 | 14-Nov-17 | 9:00 | Water | R | R | R | R | R | R | R | R | R | | 7 | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | |
| | | | | | 2°C | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT/RECEPTION (lab use only) | | | | FINAL SHIPMENT/RECEPTION (lab use only) | | | | | | | | | | | |
| Released by: Shaun Roberts | Date: 2017-11-15 | Time: 12:00 | Received by: | Date: NOV 16 117 | Time: 0842 | Received by: | Date: | Time: | Received by: | Date: | Time: | | | | | | | | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-NOV-17
Report Date: 14-DEC-17 16:18 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2027459
Project P.O. #: 226973
Job Reference:
C of C Numbers: 2017-11-23 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2027459-1 Water 21-NOV-17 09:30 W3 | L2027459-2 Water 21-NOV-17 10:00 W17 | L2027459-3 Water 22-NOV-17 15:30 W8A | |
|-----------------------------------|---|---|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 534 | 500 | 1560 | |
| | Hardness (as CaCO3) (mg/L) | 265 | 249 | 770 | |
| | pH (pH) | 8.09 | 8.20 | 7.91 | |
| | Total Suspended Solids (mg/L) | 4.7 | 4.0 | 16.0 | |
| | TDS (Calculated) (mg/L) | 320 | 304 | 1110 | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 247 | 217 | 565 | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 247 | 217 | 565 | |
| | Ammonia, Total (as N) (mg/L) | 0.0201 | 0.0053 | 0.442 | |
| | Chloride (Cl) (mg/L) | 4.51 | 7.01 | 16.2 | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.194 | 0.192 | 7.43 | |
| | Nitrate (as N) (mg/L) | 0.194 | 0.192 | 6.74 | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | 0.683 | |
| | Sulfate (SO4) (mg/L) | 57.4 | 59.9 | 394 | |
| | Anion Sum (meq/L) | 6.31 | 5.82 | 20.5 | |
| | Cation Sum (meq/L) | 6.13 | 5.71 | 17.7 | |
| | Cation - Anion Balance (%) | -1.4 | -1.0 | -7.3 | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 4.90 | 8.48 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0235 | 0.0502 | 0.204 | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | 0.00123 | |
| | Arsenic (As)-Total (mg/L) | 0.00026 | 0.00038 | 0.00090 | |
| | Barium (Ba)-Total (mg/L) | 0.0710 | 0.0867 | 0.179 | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | 0.000033 | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Total (mg/L) | 0.025 | 0.032 | 0.036 | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000088 | 0.0000164 | 0.000381 | |
| | Calcium (Ca)-Total (mg/L) | 61.5 | 69.8 | 246 | |
| | Chromium (Cr)-Total (mg/L) | 0.00020 | 0.00023 | 0.00152 | |
| | Cobalt (Co)-Total (mg/L) | 0.00010 | 0.00017 | 0.00132 | |
| | Copper (Cu)-Total (mg/L) | 0.00267 | 0.0156 | 0.193 | |
| | Iron (Fe)-Total (mg/L) | 0.070 | 0.079 | 7.79 | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | 0.000245 | |
| | Lithium (Li)-Total (mg/L) | 0.0031 | 0.0017 | 0.0045 | |
| | Magnesium (Mg)-Total (mg/L) | 29.5 | 20.8 | 64.9 | |
| | Manganese (Mn)-Total (mg/L) | 0.139 | 0.485 | 3.31 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2027459-1 | L2027459-2 | L2027459-3 |
|-------------------------|---------------------------------------|--------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 21-NOV-17 | 21-NOV-17 | 22-NOV-17 |
| | | Sampled Time | 09:30 | 10:00 | 15:30 |
| | | Client ID | W3 | W17 | W8A |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | | <0.0000050 | <0.0000050 | 0.0000066 |
| | Molybdenum (Mo)-Total (mg/L) | | 0.00480 | 0.00683 | 0.0159 |
| | Nickel (Ni)-Total (mg/L) | | 0.00097 | 0.00111 | 0.00270 |
| | Phosphorus (P)-Total (mg/L) | | <0.050 | <0.050 | 0.103 |
| | Potassium (K)-Total (mg/L) | | 2.27 | 3.42 | 8.60 |
| | Selenium (Se)-Total (mg/L) | | 0.000314 | 0.000390 | 0.00872 |
| | Silicon (Si)-Total (mg/L) | | 6.59 | 5.89 | 9.42 |
| | Silver (Ag)-Total (mg/L) | | <0.000010 | <0.000010 | 0.000056 |
| | Sodium (Na)-Total (mg/L) | | 17.5 | 15.1 | 50.0 |
| | Strontium (Sr)-Total (mg/L) | | 0.802 | 0.749 | 3.23 |
| | Sulfur (S)-Total (mg/L) | | 20.2 | 21.1 | 146 |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Titanium (Ti)-Total (mg/L) | | 0.00088 | 0.00216 | 0.00974 |
| | Uranium (U)-Total (mg/L) | | 0.00290 | 0.00222 | 0.00470 |
| | Vanadium (V)-Total (mg/L) | | 0.00065 | 0.00067 | 0.00383 |
| | Zinc (Zn)-Total (mg/L) | | <0.0030 | <0.0030 | 0.603 |
| | Zirconium (Zr)-Total (mg/L) | | <0.00030 | <0.00030 | 0.00071 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0013 | 0.0020 | 0.0053 |
| | Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | <0.00010 | 0.00014 |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00024 | 0.00036 | 0.00047 |
| | Barium (Ba)-Dissolved (mg/L) | | 0.0734 | 0.0728 | 0.156 |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | 0.023 | 0.027 | 0.030 |
| | Cadmium (Cd)-Dissolved (mg/L) | | 0.0000075 | <0.0000050 | 0.000276 |
| | Calcium (Ca)-Dissolved (mg/L) | | 59.4 | 67.1 | 214 |
| | Chromium (Cr)-Dissolved (mg/L) | | <0.00010 | 0.00010 | 0.00053 |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | 0.00108 |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00202 | 0.00579 | 0.0683 |
| | Iron (Fe)-Dissolved (mg/L) | | 0.037 | <0.010 | 0.183 |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | | 0.0030 | <0.0010 | 0.0036 |
| | Magnesium (Mg)-Dissolved (mg/L) | | 28.4 | 19.8 | 57.0 |
| | Manganese (Mn)-Dissolved (mg/L) | | 0.123 | 0.0115 | 2.95 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2027459-1 | L2027459-2 | L2027459-3 | | |
|-------------------------|----------------------------------|--------------|------------|------------|-------------------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 21-NOV-17 | 21-NOV-17 | 22-NOV-17 | | |
| | | Sampled Time | 09:30 | 10:00 | 15:30 | | |
| | | Client ID | W3 | W17 | W8A | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00459 | 0.00611 | 0.0131 | | |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00085 | 0.00062 | 0.00209 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | | 2.28 | 3.63 | 7.70 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000327 | 0.000372 | 0.00830 | | |
| | Silicon (Si)-Dissolved (mg/L) | | 6.40 | 5.58 | 7.76 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | 0.000011 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 17.6 | 14.6 | 46.1 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.782 | 0.747 | 2.86 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 18.2 | 19.4 | 122 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00060 ^{DLM} | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.00271 | 0.00224 | 0.00415 | | |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | 0.00103 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | <0.0010 | <0.0010 | 0.388 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | 0.00055 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|---------------------------|-----------|-----------------------------|
| Method Blank | Sulfur (S)-Total | B | L2027459-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2027459-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L2027459-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| B | Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Reference Information

Chain of Custody Numbers:

2017-11-23 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2027459-COFC

COC Number: 2017-11-23 B

Page 1 of 1

www.alsglobal.com

| | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|---------------------|--|--|-------------------------------------|------------------------------|--|--|--|--|---------------------------|--------------------------------|----------------|--|-------------|--|--|--|--|----------------------|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | | | | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | | | | | | Number of Containers | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | | |
| PO / AFE: 226973 (WUL) | | Requisitioner: | | Location: | | | | | | | | | | | | | | | | | | |
| LSD: | | ALS Contact: Shane Stack | | Sampler: CR | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | |
| W3 | | 21-11-2017 | 9:30 | Water | R | R | R | R | R | R | R | R | R | | | | | | | | 7 | |
| W17 | | 21-11-2017 | 10:00 | Water | R | R | R | R | R | R | R | R | R | | | | | | | | 7 | |
| W8A | | 22-11-2017 | 15:30 | Water | R | R | R | R | R | R | R | R | R | | | | | | | | 6 | |
| | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | |
| | | | | | 3 °C | | | | | 5 | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | |
| Released by: Corey Roberts | | Date: 2017-11-23 | | Time: | | Received by: EHF | | Date: 27 Nov 2017 | | Time: 10:33 | | Received by: JX | | Date: 11/28/17 | | Time: 15:10 | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 FAILURE TO COMPLETE ALL PORTIONS OF THIS FORM MAY DELAY ANALYSIS. PLEASE FILL IN THIS FORM LEGIBLY. BY THE USE OF THIS FORM THE USER ACKNOWLEDGES AND AGREES WITH THE TERMS AND CONDITIONS AS SPECIFIED ON THE BACK PAGE OF THE WHITE - REPORT COPY.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.
 OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 30-NOV-17
Report Date: 12-DEC-17 17:48 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2029332
Project P.O. #: 228617
Job Reference:
C of C Numbers: 2017-11-28 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2029332-1 | L2029332-2 | L2029332-3 | L2029332-4 | L2029332-5 |
|-----------------------------|---|---------------------------------|------------|----------------------|------------|------------|--------------------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 28-NOV-17 | 28-NOV-17 | 28-NOV-17 | 28-NOV-17 | 27-NOV-17 |
| | | Sampled Time | 09:30 | 15:00 | 12:20 | 09:30 | 14:15 |
| | | Client ID | W3 | W17 | W8A | F-BL | W45 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 534 | 493 | 1470 | 56.1 | 3110 |
| | Hardness (as CaCO3) (mg/L) | | 288 | 266 | 872 | <0.50 | 1680 |
| | pH (pH) | | 7.94 | 8.04 | 7.70 | 7.52 | 7.88 |
| | Total Suspended Solids (mg/L) | | <3.0 | 5.5 | 18.3 | <3.0 | 87.9 |
| | TDS (Calculated) (mg/L) | | 326 | 305 | 1090 | 30.9 | 2980 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 246 | 213 | 524 | 15.8 | 126 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 246 | 213 | 524 | 15.8 | 126 |
| | Ammonia, Total (as N) (mg/L) | | 0.0276 | 0.0097 | 0.356 | <0.0050 | 5.17 |
| | Chloride (Cl) (mg/L) | | 4.58 | 6.75 | 15.2 | 6.87 | 42 |
| | Nitrate (as N) (mg/L) | | 0.168 | 0.152 ^{HTD} | 6.04 | 0.155 | 21.3 |
| | Nitrite (as N) (mg/L) | | <0.0010 | <0.0010 | 0.768 | <0.0010 | 4.60 |
| | Sulfate (SO4) (mg/L) | | 57.3 | 58.6 | 362 | 1.00 | 1870 |
| | Anion Sum (meq/L) | | 6.27 | 5.71 | 19.0 | 0.54 | 44.5 |
| | Cation Sum (meq/L) | | 6.61 | 6.07 | 19.9 | 0.56 | 44.1 |
| | Cation - Anion Balance (%) | | 2.7 | 3.0 | 2.4 | 1.4 | -0.4 |
| | Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 5.20 | 8.80 | | <0.50 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0443 | 0.0194 | 0.0808 | <0.0030 | 0.802 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | 0.00018 | 0.00044 | <0.00010 | 0.00036 |
| | Arsenic (As)-Total (mg/L) | | 0.00032 | 0.00038 | 0.00072 | <0.00010 | 0.00052 |
| | Barium (Ba)-Total (mg/L) | | 0.0791 | 0.0783 | 0.177 | 0.000244 | 0.144 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | 0.000029 | <0.000020 | <0.000040 ^{DLA} |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} |
| | Boron (B)-Total (mg/L) | | 0.024 | 0.029 | 0.033 | <0.010 | 0.342 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000141 | 0.0000095 | 0.000370 | <0.0000050 | 0.000097 |
| | Calcium (Ca)-Total (mg/L) | | 59.4 | 69.9 | 234 | 0.179 | 524 |
| | Chromium (Cr)-Total (mg/L) | | 0.00014 | <0.00010 | 0.00186 | <0.00010 | 0.00036 |
| | Cobalt (Co)-Total (mg/L) | | 0.00016 | 0.00012 | 0.00121 | <0.00010 | 0.00288 |
| | Copper (Cu)-Total (mg/L) | | 0.00315 | 0.00782 | 0.148 | 0.00096 | 0.105 |
| | Iron (Fe)-Total (mg/L) | | 0.125 | 0.076 | 3.96 | 0.020 | 1.27 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | 0.000254 | 0.000099 | 0.000201 | 0.00026 |
| | Lithium (Li)-Total (mg/L) | | 0.0033 | 0.0016 | 0.0044 | <0.0010 | 0.0257 |
| | Magnesium (Mg)-Total (mg/L) | | 28.2 | 19.6 | 60.7 | <0.10 | 77.9 |
| | Manganese (Mn)-Total (mg/L) | | 0.241 | 0.157 | 3.25 | 0.00051 | 1.79 |
| | Mercury (Hg)-Total (mg/L) | | <0.0000050 | <0.0000050 | 0.0000063 | <0.0000050 | <0.000025 ^{DLM} |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

12-DEC-17 17:48 (MT)

Version: FINAL

| Sample ID Description Sampled Date Sampled Time Client ID | | L2029332-1 Water 28-NOV-17 09:30 W3 | L2029332-2 Water 28-NOV-17 15:00 W17 | L2029332-3 Water 28-NOV-17 12:20 W8A | L2029332-4 Water 28-NOV-17 09:30 F-BL | L2029332-5 Water 27-NOV-17 14:15 W45 |
|---|---------------------------------------|---|--|--|---|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Molybdenum (Mo)-Total (mg/L) | 0.00462 | 0.00626 | 0.0148 | 0.000368 | 0.125 |
| | Nickel (Ni)-Total (mg/L) | 0.00114 | 0.00085 | 0.00235 | <0.00050 | 0.0057 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | 0.095 | <0.050 | <0.10 ^{DLA} |
| | Potassium (K)-Total (mg/L) | 2.34 | 3.62 | 8.40 | <0.10 | 72.3 |
| | Selenium (Se)-Total (mg/L) | 0.000305 | 0.000372 | 0.00829 | <0.000050 | 0.0160 |
| | Silicon (Si)-Total (mg/L) | 6.56 | 5.59 | 8.07 | 0.65 | 4.66 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000037 | <0.000010 | 0.000032 |
| | Sodium (Na)-Total (mg/L) | 18.4 | 14.7 | 49.0 | 11.9 | 188 |
| | Strontium (Sr)-Total (mg/L) | 0.798 | 0.745 | 3.12 | 0.00114 | 7.60 |
| | Sulfur (S)-Total (mg/L) | 20.3 | 20.6 | 133 | <0.50 | 680 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 ^{DLM} | <0.00010 ^{DLM} | 0.00010 | <0.00020 ^{DLA} |
| | Titanium (Ti)-Total (mg/L) | 0.00162 | <0.00090 | <0.0060 ^{DLM} | <0.00030 | <0.045 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.00255 | 0.00220 | 0.00412 | 0.000133 | 0.00805 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | <0.00050 | 0.00284 | <0.00050 | 0.0027 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | 0.315 | 0.0231 | 0.0089 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | 0.00065 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0017 | 0.0015 | 0.0119 | <0.0010 | 0.0083 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00014 | <0.00010 | 0.00040 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00026 | 0.00038 | 0.00051 | <0.00010 | 0.00037 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0756 | 0.0732 | 0.153 | 0.000205 | 0.135 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000040 ^{DLA} |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} |
| | Boron (B)-Dissolved (mg/L) | 0.024 | 0.027 | 0.032 | <0.010 | 0.344 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000105 | 0.0000069 | 0.000307 | <0.0000050 | <0.00010 ^{DLM} |
| | Calcium (Ca)-Dissolved (mg/L) | 62.4 | 69.4 | 236 | 0.168 | 519 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00060 ^{DLB} | <0.00010 | <0.00020 ^{DLA} |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00013 | <0.00010 | 0.00115 | <0.00010 | 0.00266 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00249 | 0.00568 | 0.0765 | 0.00073 | 0.00353 |
| | Iron (Fe)-Dissolved (mg/L) | 0.065 | 0.046 | 0.236 | 0.015 | <0.020 ^{DLA} |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | 0.000158 | <0.00010 ^{DLA} |
| | Lithium (Li)-Dissolved (mg/L) | 0.0034 | 0.0016 | 0.0044 | <0.0010 | 0.0231 |
| | Magnesium (Mg)-Dissolved (mg/L) | 32.1 | 22.6 | 68.5 | <0.10 | 93.4 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.230 | 0.103 | 3.44 | 0.00047 | 1.89 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2029332-1 Water 28-NOV-17 09:30 W3 | L2029332-2 Water 28-NOV-17 15:00 W17 | L2029332-3 Water 28-NOV-17 12:20 W8A | L2029332-4 Water 28-NOV-17 09:30 F-BL | L2029332-5 Water 27-NOV-17 14:15 W45 |
|---|----------------------------------|---|--|--|---|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Molybdenum (Mo)-Dissolved (mg/L) | 0.00431 | 0.00575 | 0.0137 | 0.000332 | 0.121 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00098 | 0.00079 | 0.00174 | <0.00050 | 0.0056 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.10 ^{DLA} |
| | Potassium (K)-Dissolved (mg/L) | 2.01 | 3.64 | 8.09 | <0.10 | 69.3 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000306 | 0.000402 | 0.00907 | <0.000050 | 0.0157 |
| | Silicon (Si)-Dissolved (mg/L) | 6.57 | 5.68 | 7.83 | 0.610 | 3.21 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000013 | <0.000010 | <0.000020 ^{DLA} |
| | Sodium (Na)-Dissolved (mg/L) | 18.2 | 14.8 | 48.8 | 12.6 | 191 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.756 | 0.697 | 2.98 | 0.00101 | 7.01 |
| | Sulfur (S)-Dissolved (mg/L) | 19.9 | 20.3 | 129 | <0.50 | 721 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 ^{DLA} |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00090 | <0.00030 | <0.00060 ^{DLA} |
| | Uranium (U)-Dissolved (mg/L) | 0.00245 | 0.00206 | 0.00386 | 0.000128 | 0.00752 ^{DLA} |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00119 | <0.00050 | <0.0010 ^{DLA} |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0032 | 0.0010 | 0.212 | 0.0224 | 0.0030 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | 0.00055 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------------|-------------------------|-----------|-----------------------------|
| Method Blank | Barium (Ba)-Dissolved | MB-LOR | L2029332-1, -2, -3, -5 |
| Method Blank | Chromium (Cr)-Dissolved | MB-LOR | L2029332-1, -2, -3, -5 |
| Laboratory Control Sample | Titanium (Ti)-Dissolved | MES | L2029332-4 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L2029332-1, -2, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2029332-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2029332-1, -2, -3, -4, -5 |
| Matrix Spike | Iron (Fe)-Total | MS-B | L2029332-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2029332-1, -2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2029332-1, -2, -3, -4, -5 |
| Matrix Spike | Nickel (Ni)-Total | MS-B | L2029332-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2029332-3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2029332-1, -2, -3, -4, -5 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L2029332-1, -2, -3, -4, -5 |
| Matrix Spike | Tin (Sn)-Total | MS-B | L2029332-3 |
| Matrix Spike | Titanium (Ti)-Total | MS-B | L2029332-1, -2, -3, -4, -5 |
| Matrix Spike | Nitrite (as N) | MS-B | L2029332-1, -2, -3, -4, -5 |
| Matrix Spike | Nitrate (as N) | MS-B | L2029332-1, -2, -3, -4, -5 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLA | Detection Limit adjusted for required dilution |
| DLB | Detection Limit Raised. Analyte detected at comparable level in Method Blank. |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| HTD | Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MES | Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|---|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Reference Information

Chain of Custody Numbers:

2017-11-28 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|--|---|---|-------------------------------------|--|--|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | EMERGENCY | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | Analysis Request | | | | | | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 228617 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: CR | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample identification and/or Coordinates (This description will appear on the report) | | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions Total Suspended Solids (TSS) Total Dissolved Solids (TDS) Total Metals (TM), Hardness Dissolved Metals (DM) (filtered and preserved) Total Mercury, Hardness Dissolved Mercury (1) (Filtered + preserved) Total Nutrients (Ammonia) Dissolved Organic Carbon (DOC) | Number of Containers | | | | | | | | | | | | | | | | | |
| | W3 | | 28-11-2017 | 9:30 | Water | | | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | 7 |
| | W17 | | 28-11-2017 | 15:00 | Water | | | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | 7 |
| | W8A | | 28-11-2017 | 12:20 | Water | | | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | 6 |
| | F-BL | | 28-11-2017 | 9:30 | Water | | | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | 7 |
| | W45 | | 27-11-2017 | 14:15 | Water | | | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | 6 |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | Frozen <input type="checkbox"/> SIP Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input type="checkbox"/> INITIAL COOLER TEMPERATURES °C: 2°C FINAL COOLER TEMPERATURES °C: 2 | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | |
| Released by: Corey Roberts | Date: 29-11-2017 | Time: | Received by: <i>OW</i> | Date: Nov 30/17 | Time: 12:07 | Received by: <i>JL</i> | Date: DEC - 1 2017 | Time: <i>11:10</i> | | | | | | | | | | | | | | | | |

**Short Holding Time
Rush Processing**



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 08-DEC-17
Report Date: 22-DEC-17 15:34 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2032801
Project P.O. #: 228617
Job Reference:
C of C Numbers: 2017-12-06 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2032801-1 Water 04-DEC-17 09:25 W17 | L2032801-2 Water 04-DEC-17 10:00 W8A | L2032801-3 Water 04-DEC-17 14:20 W46 | L2032801-4 Water 04-DEC-17 14:45 W7 | L2032801-5 Water 05-DEC-17 11:55 W12 | |
|---|--|--|--|---|--|--------------------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 490 | 1490 | 624 | 407 | 2500 |
| | Hardness (as CaCO3) (mg/L) | 260 | 894 | 318 | 202 | 1310 |
| | pH (pH) | 8.07 | 7.83 | 8.02 | 7.96 | 7.98 |
| | Total Suspended Solids (mg/L) | <3.0 | 42.7 | <3.0 | 3.3 | 6.0 |
| | TDS (Calculated) (mg/L) | 307 | 1140 | 375 | 225 | 2200 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 217 | 480 | 297 | 207 | 203 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 217 | 480 | 297 | 207 | 203 |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.395 | 0.0144 | 0.0148 | 4.46 |
| | Chloride (Cl) (mg/L) | 7.04 | 15.3 | 5.78 | 0.94 | 36 |
| | Nitrate (as N) (mg/L) | 0.136 | 6.74 | 0.0130 | 0.0106 | 12.6 |
| | Nitrite (as N) (mg/L) | <0.0010 | 0.568 | 0.0021 | <0.0010 | 4.68 |
| | Sulfate (SO4) (mg/L) | 58.4 | 416 | 57.8 | 18.0 | 1280 |
| | Anion Sum (meq/L) | 5.77 | 19.2 | 7.33 | 4.55 | 32.9 |
| | Cation Sum (meq/L) | 6.03 | 20.8 | 7.39 | 4.60 | 34.8 |
| | Cation - Anion Balance (%) | 2.2 | 4.0 | 0.4 | 0.6 | 2.8 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 9.82 | | 11.8 | 9.83 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0109 | 0.0379 | 0.0108 | 0.0330 | 0.0707 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00029 | 0.00012 | 0.00038 | 0.00032 |
| | Arsenic (As)-Total (mg/L) | 0.00034 | 0.00067 | 0.00057 | 0.00050 | 0.00048 |
| | Barium (Ba)-Total (mg/L) | 0.0781 | 0.168 | 0.135 | 0.112 | 0.0937 |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | 0.000023 | <0.000020 | <0.000020 | <0.000040 ^{DLA} |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} |
| | Boron (B)-Total (mg/L) | 0.033 | 0.037 | 0.013 | <0.010 | 0.296 |
| | Cadmium (Cd)-Total (mg/L) | 0.0000081 | 0.000364 | 0.0000201 | 0.0000172 | 0.000185 |
| | Calcium (Ca)-Total (mg/L) | 70.4 | 233 | 78.5 | 50.2 | 398 |
| | Chromium (Cr)-Total (mg/L) | 0.00011 | 0.00074 | 0.00079 | 0.00039 | <0.00020 ^{DLA} |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | 0.00137 | 0.00026 | 0.00017 | 0.00148 |
| | Copper (Cu)-Total (mg/L) | 0.00715 | 0.122 | 0.00394 | 0.0113 | 0.0864 |
| | Iron (Fe)-Total (mg/L) | 0.015 | 1.79 | 0.178 | 0.137 | 0.143 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | 0.000077 | <0.000050 | <0.000050 | <0.00010 ^{DLA} |
| | Lithium (Li)-Total (mg/L) | 0.0021 | 0.0047 | 0.0023 | 0.0015 | 0.0203 |
| | Magnesium (Mg)-Total (mg/L) | 19.6 | 60.1 | 28.9 | 18.2 | 67.9 |
| | Manganese (Mn)-Total (mg/L) | 0.0895 | 3.40 | 0.329 | 0.136 | 1.22 |
| | Mercury (Hg)-Total (mg/L) | <0.000050 | 0.000083 | <0.000050 | 0.000050 | 0.000051 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L2032801-6 | L2032801-7 | L2032801-8 | L2032801-9 |
|-----------------------------------|---|--------------|--------------|-----------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water |
| | | 05-DEC-17 | 13:50 | W30 | 05-DEC-17 | 14:00 | 05-DEC-17 | 14:25 |
| | | | | | W30 | W15 | W3 | DUP |
| Grouping | Analyte | | | | | | | |
| WATER | | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 892 | 1250 | 533 | 1250 | | | |
| | Hardness (as CaCO3) (mg/L) | 469 | 751 | 266 | 743 | | | |
| | pH (pH) | 8.02 | 7.92 | 8.12 | 7.93 | | | |
| | Total Suspended Solids (mg/L) | 12.7 | <3.0 | 3.3 | <3.0 | | | |
| | TDS (Calculated) (mg/L) | 590 | 905 | 317 | 904 | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 332 | 435 | 242 | 436 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 332 | 435 | 242 | 436 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.599 | 0.432 | 0.0243 | 0.434 | | | |
| | Chloride (Cl) (mg/L) | 6.1 | 6.2 | 4.39 | 6.2 | | | |
| | Nitrate (as N) (mg/L) | 1.37 | 11.5 | 0.178 | 11.5 | | | |
| | Nitrite (as N) (mg/L) | 0.0488 | 0.0452 | 0.0011 | 0.0479 | | | |
| | Sulfate (SO4) (mg/L) | 180 | 286 | 56.6 | 287 | | | |
| | Anion Sum (meq/L) | 10.7 | 15.7 | 6.18 | 15.7 | | | |
| | Cation Sum (meq/L) | 10.9 | 16.5 | 6.24 | 16.4 | | | |
| | Cation - Anion Balance (%) | 1.0 | 2.8 | 0.5 | 2.1 | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 24.1 | 5.45 | 26.3 | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.122 | 0.0299 | 0.0423 | 0.0287 | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00023 | 0.00023 | <0.00010 | 0.00022 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00131 | 0.00060 | 0.00025 | 0.00059 | | | |
| | Barium (Ba)-Total (mg/L) | 0.257 | 0.191 | 0.0831 | 0.200 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Boron (B)-Total (mg/L) | 0.012 | <0.010 | 0.027 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000202 | 0.0000271 | 0.0000100 | 0.0000274 | | | |
| | Calcium (Ca)-Total (mg/L) | 118 | 199 | 60.7 | 198 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00017 | 0.00038 | 0.00014 | 0.00034 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00106 | 0.00044 | 0.00012 | 0.00044 | | | |
| | Copper (Cu)-Total (mg/L) | 0.0306 | 0.0459 | 0.00304 | 0.0483 | | | |
| | Iron (Fe)-Total (mg/L) | 0.730 | 0.738 | 0.106 | 0.719 | | | |
| | Lead (Pb)-Total (mg/L) | 0.000075 | <0.000050 | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | 0.0031 | 0.0017 | 0.0036 | 0.0017 | | | |
| | Magnesium (Mg)-Total (mg/L) | 43.6 | 53.6 | 28.9 | 53.0 | | | |
| | Manganese (Mn)-Total (mg/L) | 5.70 | 0.765 | 0.162 | 0.753 | | | |
| | Mercury (Hg)-Total (mg/L) | 0.0000056 | <0.0000050 | 0.0000070 | 0.0000070 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2032801-1 Water 04-DEC-17 09:25 W17 | L2032801-2 Water 04-DEC-17 10:00 W8A | L2032801-3 Water 04-DEC-17 14:20 W46 | L2032801-4 Water 04-DEC-17 14:45 W7 | L2032801-5 Water 05-DEC-17 11:55 W12 |
|---|---------------------------------------|--|--|--|---|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Molybdenum (Mo)-Total (mg/L) | 0.00613 | 0.0154 | 0.00199 | 0.00116 | 0.0888 |
| | Nickel (Ni)-Total (mg/L) | 0.00085 | 0.00200 | 0.00153 | 0.00120 | 0.0038 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.066 | <0.050 | <0.050 | <0.10 ^{DLA} |
| | Potassium (K)-Total (mg/L) | 3.71 | 8.44 | 3.03 | 1.61 | 49.6 |
| | Selenium (Se)-Total (mg/L) | 0.000384 | 0.00805 | 0.000117 | 0.000107 | 0.0121 |
| | Silicon (Si)-Total (mg/L) | 5.78 | 8.04 | 9.42 | 7.89 | 4.68 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | 0.000035 | <0.000010 | <0.000010 | <0.000020 ^{DLA} |
| | Sodium (Na)-Total (mg/L) | 15.4 | 51.7 | 20.9 | 11.4 | 145 |
| | Strontium (Sr)-Total (mg/L) | 0.742 | 3.29 | 0.815 | 0.515 | 7.63 |
| | Sulfur (S)-Total (mg/L) | 20.4 | 135 | 20.5 | 6.36 | 471 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 ^{DLA} |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 ^{DLA} |
| | Titanium (Ti)-Total (mg/L) | <0.00050 ^{DLM} | <0.0030 ^{DLM} | 0.00053 | 0.00207 | <0.0040 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.00238 | 0.00440 | 0.00201 | 0.00120 | 0.00859 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00225 | 0.00062 | 0.00065 | <0.0010 ^{DLA} |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.239 | 0.0035 | 0.0238 | 0.0090 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | 0.00064 | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0016 | 0.0070 | 0.0066 | 0.0042 | 0.0050 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00011 | <0.00010 | 0.00011 | 0.00028 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00040 | 0.00065 | 0.00061 | 0.00055 | 0.00054 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0696 | 0.151 | 0.127 | 0.103 | 0.0843 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000040 ^{DLA} |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} |
| | Boron (B)-Dissolved (mg/L) | 0.035 | 0.040 | 0.014 | <0.010 | 0.287 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000060 | 0.000391 | 0.0000217 | 0.0000208 | <0.00020 ^{DLM} |
| | Calcium (Ca)-Dissolved (mg/L) | 68.9 | 250 | 76.1 | 48.6 | 408 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00055 | 0.00021 | 0.00023 | <0.00020 ^{DLA} |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00130 | 0.00022 | 0.00014 | 0.00134 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00574 | 0.0677 | 0.00299 | 0.00241 | 0.0577 |
| | Iron (Fe)-Dissolved (mg/L) | <0.010 | 0.251 | 0.095 | 0.020 | <0.020 ^{DLA} |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.00010 ^{DLA} |
| | Lithium (Li)-Dissolved (mg/L) | 0.0018 | 0.0053 | 0.0017 | <0.0010 | 0.0215 |
| | Magnesium (Mg)-Dissolved (mg/L) | 21.4 | 65.6 | 31.1 | 19.6 | 71.1 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0171 | 3.75 | 0.337 | 0.126 | 1.26 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2032801-6 | L2032801-7 | L2032801-8 | L2032801-9 |
|-------------------------|---------------------------------------|--------------|------------|------------------------|-----------------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 05-DEC-17 | 05-DEC-17 | 05-DEC-17 | 05-DEC-17 |
| | | Sampled Time | 13:50 | 14:00 | 14:25 | |
| | | Client ID | W30 | W15 | W3 | DUP |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Molybdenum (Mo)-Total (mg/L) | | 0.00368 | 0.00370 | 0.00483 | 0.00356 |
| | Nickel (Ni)-Total (mg/L) | | 0.00118 | 0.00175 | 0.00110 | 0.00220 |
| | Phosphorus (P)-Total (mg/L) | | 0.066 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Total (mg/L) | | 6.56 | 5.28 | 2.35 | 5.42 |
| | Selenium (Se)-Total (mg/L) | | 0.00176 | 0.00282 | 0.000291 | 0.00276 |
| | Silicon (Si)-Total (mg/L) | | 6.20 | 9.25 | 6.71 | 9.27 |
| | Silver (Ag)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | | 24.0 | 27.3 | 19.5 | 26.8 |
| | Strontium (Sr)-Total (mg/L) | | 1.16 | 1.69 | 0.826 | 1.69 |
| | Sulfur (S)-Total (mg/L) | | 65.6 | 107 | 20.2 | 106 |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | | 0.00450 | <0.0020 ^{DLM} | 0.00189 | 0.00140 |
| | Uranium (U)-Total (mg/L) | | 0.00115 | 0.00392 | 0.00299 | 0.00390 |
| | Vanadium (V)-Total (mg/L) | | 0.00078 | <0.00050 | 0.00055 | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | | 0.0048 | 0.0229 | <0.0030 | 0.0221 |
| | Zirconium (Zr)-Total (mg/L) | | <0.00030 | 0.00039 | <0.00030 | 0.00037 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0042 | 0.0062 | 0.0018 | 0.0066 |
| | Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | 0.00016 | <0.00010 | 0.00016 |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00132 | 0.00068 | 0.00029 | 0.00066 |
| | Barium (Ba)-Dissolved (mg/L) | | 0.229 | 0.175 | 0.0727 | 0.173 |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | 0.011 | <0.010 | 0.027 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | | 0.0000124 | 0.0000297 | 0.0000113 | 0.0000309 |
| | Calcium (Ca)-Dissolved (mg/L) | | 116 | 206 | 57.6 | 202 |
| | Chromium (Cr)-Dissolved (mg/L) | | <0.00010 | 0.00026 | <0.00010 | 0.00026 |
| | Cobalt (Co)-Dissolved (mg/L) | | 0.00089 | 0.00040 | 0.00013 | 0.00039 |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00835 | 0.0367 | 0.00205 | 0.0372 |
| | Iron (Fe)-Dissolved (mg/L) | | 0.088 | 0.062 | 0.064 | 0.061 |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | | 0.0026 | 0.0018 | 0.0037 | 0.0018 |
| | Magnesium (Mg)-Dissolved (mg/L) | | 43.3 | 57.6 | 29.7 | 57.8 |
| | Manganese (Mn)-Dissolved (mg/L) | | 5.94 | 0.820 | 0.229 ^{DTMF} | 0.830 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L2032801-1 | L2032801-2 | L2032801-3 | L2032801-4 | L2032801-5 |
|-------------------------|----------------------------------|--------------|--------------|-----------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | | | | 04-DEC-17 | 04-DEC-17 | 04-DEC-17 | 04-DEC-17 | 05-DEC-17 |
| | | | | | 09:25 | 10:00 | 14:20 | 14:45 | 11:55 |
| | | | | | W17 | W8A | W46 | W7 | W12 |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Molybdenum (Mo)-Dissolved (mg/L) | 0.00528 | 0.0126 | 0.00171 | 0.00101 | 0.0790 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00068 | 0.00182 | 0.00135 | 0.00106 | 0.0035 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.10 | | | DLA |
| | Potassium (K)-Dissolved (mg/L) | 3.74 | 9.11 | 2.94 | 1.57 | 51.8 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000522 | 0.0104 | 0.000216 | 0.000128 | 0.0128 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.61 | 8.28 | 9.43 | 7.46 | 4.50 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | 0.000011 | <0.000010 | <0.000010 | <0.000020 | | | DLA |
| | Sodium (Na)-Dissolved (mg/L) | 16.9 | 58.0 | 21.7 | 11.9 | 159 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.742 | 3.03 | 0.796 | 0.503 | 7.16 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 20.8 | 148 | 21.9 | 6.49 | 511 | | | DLA |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 | | | DLA |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | | | DLA |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00080 | 0.00047 | <0.00030 | <0.00060 | | | DLA |
| | Uranium (U)-Dissolved (mg/L) | 0.00213 | 0.00395 | 0.00194 | 0.00112 | 0.00795 | | | DLA |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | 0.00126 | <0.00050 | <0.00050 | <0.0010 | | | DLB |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0025 | 0.207 | <0.0050 | 0.0302 | <0.0090 | | | DLB |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | 0.00056 | <0.00030 | <0.00030 | <0.00030 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2032801-6 Water 05-DEC-17 13:50 W30 | L2032801-7 Water 05-DEC-17 14:00 W15 | L2032801-8 Water 05-DEC-17 14:25 W3 | L2032801-9 Water 05-DEC-17 DUP |
|---|----------------------------------|--|--|---|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Molybdenum (Mo)-Dissolved (mg/L) | 0.00304 | 0.00285 | 0.00392 | 0.00283 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00093 | 0.00158 | 0.00088 | 0.00160 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | 6.73 | 5.58 | 2.18 | 5.59 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00242 ^{DTMF} | 0.00387 ^{DTMF} | 0.000390 | 0.00371 |
| | Silicon (Si)-Dissolved (mg/L) | 5.61 | 9.41 | 6.38 | 9.53 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 25.1 | 30.4 | 19.6 | 30.7 |
| | Strontium (Sr)-Dissolved (mg/L) | 1.08 | 1.55 | 0.748 | 1.50 |
| | Sulfur (S)-Dissolved (mg/L) | 66.4 | 111 | 20.5 | 115 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | <0.00050 ^{DLM} | <0.00030 | <0.00060 ^{DLM} |
| | Uranium (U)-Dissolved (mg/L) | 0.00104 | 0.00345 | 0.00257 | 0.00341 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0050 ^{DLB} | 0.0228 | <0.0020 ^{DLB} | 0.0231 |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|--|
| Method Blank | Zinc (Zn)-Dissolved | MB-LOR | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2032801-1, -3, -4, -7, -8, -9 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2032801-1, -3, -4, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2032801-1, -2, -3, -4, -5, -6, -7, -8, -9 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| DLA | Detection Limit adjusted for required dilution |
| DLB | Detection Limit Raised. Analyte detected at comparable level in Method Blank. |
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| DTMF | Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants were likely introduced to dissolved sample during field filtration. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|---|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-MAN-WR | Water | Total Suspended Solids by Gravimetric | APHA 2540 D |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Reference Information

Chain of Custody Numbers:

2017-12-06 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.


UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L2032801-COFC

www.alsglobal.com

| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | |
|--|---|--|--|----------------|--|-------------------------------------|------------------------------|-----------------------------|--|-------------------------|--|---------------------------|--------------------------------|--|-------|--|--|----------------------|
| Contact and company name below will appear on the final report | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | |
| Contact: | Minto Environment - Coordinator | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | |
| Phone: | 1-804-759-4659 | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | Analysis Request | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | |
| PO / AFE: 228617 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: SR/CP | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | | | Number of Containers |
| | W17 | 4-Dec-17 | 9:25 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| | W8A | 4-Dec-17 | 10:00 | Water | R | R | R | R | R | R | R | R | R | | | | | 6 |
| | W46 | 4-Dec-17 | 14:20 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| | W7 | 4-Dec-17 | 14:45 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| | W12 | 5-Dec-17 | 11:55 | Water | R | R | R | R | R | R | R | R | R | | | | | 6 |
| | W30 | 5-Dec-17 | 13:50 | Water | R | R | R | R | R | R | R | R | R | | | | | 6 |
| | W15 | 5-Dec-17 | 14:00 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| | W3 | 5-Dec-17 | 14:25 | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| | DUP | 5-Dec-17 | | Water | R | R | R | R | R | R | R | R | R | | | | | 7 |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C: 30c, 30c | | | | | | | | | | | | | |
| | | | | | FINAL COOLER TEMPERATURES °C: | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | |
| Released by: Shaun Roberts | Date: 2017-12-06 | Time: 12:00 | Received by:  | Date: DEC 8/17 | Time: 09:10 | Received by: | | | | | | Date: | | | Time: | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 13-DEC-17
Report Date: 22-DEC-17 16:42 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2035054
Project P.O. #: 228617
Job Reference:
C of C Numbers: 2017-12-13 A
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2035054-1 | Water | 12-DEC-17 | 10:15 | W3 |
|-----------------------------------|--|------------|-------|-----------|-------|----|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | 514 | | | | |
| | Hardness (as CaCO3) (mg/L) | 266 | | | | |
| | pH (pH) | 8.03 | | | | |
| | Total Suspended Solids (mg/L) | 5.6 | | | | |
| | TDS (Calculated) (mg/L) | 318 | | | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 246 | | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 246 | | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0117 | | | | |
| | Chloride (Cl) (mg/L) | 4.35 | | | | |
| | Nitrate and Nitrite (as N) (mg/L) | 0.200 | | | | |
| | Nitrate (as N) (mg/L) | 0.200 | | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | | | | |
| | Sulfate (SO4) (mg/L) | 56.5 | | | | |
| | Anion Sum (meq/L) | 6.22 | | | | |
| | Cation Sum (meq/L) | 6.19 | | | | |
| | Cation - Anion Balance (%) | -0.3 | | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 5.01 | | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.315 | | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00101 | | | | |
| | Arsenic (As)-Total (mg/L) | 0.00037 | | | | |
| | Barium (Ba)-Total (mg/L) | 0.0864 | | | | |
| | Beryllium (Be)-Total (mg/L) | <0.000020 | | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | | | | |
| | Boron (B)-Total (mg/L) | 0.025 | | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000163 | | | | |
| | Calcium (Ca)-Total (mg/L) | 58.2 | | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00039 | | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00027 | | | | |
| | Copper (Cu)-Total (mg/L) | 0.0654 | | | | |
| | Iron (Fe)-Total (mg/L) | 0.603 | | | | |
| | Lead (Pb)-Total (mg/L) | 0.000153 | | | | |
| | Lithium (Li)-Total (mg/L) | 0.0034 | | | | |
| | Magnesium (Mg)-Total (mg/L) | 28.8 | | | | |
| | Manganese (Mn)-Total (mg/L) | 0.165 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2035054-1 | | | |
|-------------------------|--|------------|--|--|--|
| | | Water | | | |
| | | 12-DEC-17 | | | |
| | | 10:15 | | | |
| | | W3 | | | |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00467 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00114 | | | |
| | Phosphorus (P)-Total (mg/L) | 0.055 | | | |
| | Potassium (K)-Total (mg/L) | 2.34 | | | |
| | Selenium (Se)-Total (mg/L) | 0.000364 | | | |
| | Silicon (Si)-Total (mg/L) | 7.20 | | | |
| | Silver (Ag)-Total (mg/L) | 0.000032 | | | |
| | Sodium (Na)-Total (mg/L) | 17.9 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.783 | | | |
| | Sulfur (S)-Total (mg/L) | 22.2 | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.0230 | | | |
| | Uranium (U)-Total (mg/L) | 0.00298 | | | |
| | Vanadium (V)-Total (mg/L) | 0.00170 | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0032 | | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | | | |
| | Dissolved Metals Filtration Location | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0020 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00027 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0838 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.023 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000069 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 58.9 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00226 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.031 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0031 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 28.8 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.137 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2035054-1 | Water | 12-DEC-17 | 10:15 | W3 |
|-------------------------|--|------------|-------|-----------|-------|----|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00421 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00079 | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.43 | | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000329 | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.38 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 18.6 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.763 | | | | |
| | Sulfur (S)-Dissolved (mg/L) | 19.9 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00030 | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00274 | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0023 | | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------------|---------------------------|-----------|-----------------------------|
| Method Blank | Magnesium (Mg)-Dissolved | MB-LOR | L2035054-1 |
| Laboratory Control Sample | Antimony (Sb)-Total | MES | L2035054-1 |
| Laboratory Control Sample | Barium (Ba)-Total | MES | L2035054-1 |
| Matrix Spike | Silver (Ag)-Dissolved | MES | L2035054-1 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2035054-1 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2035054-1 |
| Matrix Spike | Iron (Fe)-Dissolved | MS-B | L2035054-1 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2035054-1 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L2035054-1 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L2035054-1 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L2035054-1 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L2035054-1 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L2035054-1 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2035054-1 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L2035054-1 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L2035054-1 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L2035054-1 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L2035054-1 |
| Matrix Spike | Potassium (K)-Total | MS-B | L2035054-1 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L2035054-1 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L2035054-1 |
| Matrix Spike | Sulfur (S)-Total | MS-B | L2035054-1 |
| Matrix Spike | Nitrite (as N) | MS-B | L2035054-1 |
| Matrix Spike | Nitrate (as N) | MS-B | L2035054-1 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2035054-1 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|---|
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MES | Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

Reference Information

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-12-13 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

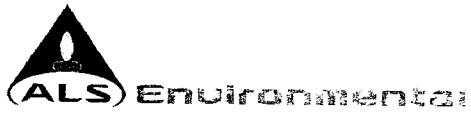
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



www.alsglobal.com

Request Form

Canada Toll Free: 1 800 668 9878



L2035054-COFC

COC Number: 2017-12-13 A

Page of

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|--|-------------|--|--|-------------------------------------|------------------------------|--|--|-------------------------|--|---------------------------|--------------------------------|--------------|--|-------------|--|--|--|----------------------|--------------|-------------|--|---|---|---|---|---|---|---|---|---|--|--|--|--|---|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (1) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | | | | | Number of Containers | | | | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: | 228617 (WUL) | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Shane Stack | Sampler: | | | | | | | | | | | | | | | | | SR | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | | | | | | | | | | | | | | | | | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | |
| | W3 | | | 12-Dec-17 | | | | | | | | | | | | | | | | | 10:15 | Water | | R | R | R | R | R | R | R | R | R | | | | | 7 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | 3°C | | | | | | 16.7 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2017-12-13 | | Time: 12:00 | | Received by: <i>AS</i> | | Date: DEC 13/17 | | Time: 16:42 | | Received by: TP | | Date: DEC 14 | | Time: 16:15 | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 20-DEC-17
Report Date: 12-JAN-18 17:01 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2037961
Project P.O. #: 228617
Job Reference:
C of C Numbers: 2017-12-20 B
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2037961-1 | L2037961-2 | L2037961-3 | L2037961-4 | L2037961-5 |
|-----------------------------------|---|--------------|--------------------------|--------------------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 18-DEC-17 | 18-DEC-17 | 19-DEC-17 | 19-DEC-17 | 19-DEC-17 |
| | | Sampled Time | 15:15 | 15:30 | 09:30 | 10:15 | 13:35 |
| | | Client ID | W45 | W14 | W3 | W17 | W8A |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 3260 | 3550 | 560 | 530 | 1600 |
| | Hardness (as CaCO3) (mg/L) | | 1650 | 1660 | 281 | 268 | 929 |
| | pH (pH) | | 7.80 | 8.18 | 8.18 | 8.23 | 7.80 |
| | Total Suspended Solids (mg/L) | | 86.9 | 45.3 | <3.0 | 4.8 | 16.1 |
| | TDS (Calculated) (mg/L) | | 2960 | 3190 | 320 | 311 | 1100 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 134 | 105 | 240 | 218 | 530 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 134 | 105 | 240 | 218 | 530 |
| | Ammonia, Total (as N) (mg/L) | | 4.69 | 8.32 | 0.0114 | 0.0060 | 0.330 |
| | Chloride (Cl) (mg/L) | | 41 | 46 | 4.41 | 7.02 | 8.21 |
| | Nitrate and Nitrite (as N) (mg/L) | | 23.4 | 33.4 | 0.211 | 0.102 | 4.67 |
| | Nitrate (as N) (mg/L) | | 17.6 | 28.8 | 0.211 | 0.102 | 3.49 |
| | Nitrite (as N) (mg/L) | | 5.79 | 4.53 | <0.0010 | <0.0010 | 1.18 |
| | Sulfate (SO4) (mg/L) | | 1870 | 2020 | 57.8 | 60.0 | 361 |
| | Anion Sum (meq/L) | | 44.4 | 47.8 | 6.14 | 5.80 | 18.7 |
| | Cation Sum (meq/L) | | 43.6 | 45.8 | 6.48 | 6.13 | 21.4 |
| | Cation - Anion Balance (%) | | -0.9 | -2.0 | 2.7 | 2.8 | 6.7 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 73.3 | 108 | 5.35 | 8.95 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.637 | 0.268 | 0.0283 | 0.0711 | 0.0436 |
| | Antimony (Sb)-Total (mg/L) | | 0.00033 | 0.00060 | <0.00010 | 0.00011 | 0.00023 |
| | Arsenic (As)-Total (mg/L) | | 0.00064 | 0.00076 | 0.00030 | 0.00044 | 0.00071 |
| | Barium (Ba)-Total (mg/L) | | 0.125 | 0.136 | 0.0727 | 0.0805 | 0.151 |
| | Beryllium (Be)-Total (mg/L) | | <0.000040 ^{DLA} | <0.000040 ^{DLA} | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.361 | 0.456 | 0.028 | 0.032 | 0.042 |
| | Cadmium (Cd)-Total (mg/L) | | <0.00016 ^{DLM} | <0.00013 ^{DLM} | 0.0000060 | 0.0000172 | 0.000464 |
| | Calcium (Ca)-Total (mg/L) | | 512 | 545 | 60.2 | 70.1 | 252 |
| | Chromium (Cr)-Total (mg/L) | | 0.00023 | 0.00042 | 0.00015 | 0.00021 | 0.00071 |
| | Cobalt (Co)-Total (mg/L) | | 0.00381 | 0.00071 | <0.00010 | 0.00016 | 0.00129 |
| | Copper (Cu)-Total (mg/L) | | 0.0480 | 0.0972 | 0.00260 | 0.0206 | 0.167 |
| | Iron (Fe)-Total (mg/L) | | 0.938 | 0.288 | 0.057 | 0.102 | 1.95 |
| | Lead (Pb)-Total (mg/L) | | 0.00043 | 0.00016 | <0.000050 | 0.000076 | 0.000085 |
| | Lithium (Li)-Total (mg/L) | | 0.0278 | 0.0294 | 0.0039 | 0.0020 | 0.0051 |
| | Magnesium (Mg)-Total (mg/L) | | 88.9 | 104 | 31.9 | 21.6 | 70.3 |
| | Manganese (Mn)-Total (mg/L) | | 1.88 | 1.29 | 0.0917 | 0.372 | 3.50 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2037961-6 Water 19-DEC-17 15:55 W10 | L2037961-7 Water 19-DEC-17 16:00 UG1 | | |
|-----------------------------------|---|--|--|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 612 | 2800 | | |
| | Hardness (as CaCO3) (mg/L) | 316 | 1530 | | |
| | pH (pH) | 7.73 | 7.86 | | |
| | Total Suspended Solids (mg/L) | 202 | 37.3 | | |
| | TDS (Calculated) (mg/L) | 370 | 2600 | | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 286 | 180 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 286 | 180 | | |
| | Ammonia, Total (as N) (mg/L) | 1.52 | 16.5 | | |
| | Chloride (Cl) (mg/L) | 0.73 | 12 | | |
| | Nitrate and Nitrite (as N) (mg/L) | 8.99 | 34.5 | | |
| | Nitrate (as N) (mg/L) | 8.96 | 32.9 ^{HTD} | | |
| | Nitrite (as N) (mg/L) | 0.0349 | 1.53 ^{HTD} | | |
| | Sulfate (SO4) (mg/L) | 16.1 | 1600 | | |
| | Anion Sum (meq/L) | 6.72 | 39.7 | | |
| | Cation Sum (meq/L) | 7.61 | 37.0 | | |
| | Cation - Anion Balance (%) | 6.2 | -3.6 | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 13.1 | 3.36 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.714 | 0.951 | | |
| | Antimony (Sb)-Total (mg/L) | 0.00035 | 0.00062 | | |
| | Arsenic (As)-Total (mg/L) | 0.00132 | 0.00160 | | |
| | Barium (Ba)-Total (mg/L) | 0.441 | 0.0627 | | |
| | Beryllium (Be)-Total (mg/L) | 0.000023 | <0.000040 ^{DLA} | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.00010 ^{DLA} | | |
| | Boron (B)-Total (mg/L) | 0.014 | 0.774 | | |
| | Cadmium (Cd)-Total (mg/L) | 0.0000331 | 0.000145 | | |
| | Calcium (Ca)-Total (mg/L) | 96.2 | 557 | | |
| | Chromium (Cr)-Total (mg/L) | 0.00139 | 0.00042 | | |
| | Cobalt (Co)-Total (mg/L) | 0.00204 | 0.00118 | | |
| | Copper (Cu)-Total (mg/L) | 0.0177 | 0.126 | | |
| | Iron (Fe)-Total (mg/L) | 14.8 | 1.24 | | |
| | Lead (Pb)-Total (mg/L) | 0.000267 | 0.00132 | | |
| | Lithium (Li)-Total (mg/L) | 0.0016 | 0.0140 | | |
| | Magnesium (Mg)-Total (mg/L) | 19.9 | 45.8 | | |
| | Manganese (Mn)-Total (mg/L) | 2.09 | 0.227 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2037961-1 Water 18-DEC-17 15:15 W45 | L2037961-2 Water 18-DEC-17 15:30 W14 | L2037961-3 Water 19-DEC-17 09:30 W3 | L2037961-4 Water 19-DEC-17 10:15 W17 | L2037961-5 Water 19-DEC-17 13:35 W8A |
|---|---------------------------------------|--|--|---|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.00010 ^{DLM} | <0.0000050 | <0.0000050 | 0.0000055 ^{DLM} |
| | Molybdenum (Mo)-Total (mg/L) | 0.113 | 0.119 | 0.00457 | 0.00601 | 0.0149 |
| | Nickel (Ni)-Total (mg/L) | 0.0050 | 0.0020 | 0.00083 | 0.00104 | 0.00171 |
| | Phosphorus (P)-Total (mg/L) | <0.10 ^{DLA} | <0.10 ^{DLA} | <0.050 | <0.050 | 0.055 |
| | Potassium (K)-Total (mg/L) | 72.4 | 86.9 | 2.38 | 3.81 | 8.89 |
| | Selenium (Se)-Total (mg/L) | 0.0135 | 0.0120 | 0.000255 | 0.000294 | 0.00798 |
| | Silicon (Si)-Total (mg/L) | 4.46 | 3.01 | 6.27 | 5.73 | 7.80 |
| | Silver (Ag)-Total (mg/L) | 0.000026 | <0.000020 ^{DLA} | <0.000010 | <0.000010 | 0.000029 |
| | Sodium (Na)-Total (mg/L) | 198 | 231 | 19.3 | 14.9 | 52.2 |
| | Strontium (Sr)-Total (mg/L) | 7.08 | 7.76 | 0.763 | 0.782 | 3.35 |
| | Sulfur (S)-Total (mg/L) | 661 | 733 | 19.5 | 20.3 | 144 |
| | Thallium (Tl)-Total (mg/L) | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00020 ^{DLA} | <0.00020 ^{DLA} | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.0363 | <0.0066 ^{DLM} | <0.0012 ^{DLM} | 0.00345 | <0.0033 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.00898 | 0.0110 | 0.00292 | 0.00236 | 0.00448 |
| | Vanadium (V)-Total (mg/L) | 0.0023 | 0.0010 | 0.00068 | 0.00087 | 0.00245 |
| | Zinc (Zn)-Total (mg/L) | 0.0061 | <0.0060 ^{DLA} | <0.0030 | 0.0034 | 0.238 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | 0.00054 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0123 | 0.0279 | 0.0023 | 0.0013 | 0.0090 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00037 | 0.00062 | <0.00010 | <0.00010 | 0.00018 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00045 | 0.00056 | 0.00023 | 0.00034 | 0.00053 |
| | Barium (Ba)-Dissolved (mg/L) | 0.129 | 0.166 | 0.0731 | 0.0766 | 0.168 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000040 ^{DLA} | <0.000040 ^{DLA} | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.324 | 0.381 | 0.023 | 0.027 | 0.036 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000042 | <0.000010 ^{DLA} | <0.0000050 | <0.0000050 | 0.000518 |
| | Calcium (Ca)-Dissolved (mg/L) | 524 | 502 | 60.8 | 71.3 | 254 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00020 ^{DLA} | <0.00020 ^{DLA} | 0.00016 | <0.00010 | 0.00044 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00365 | 0.00054 | <0.00010 | <0.00010 | 0.00136 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00287 | 0.00236 | 0.00226 | 0.00632 | 0.108 |
| | Iron (Fe)-Dissolved (mg/L) | 0.062 | <0.020 ^{DLA} | 0.024 | <0.010 | 0.311 |
| | Lead (Pb)-Dissolved (mg/L) | <0.00010 ^{DLA} | <0.00010 ^{DLA} | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0237 | 0.0243 | 0.0033 | 0.0018 | 0.0047 |
| | Magnesium (Mg)-Dissolved (mg/L) | 83.9 | 98.2 | 31.4 | 21.9 | 71.5 |
| | Manganese (Mn)-Dissolved (mg/L) | 1.88 | 1.25 | 0.0848 | 0.00925 | 4.01 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2037961-6 | L2037961-7 |
|-------------------------|---------------------------------------|--------------------------|--------------------------|------------|
| | | Description | Water | Water |
| | | Sampled Date | 19-DEC-17 | 19-DEC-17 |
| | | Sampled Time | 15:55 | 16:00 |
| | | Client ID | W10 | UG1 |
| Grouping | Analyte | | | |
| WATER | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.000025 ^{DLM} | <0.0000050 | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00139 | 0.0271 | |
| | Nickel (Ni)-Total (mg/L) | 0.00192 | 0.0032 | |
| | Phosphorus (P)-Total (mg/L) | 0.135 | <0.10 ^{DLA} | |
| | Potassium (K)-Total (mg/L) | 2.37 | 12.9 | |
| | Selenium (Se)-Total (mg/L) | 0.000136 | 0.00093 | |
| | Silicon (Si)-Total (mg/L) | 6.79 | 8.67 | |
| | Silver (Ag)-Total (mg/L) | 0.000013 | 0.000084 | |
| | Sodium (Na)-Total (mg/L) | 11.8 | 105 | |
| | Strontium (Sr)-Total (mg/L) | 0.570 | 7.83 | |
| | Sulfur (S)-Total (mg/L) | 5.76 | 519 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | 0.000030 | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00020 ^{DLA} | |
| | Titanium (Ti)-Total (mg/L) | 0.0304 | 0.0578 | |
| | Uranium (U)-Total (mg/L) | 0.000449 | 0.00868 | |
| | Vanadium (V)-Total (mg/L) | 0.00330 | 0.0035 | |
| | Zinc (Zn)-Total (mg/L) | 0.0137 | 0.0143 | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0158 | 0.0067 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00067 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00067 | 0.00137 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.373 | 0.0510 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000040 ^{DLA} | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | |
| | Boron (B)-Dissolved (mg/L) | 0.012 | 0.627 | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000096 | 0.000110 | |
| | Calcium (Ca)-Dissolved (mg/L) | 93.9 | 537 | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00020 ^{DLA} | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00168 | 0.00085 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00112 | 0.0104 | |
| | Iron (Fe)-Dissolved (mg/L) | 9.49 | <0.020 ^{DLA} | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.00010 ^{DLA} | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0013 | 0.0119 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 19.7 | 46.9 | |
| | Manganese (Mn)-Dissolved (mg/L) | 2.18 | 0.202 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L2037961-1 | L2037961-2 | L2037961-3 | L2037961-4 | L2037961-5 |
|-------------------------|----------------------------------|--------------------------|--------------------------|------------|------------|------------|------------|------------|------------|
| | | | | | Water | Water | Water | Water | Water |
| | | | | | 18-DEC-17 | 18-DEC-17 | 19-DEC-17 | 19-DEC-17 | 19-DEC-17 |
| | | | | | 15:15 | 15:30 | 09:30 | 10:15 | 13:35 |
| | | | | | W45 | W14 | W3 | W17 | W8A |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.00025 ^{DLM} | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.118 | 0.123 | 0.00428 | 0.00556 | 0.0144 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0047 | 0.0018 | 0.00075 | 0.00071 | 0.00178 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.10 ^{DLA} | <0.10 ^{DLA} | <0.050 | <0.050 | <0.050 | | | |
| | Potassium (K)-Dissolved (mg/L) | 70.7 | 83.8 | 2.31 | 3.81 | 9.55 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.0140 | 0.0141 | 0.000281 | 0.000354 | 0.00865 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 2.95 | 2.47 | 6.21 | 5.53 | 7.88 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | 0.000014 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 192 | 228 | 18.3 | 15.4 | 54.4 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 7.46 | 7.43 | 0.863 | 0.817 | 3.71 | | | |
| | Sulfur (S)-Dissolved (mg/L) | 638 | 715 | 19.5 | 20.0 | 145 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.000020 ^{DLA} | <0.000020 ^{DLA} | <0.000010 | <0.000010 | <0.000010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLA} | <0.00060 ^{DLA} | <0.00030 | <0.00030 | 0.00067 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00883 | 0.0113 | 0.00262 | 0.00220 | 0.00420 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 ^{DLA} | <0.0010 ^{DLA} | <0.00050 | <0.00050 | 0.00127 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0023 | <0.0020 ^{DLA} | <0.0010 | 0.0015 | 0.212 | | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | 0.00060 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | L2037961-6 | L2037961-7 | | | |
|-------------------------|----------------------------------|-------------------------|--------------------------|--|--|
| Description | Water | Water | | | |
| Sampled Date | 19-DEC-17 | 19-DEC-17 | | | |
| Sampled Time | 15:55 | 16:00 | | | |
| Client ID | W10 | UG1 | | | |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00123 | 0.0274 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00089 | 0.0031 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.050 | <0.10 ^{DLA} | | |
| | Potassium (K)-Dissolved (mg/L) | 2.28 | 13.5 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000085 | 0.00113 | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.80 | 7.22 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | | |
| | Sodium (Na)-Dissolved (mg/L) | 12.6 | 110 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.590 | 7.97 | | |
| | Sulfur (S)-Dissolved (mg/L) | 5.35 | 540 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000020 ^{DLA} | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00020 ^{DLA} | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.00060 ^{DLM} | <0.00060 ^{DLA} | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000384 | 0.00808 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.0010 ^{DLA} | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0101 | 0.0085 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|---|-----------|------------------------------------|
| Method Blank | Alkalinity, Total (as CaCO ₃) | B | L2037961-1, -2, -3, -4, -5, -6, -7 |
| Method Blank | Manganese (Mn)-Dissolved | MB-LOR | L2037961-2 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2037961-1, -2, -3 |
| Matrix Spike | Sulfate (SO ₄) | MS-B | L2037961-7 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| B | Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable. |
| DLA | Detection Limit adjusted for required dilution |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| HTD | Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are

Reference Information

included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

| | |
|----|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |
|----|---|

Chain of Custody Numbers:

2017-12-20 B

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2037961-COFC

COC Number: 2017-12-20 B

Page 1 of 1

www.alsglobal.com

| | | | | | | | | | | | | | | | | |
|--|---|--|---------------------------------|----------------------------|--|--------------------|---|------------------------------|--|-----------------------------|--|-------------------------|--|---------------------------|--------------------------------|----------------------|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | | | EMERGENCY | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 4 day [P4] <input type="checkbox"/> | | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: _____ | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | |
| PO / AFE: 228617 (WUL) | | Requisitioner: | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Shane Stack | | Sampler: CR | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers |
| W45 | | | | 18-12-2017 | 15:15 | Water | R | R | R | R | R | R | R | R | R | 7 |
| W14 | | | | 18-12-2017 | 15:30 | Water | R | R | R | R | R | R | R | R | R | 7 |
| W3 | | | | 19-12-2017 | 9:30 | Water | R | R | R | R | R | R | R | R | R | 7 |
| W17 | | | | 19-12-2017 | 10:15 | Water | R | R | R | R | R | R | R | R | R | 7 |
| W8A | | | | 19-12-2017 | 13:35 | Water | R | R | R | R | R | R | R | R | R | 6 |
| W10 | | | | 19-12-2017 | 15:55 | Water | R | R | R | R | R | R | R | R | R | 7 |
| UG1 | | | | 19-12-2017 | 16:00 | Water | R | R | R | R | R | R | R | R | R | 7 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C: 7°C | | | | | | | | | | | |
| | | | | | FINAL COOLER TEMPERATURES °C: 2 | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | |
| Released by: Corey Roberts | Date: 20-12-2017 | Time: | Received by: <i>(Signature)</i> | Date: DEC 20/17 | Time: 15:30 | Received by: JC | Date: 12/22/17 | Time: 14:00 | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-DEC-17
Report Date: 15-JAN-18 19:12 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2039348
Project P.O. #: 228617
Job Reference:
C of C Numbers: 2017-12-27 A
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2039348-1 | L2039348-2 | L2039348-3 | L2039348-4 |
|-----------------------------------|---|--------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 26-DEC-17 | 26-DEC-17 | 26-DEC-17 | 26-DEC-17 |
| | | Sampled Time | 09:50 | 10:20 | 11:10 | |
| | | Client ID | W3 | W17 | W8A | DUP |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 558 | 534 | 1560 | 535 |
| | Hardness (as CaCO3) (mg/L) | | 291 | 279 | 914 | 284 |
| | pH (pH) | | 8.23 | 8.28 | 7.96 | 8.26 |
| | Total Suspended Solids (mg/L) | | 3.2 | 4.4 | 8.0 | <3.0 |
| | TDS (Calculated) (mg/L) | | 331 | 320 | 1150 | 324 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 251 | 229 | 575 | 230 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 251 | 229 | 575 | 230 |
| | Ammonia, Total (as N) (mg/L) | | 0.0106 | <0.0050 | 0.282 | <0.0050 |
| | Chloride (Cl) (mg/L) | | 4.41 | 6.90 | 16.1 | 7.05 |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.204 | 0.0916 | 7.62 | 0.0903 |
| | Nitrate (as N) (mg/L) | | 0.204 | 0.0916 | 7.02 | 0.0903 |
| | Nitrite (as N) (mg/L) | | <0.0010 | <0.0010 | 0.602 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 57.0 | 58.2 | 367 | 59.7 |
| | Anion Sum (meq/L) | | 6.34 | 5.98 | 20.1 | 6.04 |
| | Cation Sum (meq/L) | | 6.78 | 6.40 | 21.1 | 6.50 |
| | Cation - Anion Balance (%) | | 3.3 | 3.4 | 2.4 | 3.6 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 5.40 | 9.40 | | 9.55 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0184 | 0.0481 | 0.0323 | 0.0462 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | 0.00011 | 0.00020 | 0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00029 | 0.00039 | 0.00071 | 0.00039 |
| | Barium (Ba)-Total (mg/L) | | 0.0786 | 0.0818 | 0.177 | 0.0840 |
| | Beryllium (Be)-Total (mg/L) | | <0.000020 | <0.000020 | 0.000022 | <0.000020 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | 0.027 | 0.031 | 0.039 | 0.030 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000065 | 0.0000124 | 0.000456 | 0.0000121 |
| | Calcium (Ca)-Total (mg/L) | | 62.3 | 74.4 | 249 | 71.0 |
| | Chromium (Cr)-Total (mg/L) | | 0.00011 | 0.00021 | 0.00085 | 0.00017 |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | 0.00012 | 0.00147 | 0.00013 |
| | Copper (Cu)-Total (mg/L) | | 0.00289 | 0.0133 | 0.165 | 0.0139 |
| | Iron (Fe)-Total (mg/L) | | 0.042 | 0.058 | 2.15 | 0.062 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | 0.000107 | 0.000080 | 0.000069 |
| | Lithium (Li)-Total (mg/L) | | 0.0039 | 0.0020 | 0.0048 | 0.0018 |
| | Magnesium (Mg)-Total (mg/L) | | 32.6 | 22.6 | 67.8 | 22.7 |
| | Manganese (Mn)-Total (mg/L) | | 0.0868 | 0.207 | 4.52 | 0.246 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2039348-1 Water 26-DEC-17 09:50 W3 | L2039348-2 Water 26-DEC-17 10:20 W17 | L2039348-3 Water 26-DEC-17 11:10 W8A | L2039348-4 Water 26-DEC-17 DUP |
|---|---------------------------------------|---|--|--|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00499 | 0.00638 | 0.0144 | 0.00653 |
| | Nickel (Ni)-Total (mg/L) | 0.00087 | 0.00093 | 0.00168 | 0.00100 |
| | Phosphorus (P)-Total (mg/L) | <0.050 | <0.050 | 0.076 | <0.050 |
| | Potassium (K)-Total (mg/L) | 2.33 | 4.00 | 9.03 | 3.93 |
| | Selenium (Se)-Total (mg/L) | 0.000333 | 0.000324 | 0.00766 | 0.000339 |
| | Silicon (Si)-Total (mg/L) | 7.08 | 6.04 | 8.50 | 6.07 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000028 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 20.5 | 16.3 | 53.0 | 16.0 |
| | Strontium (Sr)-Total (mg/L) | 0.864 | 0.797 | 3.47 | 0.767 |
| | Sulfur (S)-Total (mg/L) | 21.8 | 21.5 | 138 | 21.7 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.00060 ^{DLM} | 0.00266 | 0.00205 | <0.0030 ^{DLM} |
| | Uranium (U)-Total (mg/L) | 0.00297 | 0.00235 | 0.00451 | 0.00247 |
| | Vanadium (V)-Total (mg/L) | <0.00050 | 0.00058 | 0.00281 | 0.00059 |
| | Zinc (Zn)-Total (mg/L) | 0.0033 | <0.0030 | 0.197 | <0.0030 |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | 0.00065 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0015 | 0.0020 | 0.0071 | 0.0014 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00023 | 0.00034 | 0.00058 | 0.00037 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0775 | 0.0811 | 0.178 | 0.0815 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | 0.025 | 0.029 | 0.036 | 0.029 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | 0.000426 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 62.5 | 73.9 | 247 | 75.9 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00012 | 0.00060 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00147 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00201 | 0.00628 | 0.0907 | 0.00633 |
| | Iron (Fe)-Dissolved (mg/L) | 0.016 | <0.010 | 0.290 | <0.010 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0036 | 0.0018 | 0.0045 | 0.0017 |
| | Magnesium (Mg)-Dissolved (mg/L) | 32.8 | 22.9 | 72.3 | 23.0 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0825 | 0.0209 | 4.55 | 0.0218 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2039348-1 | L2039348-2 | L2039348-3 | L2039348-4 |
|-------------------------|----------------------------------|--------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 26-DEC-17 | 26-DEC-17 | 26-DEC-17 | 26-DEC-17 |
| | | Sampled Time | 09:50 | 10:20 | 11:10 | |
| | | Client ID | W3 | W17 | W8A | DUP |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | 0.0000080 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00414 | 0.00526 | 0.0120 | 0.00551 |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00091 | 0.00076 | 0.00172 | 0.00076 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | <0.050 |
| | Potassium (K)-Dissolved (mg/L) | | 2.40 | 4.00 | 9.50 | 4.03 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000343 | 0.000330 | 0.00716 | 0.000400 |
| | Silicon (Si)-Dissolved (mg/L) | | 6.84 | 5.93 | 8.04 | 5.95 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | 0.000011 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 20.8 | 16.7 | 55.3 | 16.3 |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.871 | 0.805 | 3.52 | 0.842 |
| | Sulfur (S)-Dissolved (mg/L) | | 20.9 | 20.7 | 129 | 20.9 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | 0.00095 | <0.00030 |
| | Uranium (U)-Dissolved (mg/L) | | 0.00278 | 0.00222 | 0.00416 | 0.00227 |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | 0.00136 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0015 | 0.0014 | 0.176 | <0.0010 |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | 0.00072 | <0.00030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Method Blank | Manganese (Mn)-Dissolved | B | L2039348-1, -2, -3, -4 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L2039348-1, -2, -4 |
| Matrix Spike | Sulfate (SO4) | MS-B | L2039348-2, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| B | Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable. |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |

Reference Information

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2017-12-27 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2039348-COFC

COC Number: 2017-12-27 A

Page 1 of 1

www.alsglobal.com

| | | | | | | | | | | | | | | | | | |
|--|--|--|--|---|---|-------------------------------------|---|--|------------------------------|-----------------------------|--|-------------------------|--|---------------------------|--------------------------------|----------------------|--|
| Report To Contact and company name below will appear on the final report. | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | |
| Project Information | | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | | AFE/Cost Center: | | PO# | | | | | | | | | | | |
| Job #: | | | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | |
| PO / AFE: 228617 (WUL) | | | | Requisitioner: | | | | | | | | | | | | | |
| LSD: | | | | Location: | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | ALS Contact: Shane Stack | | Sampler: CR | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (Tm), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | |
| W3 | | | | 26-12-2017 | 9:50 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| W17 | | | | 26-12-2017 | 10:20 | Water | R | R | R | R | R | R | R | R | R | 7 | |
| W8A | | | | 26-12-2017 | 11:10 | Water | R | R | R | R | R | R | R | R | R | 6 | |
| DUP | | | | 26-12-2017 | | Water | R | R | R | R | R | R | R | R | R | 7 | |
| Short Holding Time Rush Processing | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | |
| | | | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | |
| | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | |
| | | | | | | | | 3°C | | | | | 0.3 | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Corey Roberts | | Date: 27-12-2017 | | Time: | | Received by: | | Date: DEC 27 / 17 | | Time: 15:24 | | Received by: | | Date: DEC 29 2017 | | Time: 11 AM | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Appendix J – Minto Mine Phase 4 EEM Interpretive Report



A Trinity Consultants Company

**Minto Mine
Phase 4 Environmental Effects
Monitoring Interpretive Report**

Prepared for:
Minto Mine
Whitehorse, Yukon

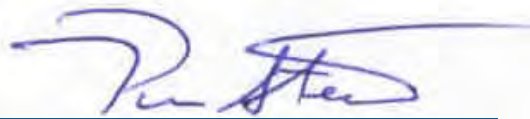
Prepared by:
Minnow Environmental Inc.
Victoria, British Columbia

With Major Contributions by:
Alexco Environmental Group
Whitehorse, Yukon

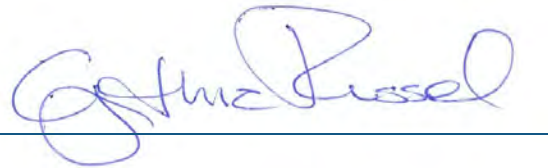
January 2018

Minto Mine
Phase 4 Environmental Effects Monitoring
Interpretive Report

Pierre Stecko, M.Sc., EP, RPBio
Project Manager

A handwritten signature in blue ink, appearing to read 'Pierre Stecko', written over a horizontal line.

Cynthia Russel, B.Sc.
Technical Reviewer

A handwritten signature in blue ink, appearing to read 'Cynthia Russel', written over a horizontal line.

EXECUTIVE SUMMARY

The Minto Mine, operated by the Capstone Mining Corporation, is an open pit copper/gold/silver mine located approximately 240 km northwest of Whitehorse in the Yukon Territory. The mine is located in the upper reaches of the Minto Creek watershed approximately 10 km west of the Minto Creek confluence with the Yukon River. Commercial production at the Minto Mine commenced in October 2007 and the mine is projected to run to 2020. Milling (concentrating) is done on site and tailings are stored in a dry stack Tailings Storage Facility (TSF; now closed) and in mined-out open pits (active). Site water is ultimately managed in a Water Storage Pond located approximately 1.5 kilometers to the east (down-gradient) of the mill. The Minto Mine has one point of effluent discharge to Minto Creek from the Water Storage Pond, and discharge is intermittent as needed. The Minto Mine is required to undertake Environmental Effects Monitoring (EEM) under the federal Metal Mining Effluent Regulations (MMER). The current phase of EEM (Phase 4) is a “biological monitoring study to assess effects” following the completion of a “biological monitoring study to investigate confirmed effects” in Phase 3. The Minto Mine Phase 4 EEM was completed between June and September 2016, and provided sublethal toxicity testing of Minto Mine effluent, an assessment of the influence of Minto Mine effluent discharge on water chemistry and benthic invertebrate community condition of Minto Creek relative to reference sites, and an assessment of the controlled exposure of a sentinel fish (kokanee as a surrogate for chinook salmon) to Minto Mine effluent.

Effluent sublethal toxicity tests conducted by the mine from 2015 to present (the Phase 4 EEM period) showed no effects to the survival of rainbow trout embryos, the survival or reproduction of *Ceriodaphnia dubia* (a cladoceran invertebrate often referred to as a water flea), nor to the growth of *Pseudokirchneriella subcapitata* (a green algae) or *Lemna minor* (a plant). This suggests a low probability of toxicity in the receiving environment.

Routine water quality monitoring indicated an influence of the Minto Mine on Minto Creek evident in conductivity, hardness, nitrate, aluminum, arsenic, iron, and selenium that were greater than reference. Of these, concentrations of nitrate were most strongly associated with the release of water from the Water Storage Pond, but remained below the Canadian Water Quality Guideline for the protection of aquatic life (CWQG). Aluminum and arsenic had mean concentrations greater CWQG, but this occurred at both the effluent-exposed and reference stations. During the Phase 4 EEM benthic survey (in September 2016) water of upper Minto Creek had concentrations of nitrate, total Kjeldahl nitrogen, total phosphorus, copper, and molybdenum greater than the range of reference concentrations. Of these, only copper was present at a concentration greater than the CWQG, but did not exceed the applicable site-specific water quality objective (SSWQO). Of the analytes identified as elevated relative to reference in routine water quality monitoring or



during the EEM benthic survey (conductivity, hardness, nitrate, phosphorus, aluminum, arsenic, copper, iron, molybdenum, and selenium), all except for aluminum and arsenic increased in the fish exposure vessels in proportion to effluent concentration.

The benthic invertebrate community of Minto Creek was evaluated using two approaches: a reference condition approach (RCA) that evaluates individual sites relative to a range of reference (based on ten reference sites) and a control-impact (CI) comparison of the exposed area mean against the reference mean. The latter, completed at the request of Environment and Climate Change Canada (ECCC), assumes that within-area variability (upper Minto Creek) and among-area variability (reference sites) are comparable, which may not be true. Mine-exposed benthic invertebrate communities of upper Minto Creek were within reference condition for all four primary EEM metrics (density, taxon richness, Simpson's evenness, and Bray Curtis [BC] distance [also known as the BC index of dissimilarity]). Evaluation by control-impact comparison indicated that mean taxon richness, mean Simpson's evenness, and mean BC distance did not differ from the reference means, whereas mean density of the effluent-exposed upper Minto Creek area was significantly lower than reference. The difference in density was at a magnitude of -1.2 standard deviations, which is below the Critical Effect Size (CES) of ± 2 standard deviations and therefore may not be ecologically meaningful. Supplementary examination of taxon proportions indicated lower relative abundances of EPT taxa (Ephemeroptera, Plecoptera, and Trichoptera; mayflies, stoneflies, and caddisflies) at effluent-exposed upper Minto Creek than reference, which was primarily due to lower relative abundance of Plecoptera (individually), and also indicated higher relative abundances of Trichoptera and oligochaetes. As Plecoptera and Trichoptera are considered to be sensitive organisms and oligochaetes are considered to be tolerant organisms, these results are equivocal with respect to a potential effluent-related influence. Correlation analysis indicated negative relationships between benthic invertebrate density and water quality, and a negative relationship between the proportion of oligochaetes and dissolved oxygen.

Fish population health was evaluated using an on-site laboratory exposure to Minto Mine effluent at two concentrations (14% and 25%) in comparison to Yukon River reference water. The fish survey indicated that fish exposed to the higher effluent concentration (25%) for 47 days were slightly larger and of better condition than those exposed to reference water. Fish exposed to the lower effluent concentration (14%) for 47 days did not differ from reference on the basis of size, but had slightly lower condition than reference fish. In all cases, the magnitudes of the observed differences were very small, and were presumably detected due to the high power associated with large sample size (minimum 152 fish) and uniform fish size. In the case of condition (fish weight-at-length) - the key effect endpoint evaluated in this fish survey - the magnitudes of difference (-2.7% and +2.3% for 14% effluent and 25% effluent, respectively) were well below the CES of 10%. These differences are therefore not considered to be ecologically meaningful.



The results of the Phase 4 EEM were generally consistent with those of the previous EEM (i.e., the Phase 3 benthic invertebrate community survey and the Phase 2 fish survey). Specifically, the results of the Phase 4 EEM benthic invertebrate community survey were consistent with the results of the Phase 3 EEM - RCA analysis in two consecutive EEM Phases has indicated no effect. A supporting CI comparison in this study (Phase 4) suggested lower density at the effluent-exposed area, but this result was opposite from the apparent greater density observed at one of three sites evaluated by RCA in Phase 3. The results of the Phase 4 EEM fish study were similar to those of the Phase 2 EEM fish study (no fish study was completed in association with the Phase 3 Investigation of Cause study of differences in benthic invertebrate communities). These two consecutive EEM Phases have indicated slightly greater fish size and condition associated with effluent exposure. However, the associated magnitudes of difference for the EEM-effect endpoint (condition) was less than 3%, well below the CES of 10%.



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1 INTRODUCTION

1.1 Site Description

The Minto Mine is a high grade copper mine located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R-6A approximately 240 km northwest of Whitehorse, Yukon Territory (62° 37' N latitude and 137 °15' W longitude; Figure 1.1). It is owned and operated by the Minto Explorations Ltd. a wholly owned subsidiary of Capstone Mining Corporation. Development of the mine was initiated in 1997, commercial operations started in October 2007, and the currently anticipated operating life is to 2020. The Minto Mine is permitted to conduct open pit and underground mining, and to mill the copper/gold/silver ore at a rate of 4,200 tonnes of per day. In 2016 (the most recent year of record), the Minto Mine produced 69.3 million pounds of copper from milling approximately 1.49 million tones or ore.

In addition to open pit mines, underground mines, and the mill, the Minto Mine site includes a number of waste rock dumps, a concentrate storage shed, a tailings storage facility (TSF), a water retention dam with a water storage pond (WSP), a water treatment plant, administrative offices, an airstrip, and a camp (Figure 1.2). Mill tailings are stored in a dry stack TSF and in mined-out open pits. Mine-impacted seepage from the TSF and under the Mill Valley Fill (MVF) is collected at the toe of the MVF in sump W62 and is pumped to the main pit (Figure 1.2). Non-impacted water and treated mine-impacted water are collected in the WSP (Figure 1.2). Effluent from the WSP is periodically discharged to Minto Creek under conditions specified in Water Use Licence (WUL) QZ14-031 (August 2015). Minto Creek, in turn, discharges to the Yukon River approximately 7.7 km south-east of the WSP (Figure 1.2).

1.2 Regulatory Context

Federal effluent regulations for the metal mining industry (Metal Mining Effluent Regulations; MMER) were most recently amended in September 2017 (Government of Canada 2017a). These regulations, administered under the federal *Fisheries Act*, apply to mining and milling operations that have discharged effluent at a rate greater than 50 m³/day and therefore apply to the Minto Mine. The MMER outline requirements for routine effluent monitoring, acute lethality testing, and Environmental Effects Monitoring (EEM). The objective of EEM is to determine whether mine effluent discharge is causing an effect on fish, benthic invertebrate communities, and/or the use of fisheries resources. The Minto Mine triggered the MMER on July 10th 2006.

1.3 Background

In accordance with the MMER, the Minto Mine has completed three phases of EEM (Minnow and Access 2009, 2012; Minnow 2015) and is presently in Phase 4. The Phase 3 EEM

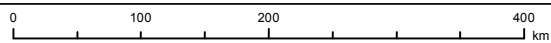




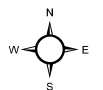
Map of Canada



Location of the Minto Mine



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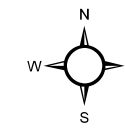
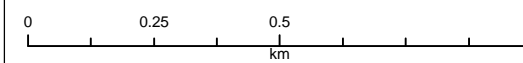


Figure 1.1



LEGEND

- Final Effluent Discharge Point
- Water Retention Dam
- Mine Footprint
- Minto Creek Detention Structure
- Building



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Minto Mine Site Layout and Receiving Environment

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Figure 1.2

biological study was an Investigation of Cause (IOC) study (or “biological monitoring study to investigate confirmed effects”; Environment Canada 2012). The requirement for IOC was triggered by a finding of consistent differences in the structure of the benthic invertebrate community of Minto Creek compared to reference (as indicated by the Bray-Curtis Index of Dissimilarity) through the first two phases of EEM. The IOC indicated that the differences were likely due to comparison to too few reference areas (limited characterization of the range of reference conditions) and that the benthic invertebrate community of Minto Creek was within reference condition defined by a larger group of physically comparable reference sites. Accordingly, the Phase 4 EEM returned to periodic monitoring (or “biological monitoring studies to assess effects”; Environment Canada 2012). A study design for the Minto Mine Phase 4 EEM was prepared and submitted to Environment and Climate Change Canada (ECCC) in February 2016 (Minnow 2016). Some adjustments to the study design were made following discussion with ECCC in July 2016. Biological monitoring was implemented between June and September 2016 and the study results are presented and interpreted in this report. Briefly, the Phase 4 EEM included a benthic invertebrate community study of Minto Creek using the Reference Condition Approach (RCA), *in situ* fishing at lower Minto Creek and reference, an on-site laboratory based fish exposure study of Minto Mine effluent and reference water mixtures, and supporting physical, chemical and biological measures (described in detail in Section 2.0).

1.4 Effluent Discharge and Quality

Minto Mine final effluent is discharged to Minto Creek via a control structure located at monitoring Station W3 (Figure 1.2). This location captures effluent discharged from the WSP as well as surface and groundwater inputs to the section of Minto Creek between the toe of the WSP and Station W3 (Figure 1.2). A total of 576,734 m³ of effluent was discharged to Minto Creek at Station W3 over the period from 2015 to end of August 2017 (the Phase 4 EEM period for which data were available; 328,526 m³ in 59 discharge days in 2015, 166,897 m³ in 167 discharge days in 2016, and 81,311 m³ in 72 discharge days in 2017; Appendix Table A.1). Highest rates of discharge in 2015 and 2016 were in April during freshet whereas the highest rate in 2017 was mid-June (Figure 1.3). Maximum daily rates of discharge in 2015, 2016, and 2017 were 12,614 m³/d in 2015, 2,253 m³/d in 2016, and 4,411 m³/d in 2017 (Figure 1.3). The Minto Mine targets an effluent concentration in lower Minto Creek of no more than 25% effluent (1 part effluent to 3 parts creek water). Concurrent monitoring of effluent discharge rates and water flow rates in lower Minto Creek in 2016 and 2017 (not completed in 2015) documented an average of 17.7% effluent on days when the mine was discharging (Appendix Figure A.1).

Minto Mine effluent quality met all limits specified under the MMER over the period from 2015 to end of August 2017 (Appendix Table A.2). No acute toxicity to rainbow trout or to *Daphnia magna*



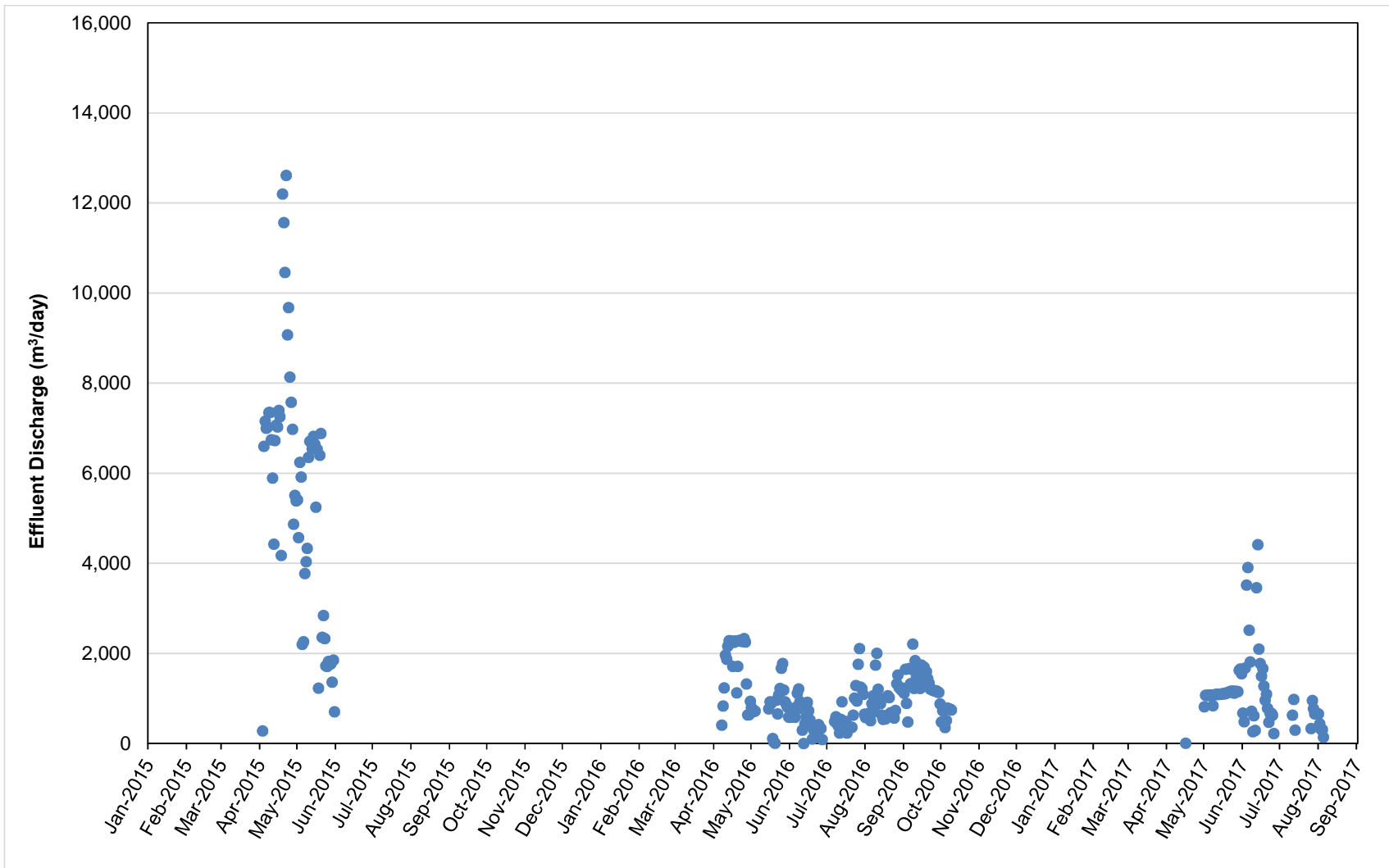


Figure 1.3: Daily Minto Mine Effluent Discharge Volume, 2015 to August 2017

were observed over this period (Appendix Table A.3). Lastly, routine effluent quality monitoring (Appendix Table A.2) and effluent characterization (conducted four times per year; Appendix Table A.4) indicate that effluent has been of consistent quality through the Phase 4 EEM period.



2 METHODS

2.1 Overview

The Phase 4 EEM study for the Minto Mine consisted of the following components: 1) effluent sublethal toxicity testing; 2) receiving water quality monitoring; 3) a benthic invertebrate community survey; 4) *in situ* fish collection and measurement; and 5) a fish exposure study implemented at an on-site laboratory. A fish tissue (mercury) assessment was not required because mercury concentrations in final effluent have not exceeded 0.0001 mg/L (Appendix Table A.4; Environment Canada 2012).

The benthic invertebrate community survey, supported by physical measures and water quality, was conducted from September 22nd to 25th, 2016. The benthic survey included an evaluation of upper Minto Creek (5 replicate sites) using a Reference Condition Approach (RCA) that included 10 reference sites (Table 2.1; Figure 2.1). At the request of Environment and Climate Change Canada (ECCC), additional evaluation of the upper Minto Creek was completed using a Control-Impact (CI) approach¹. The fish survey was comprised of two parts. An *in situ* non-lethal survey in lower Minto Creek with lower Big Creek serving as reference was attempted, with monthly sampling from June to September 2016 (Minto 2017; Table 2.1; Figure 2.1). However, because the abundance of fish in Minto Creek is typically too low to support a statistically meaningful *in situ* fish survey (i.e., per Environment Canada 2012), an on-site laboratory exposure study was completed at the Minto Mine site from August 7th to September 22nd 2016 (Table 2.1; Figure 2.1).

2.2 Effluent Sublethal Toxicity

Under the MMER, the Minto Mine implements sublethal toxicity testing of final effluent on an annual frequency. Sublethal toxicity samples were collected into 20 litre plastic containers. Following collection, samples were placed on ice inside coolers and shipped to Nautilus Environmental via ALS Environmental Laboratory (Burnaby BC) where they arrived within 48 hours. Sample appearance, odour, temperature, and hardness were recorded upon arrival at the laboratory. Tests were conducted using rainbow trout (*Oncorhynchus mykiss*) embryos, the invertebrate *Ceriodaphnia dubia*, the green algae *Pseudokirchneriella subcapitata* and the plant *Lemna minor* using Environment Canada test methods (1998, 2007a,b,c). Sublethal toxicity data were subsequently reported to ECCC as part of Minto Mine annual reports and are synthesized in this report.

¹ It is noted that this requested comparison assumes that within-area variability (upper Minto Creek) and among-area variability (reference sites) are comparable, which may not be true.



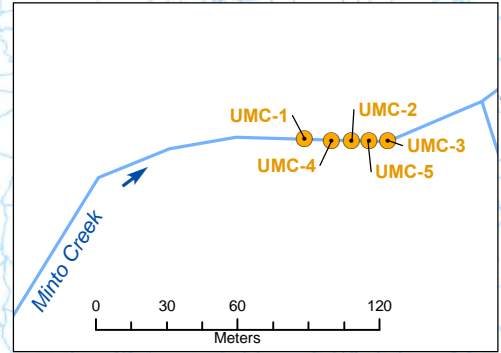
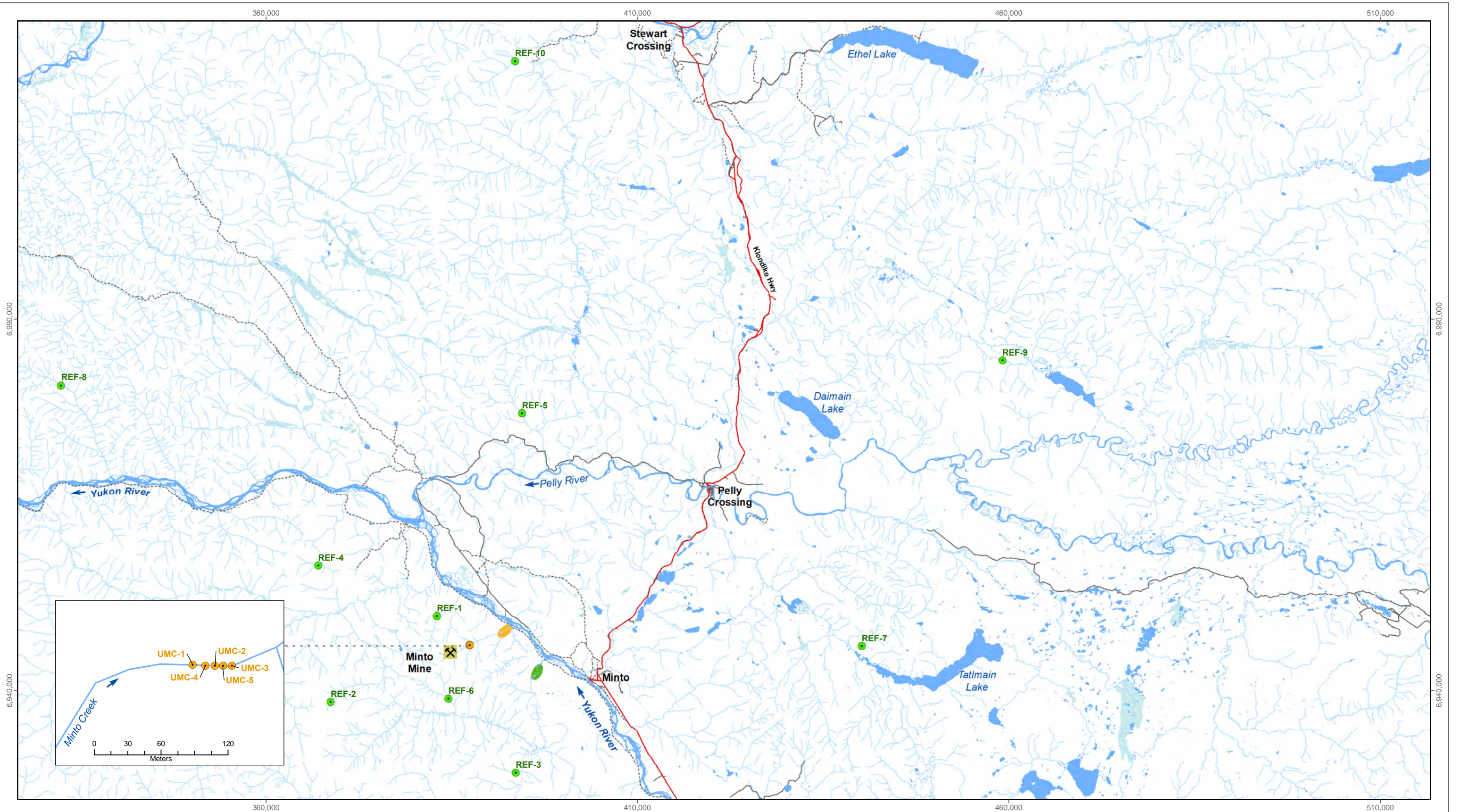
Table 2.1: Overview of the Minto Mine Phase 4 EEM Study Design for Biological Monitoring

| Area | Benthic Invertebrate Survey | | Fish Survey | |
|---------------------------------------|---|--|---|--|
| | Overview | Supporting Data | Overview | Supporting Data |
| Effluent-Exposed Areas | | | | |
| Minto Creek - Upper | Reference Condition Approach (RCA) conducted in September 2016 ¹ . Erosional habitat, five replicate stations. One sample per station with each a 3-grab composite using a Surber sampler equipped with 500 µm mesh. | Substrate characterization, water velocity, sample depth, field-based water quality ² , habitat notes, and GPS coordinates at each station. One water sample at three of five replicate stations collected during the benthic invertebrate survey. Parameter suite included all MMER compliance monitoring analytes and additional nutrients ³ . | | |
| Minto Creek - Lower | | | Non-lethal survey commencing in June 2016 and repeated monthly through September. Target the collection and measurement (length and fresh body weight) of 100 juvenile Chinook salmon. Any external abnormalities noted on all fish captured. | Fishing effort, station description, wet and bankfull width, mean depth, field-based water quality ² , habitat description and GPS coordinates. One water sample collected during each fishing effort. Parameter suite included all MMER compliance monitoring analytes and additional nutrients ³ . |
| Exposure Vessels in Laboratory | | | Exposure of 160 juvenile kokanee salmon to each of two effluent concentrations (1 part effluent and 3 parts reference water, and 1 part effluent and 6 parts reference water) for 47 days from early August to late September. Survival, length, weight, and physical condition were monitored. Results compared to the control fish. | Water flow, dissolved oxygen and temperature monitored daily. One water quality sample collected each week from each exposure vessel during testing. Parameter suite included all MMER compliance monitoring analytes and additional nutrients ³ . |
| Reference Areas | | | | |
| 10 RCA Reference Creeks | Reference Condition Approach (RCA) conducted in September 2016 ¹ . Erosional habitat. One sample per site with each a 3-grab composite using a Surber sampler equipped with 500 µm mesh. | Substrate characterization, water velocity, sample depth, field-based water quality ² , habitat notes, and GPS coordinates at each station. One water sample at each site collected during the benthic invertebrate survey. Parameter suite included all MMER compliance monitoring analytes and additional nutrients ³ . | | |
| Lower Big Creek | | | Non-lethal survey commencing in June 2016 and repeated monthly through September. Target the collection and measurement (length and fresh body weight) of 100 juvenile Chinook salmon. Any external abnormalities noted on all fish captured. | Fishing effort, station description, wet and bankfull width, mean depth, field-based water quality ² , habitat description and GPS coordinates. One water sample collected during each fishing effort. Parameter suite included all MMER compliance monitoring analytes and additional nutrients ³ . |
| Control Vessels in Laboratory | | | Exposure of 160 juvenile kokanee salmon to reference water for 47 days from early August to late September. Survival, length, weight, and physical condition were monitored. | Water flow, dissolved oxygen and temperature monitored daily. One water quality sample collected each week during testing. Parameter suite included all MMER compliance monitoring analytes and additional nutrients ³ . |

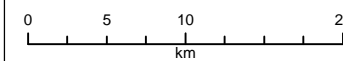
¹ Additional Control-Impact comparisons were made at the request of Environment and Climate Change Canada (ECCC).

² Field-based water quality parameter suite includes water temperature, dissolved oxygen, pH and conductivity.

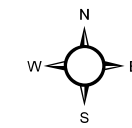
³ Analytical water quality parameter suite includes hardness, alkalinity, pH, total suspended solids, total dissolved solids, ammonia, nitrate, total Kjeldahl nitrogen, total phosphorus, total organic carbon, and ICP total metal scan (including aluminum, arsenic, cadmium, copper, iron, lead, molybdenum, selenium, nickel, and zinc).



- LEGEND**
- Minto Mine Site
 - Exposure Site
 - Reference Site
 - Water Flow Direction
 - Exposure Fishing Area
 - Reference Fishing Area
 - Road
 - Limited-use road
 - Trail



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Minto Mine C4 EEM Benthic Invertebrate Community (RCA Design) and Fish Sampling Locations

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Figure 2.1

2.3 Water Quality

Under the MMER, the Minto Mine monitors receiving water quality at a frequency of four times per year. Monitoring is conducted at lower Minto Creek (Station W2) and a north-flowing tributary to Minto Creek (Station W7), representing mine-exposed and reference conditions, respectively (Figure 2.2). In addition to routine water quality monitoring, water samples were collected to support the EEM biological surveys, including one sample at each benthic invertebrate sampling site (September 22nd to 25th 2016) and samples collected from each of the fish exposure vessels at weekly intervals (seven samples between August 8th and September 19th 2016). Results from both the routine monitoring and the EEM water quality monitoring were incorporated into the overall assessment of receiving water quality.

2.3.1 Sample Collection

During the EEM field survey, *in situ* measures of water temperature, dissolved oxygen (DO) concentration and saturation, pH, and specific conductance were collected at each benthic invertebrate community sampling site. *In situ* measurements were taken using a YSI 650MDS hand held field meter equipped with a YSI 600XLM sonde (Yellow Springs, OH) that was checked against standards daily and calibrated as required. One water sample was collected at each benthic site during the benthic invertebrate community survey. Samples were collected into pre-labelled sample bottles. All samples were maintained in coolers with ice packs during transportation or at 4°C in an on-site refrigerator until submitted to ALS Environmental (ALS; Whitehorse, Yukon).

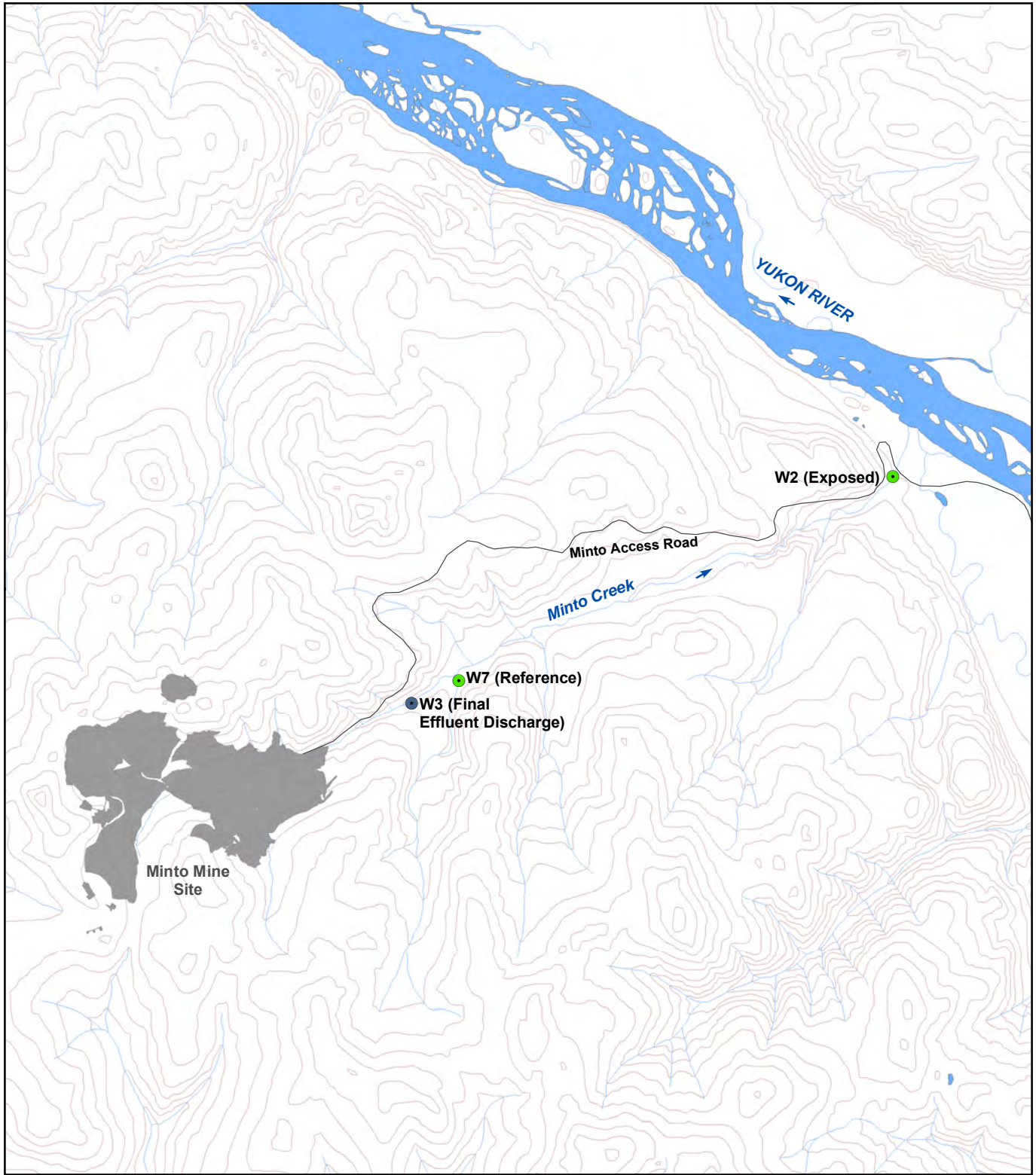
2.3.2 Laboratory Analyses

At ALS, water samples were analyzed for the analytes required under EEM (hardness, alkalinity, aluminum, arsenic, cadmium, copper, iron, lead, mercury, molybdenum, nickel, selenium, zinc, total suspended solids, ammonia, and nitrate; Environment Canada 2012) and for a number of additional analytes (dissolved organic carbon, total Kjeldahl nitrogen, and total phosphorus). Briefly, alkalinity was determined by potentiometric titration, anions by ion chromatography, metals by collision reaction cell ICP-MS (inductively coupled plasma - mass spectrometry) or ICP-OES (inductively coupled plasma - optical emission spectrophotometry), mercury by CVAFS (cold vapour atomic fluorescence spectrophotometry), dissolved organic carbon by combustion, ammonia and total Kjeldahl nitrogen by fluorescence, and phosphorus by colour. Hardness was calculated from calcium and magnesium concentrations.

2.3.3 Data Analysis

Water quality data were subject to a Data Quality Review, including the evaluation of laboratory blank results, laboratory spikes and laboratory duplicates (Appendix B). Water quality data were

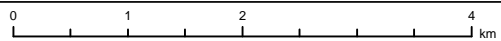




LEGEND

- Final Effluent Discharge Point
- Water Quality Stations

Minto Mine Effluent and Routine Water Quality Monitoring Stations



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Figure 2.2

evaluated relative to Canadian Water Quality Guidelines for the protection of aquatic life (CWQG; CCME 1999). Water quality of Minto Creek was also evaluated relative to reference areas. As part of the benthic invertebrate community data interpretation, Principal Components Analysis (PCA) was used to reduce the supporting water quality dataset for correlation analysis against benthic metrics. Analytes for which more than 90% of the available data were below laboratory method detection limits (MDL) were excluded from the data matrix. Principal component axes were then generated from the remaining data matrix.

For analytes that were present at greater concentrations in Minto Creek than reference, and/or analytes present at concentrations greater than CWQG, data analysis was enhanced by examining additional water quality data collected by the Minto Mine under their Water Use Licence (WUL). Specifically, data from the Phase 4 EEM period (2015-2017) were plotted with periods of discharge highlighted in order to further identify and interpret the influence of the Minto Mine on the water quality of Minto Creek.

2.4 Benthic Invertebrate Community

The benthic invertebrate community survey included an evaluation of upper Minto Creek using a Reference Condition Approach (RCA) that included 10 reference sites. The reference sites were selected based on their similarity to upper Minto Creek as determined through a combination of GIS analysis (Minnow 2014, 2015), key habitat variables measured during previous EEM (Minnow 2015), and benthic invertebrate community characteristics measured during previous EEM (Minnow 2015). Of the 10 reference sites identified in this manner (Minnow 2015), only one could not be accessed (NRC-7; the helicopter could not land nearby) and a backup site was sampled instead. Although not part of the original study design (Minnow 2015), ECCC requested a control-impact comparison of upper Minto Creek to the reference sites, which was also completed.

2.4.1 Sample Collection

Benthic invertebrate samples were collected from each of the study sites using a one-foot square (0.093 m²) Surber sampler equipped with a 500-µm mesh collection net. The Surber sampler was used after attempts to use the 0.1 m² Hess sampler (as proposed in the study design; Minnow 2015) failed due to low water depths in the exposed area. One sample was collected at each site (five sites in upper Minto Creek and 10 reference sites) with each sample representing a composite of three-grabs to ensure that the sample was representative of the station (0.279 m² in total). Each sub-sample was collected by carefully placing the base of the Surber sampler onto the substrate and pushing the sampler into the substrate after which gravel and cobble contained within the base of the sampler were carefully washed using a scrub brush while allowing the



current to carry dislodged organisms into the mesh collection net. After the area within the sampler was completely washed, any organisms adhering to the mesh were rinsed into the collection net using creek water. At that point, the sampler was moved to the next sub-sampling location and the procedure repeated. After collection of the third sub-sample, all organisms were carefully rinsed to the end of the mesh collection net and carefully transferred into a one-litre, wide-mouth plastic jar labelled with the project number, sample location and collection date. Internal labels were also used to ensure correct identification if the external labelling were to become illegible due to wear. Benthic samples were preserved with buffered formalin to a nominal concentration of 10%. Preservation occurred within six hours of collection to eliminate the potential effects of within-sample predation that could affect abundance estimates. All samples were maintained in coolers or totes at the Minto Mine until submitted to Cordillera Consulting (Summerland, British Columbia).

2.4.2 Laboratory Processing

At Cordillera, samples were analyzed following standard sorting methods and incorporating recommended Environment Canada (2012) QA/QC procedures for assessing organism recovery and sub-sampling error. Upon arrival at the laboratory, a biological stain was added to each benthic invertebrate community sample to facilitate greater sorting accuracy. The samples were washed free of formalin in a 500 µm sieve and the remaining sample material was then examined under a stereomicroscope at a magnification of at least ten times by a technician. All benthic invertebrates were removed from the sample debris and placed into vials containing a 70% ethanol solution according to major taxonomic groups (e.g., phyla, orders). A senior taxonomist later enumerated and identified the benthic organisms to the lowest practical level (typically to genus or species) using up-to-date taxonomic keys. Following identification and enumeration of benthic organisms, representative specimens of each new taxon were preserved in 75% ethanol (with 3% glycerol) in separately-labelled vials and added to the Minto Mine benthic invertebrate voucher collection. As required by Environment Canada, 10% of samples were re-sorted to verify that fewer than 10% of total organisms were missed, and 10% of the sub-samples were evaluated against a second sub-sample to verify that sub-sampling error was lower than 20% (Glozier et al. 2002; Environment Canada 2012).

2.4.3 Data Analysis – Reference Condition Approach

Benthic invertebrate community data were subject to a Data Quality Review (DQR), which included an evaluation of sorting efficiency and sub-sampling error (Appendix B). The RCA was initiated by evaluating the appropriateness of the reference sites for defining the reference condition. Indirect correlation of environmental variables with site scores derived from a reference Correspondence Analysis (CA) was used to identify the strongest (Pearson correlation with



$p < 0.10$) environmental predictors of reference benthic invertebrate community structure. Principal components analysis (PCA) of all reference sites and the exposed sites was then conducted using the significant environmental variable predictors of reference community structure to ensure that the range of 'natural' environmental conditions found at the mine-exposed sites was encompassed by the reference sites.

Benthic invertebrate communities were evaluated at the family level of taxonomy (as recommended by Environment Canada 2012) using EEM primary metrics of mean invertebrate density (organisms per m^2), mean taxon richness, Simpson's Evenness Index (calculated as in Smith and Wilson 1996; Environment Canada 2012) and the Bray-Curtis Index of Dissimilarity (calculated as in Bray and Curtis 1957). These endpoints were calculated following the exclusion of Collembola, Ostracods, Copepods, Nemata, and Turbellaria from the analysis as these taxa are either non-benthic or are generally smaller than 500 μm in size. The relative proportions of the most abundant taxa were also computed (calculated as the abundance of each respective dominant/indicator taxon relative to the total number of organisms in the sample). Dominant/indicator taxon groups were defined as those groups representing more than 5% of total organism abundance or any groups considered to be important indicators of environmental stress. All required and supplementary endpoints were summarized by reporting mean, median, minimum, maximum, standard deviation, standard error, and sample size for each sampling site.

Correspondence analysis (CA) was also used to assess benthic invertebrate community structure of mine-exposed and reference stations. CA is a multivariate technique, which is used to create synthetic species prevalence axes extracted in a sequential manner. Each score (number) on a CA axis is the sum of a weighted vector of species proportion. Species with correlated proportions vary together and will have similar weights and scores on a CA axis. When depicted in two-dimensional plots, taxa that tend to co-occur plot together, while those that rarely co-occur plot farther apart. Similarly, stations sharing many taxa plot closest to one another, while those with little in common plot farthest apart. The greatest variation among either taxa or stations is explained by the first axis, with other axes accounting for progressively less variation. This type of multivariate analysis describes not only which stations have distinct benthic communities but also how these benthic communities differ among stations (i.e., which particular taxa differ). Prior to CA, the data were screened for rare taxa, as these can distort results. Taxa occurring at 5% or fewer of the stations were removed. After screening and data reduction, a proportional data matrix was used to conduct a CA using Minitab 17 (Minitab 2015). Scores for both taxa and stations were calculated and plotted to evaluate the associations of organisms and stations.

The RCA experimental design evaluates individual mine-exposed sites against a reference condition, which is comprised of multiple reference sites (10 in this study). Therefore, a traditional



ANOVA evaluation cannot be used in an RCA design. When testing for statistical differences between a single exposed site (test site) and multiple reference sites, two non-central tests can be used; a one-sample, non-central, equivalence test; and a one-sample, non-central, interval test (Kilgour et al. 1998). Determination that a test site is different from the reference condition (i.e., outside the range of reference values) is assessed using a critical effect size of 1.96 reference standard deviations and tested using two null hypotheses: H_{01} – the absolute value of the reference mean minus the test site value is ≥ 1.96 reference standard deviations (equivalence test), and H_{02} – the absolute value of the reference mean minus the test site value is ≤ 1.96 reference standard deviations (interval test). This testing results in three possible outcomes: a non-central p-value (ncP) < 0.1 (interval test) that indicates a community endpoint is outside of the reference condition; a ncP > 0.9 (equivalence test) that indicates a community endpoint is within the reference condition; and a ncP-value between 0.1 and 0.9 that is inconclusive with respect to potential difference from the reference condition (Kilgour et al. 1998). The interval and equivalence tests can also be conducted and presented graphically using tolerance limits (Kilgour et al. 2017). The tolerance limits can be interpreted as confidence limits on the percentiles of the reference site distribution. Using an effect size of 1.96 standard deviations and an alpha of 0.1, the interval and equivalence tests are the same as comparing a value from an exposed site to the 90% one-sided confidence limits on the 2.5th and 97.5th percentiles of the reference site data set. Any exposed sites found to be statistically outside the range of reference condition (exposed value below the 90% lower limit of the 2.5th percentile or above the 90% upper limit of the 97.5th percentile) were further evaluated through inspection of the raw data and taxonomic proportions. Data were transformed and assumptions of normality were assessed prior to calculating the tolerance limits. Calculations were conducted using the RealStats add-in (Zaiontz 2017) in Microsoft Excel®. Ecological requirements and pollution sensitivity or tolerance of the dominant taxa were assessed using standard references (Edmunds et al. 1976; Clarke 1981; Chapman et al. 1982; Weiderholm 1983; Kiffney and Clements 1994; Wiggins 1996; Resh et al. 1996; Rosenberg and Resh 1996; Taylor and Bailey 1997; Barbour et al. 1999; Bode et al. 2002; Mandaville 2002; Merritt et al. 2008) in order to consider the statistical results of the benthic invertebrate community survey in the context of ecological requirements and pollution sensitivity or tolerance.

2.4.4 Data Analysis – Control-Impact

Although not part of the original study design (Minnow 2015), a control-impact comparison was also completed at the request of ECCC. Specifically, the exposed area of upper Minto Creek (replicated with 5 stations) was compared to reference (10 sites). As previously indicated, this comparison assumes that within-area variability (upper Minto Creek) and among-area variability (reference sites) are comparable, which may not be true. The CI comparisons were made on the



basis of mean values of the same metrics as used for the RCA design. Benthic metrics were plotted to explore spatial patterns in the benthic community data. T-tests were used to test for differences in mean benthic metrics between “areas” (effluent-exposed upper Minto Creek and the population of 10 reference sites). Data were transformed as necessary to satisfy assumptions of normality and homogeneity of variance. In instances where variances could not be homogenized by transformation, the t-test for unequal variances was used. When assumptions of normality could not be met, the non-parametric Mann-Whitney test was used. Statistical tests were conducted using the RealStats add-in (Zaiontz 2017) in Microsoft Excel© and plots were generated using Microsoft Excel©. Interpretation of benthic invertebrate community metrics was enhanced by inspection of raw data and taxonomic proportions to detect patterns of ecologically relevant differences between the exposed area and reference. Ecological requirements and pollution sensitivity or tolerance of the dominant taxa were assessed using standard references (Edmunds et al. 1976; Clarke 1981; Chapman et al. 1982; Weiderholm 1983; Kiffney and Clements 1994; Wiggins 1996; Resh et al. 1996; Rosenberg and Resh 1996; Taylor and Bailey 1997; Barbour et al. 1999; Bode et al. 2002; Mandaville 2002; Merritt et al. 2008).

In instances when a significant difference between effluent-exposed and reference area means was detected using ANOVA, the magnitude of the difference was calculated for that metric. The magnitude of the difference was calculated to reflect the number of reference standard deviations (SDs) as follows:

$$(\text{exposure mean} - \text{reference mean}) / \text{reference SD}$$

The reference SD was estimated as the pooled SD in the t-test or the reference areas SD when the mine-exposed and reference areas SDs were significantly different. The design had $n = 5$ mine effluent-exposed stations and $n = 10$ reference sites. This design has a power of 0.96 to detect a two SD change in the exposed mean relative to the mean of the reference areas.

2.4.5 Additional Supporting Measures

In addition to *in situ* water quality measurements and the water chemistry data collected as described above, supporting information collected at each benthic invertebrate community station included global positioning system (GPS) coordinates recorded in latitude and longitude using WGS 1984 map datum, water velocity, sampling depth, stream gradient, stream wetted width, stream bankfull width, percent cobble/gravel/sand, median intermediate pebble axis length, and median embeddedness. Additional data collected to characterize each benthic invertebrate sampling station included: water appearance, creek morphology, bank condition, instream cover, residual pool depth, instream features, overhead canopy, aquatic vegetation, riparian vegetation, surrounding land use, anthropogenic disturbance, and photographs.



GPS coordinates were recorded using a Garmin Oregon 300 handheld GPS. Water velocity was measured using a Marsh-McBirney Flo-Mate 2000 portable flow meter and depth was measured using a meter stick. Stream gradient was measured using a Suunto clinometer. Wetted and bankfull widths were measured at each sampling site using a tape measure. Percent cobble/gravel/sand was estimated visually. The intermediate axis length of 100 rocks that were washed in the Surber sampler at each station were measured and recorded. In addition, the percent embeddedness of ten rocks was evaluated and recorded. This type of substrate characterization is similar to the Canadian Aquatic Biomonitoring Network (CABIN) protocol (CABIN 2012) for characterizing benthic invertebrate habitat and provided additional information to assess and standardize habitat conditions among sampling sites. Summary statistics of intermediate axis lengths and embeddedness were calculated for each station/site per CABIN protocol.

2.4.6 Correlation Analysis

Potential relationships between benthic invertebrate community metrics and physical/chemical conditions of the study sites were explored using correlation analysis as part of causal assessment (Suter et al. 2015). In order to reduce the number of comparisons made, benthic invertebrate community metrics were compared to a reduced set of physical and chemical variables (e.g., meter measures, water velocity, water depth, median substrate size, key water chemistry analytes identified in the water quality data evaluation, water chemistry PCA axes, and habitat PCA axes). Any significant correlations found at a p-value of 0.05 were further investigated using scatter plots to determine if a continuous distribution of data was realized (possible causal relationships) or if these relationships were “leveraged” by outlying points (or groups of points). The effects of leverage were carefully considered because any difference in benthic community attributes of the effluent-exposed sites relative to reference might be correlated with mine-related differences in water quality regardless of cause. Significant correlations, coupled with careful examination of scatterplots, were used to identify the factors that most contribute to variability in benthic invertebrate community endpoints. The causative merit of these factors were then considered in light of known physical and chemical influences on benthic invertebrate communities (e.g., stimulation by nutrient enrichment, toxicity by exposure to high metal concentrations).

2.5 Supporting Field-Based Fish Study

The Minto Phase 4 EEM fish survey consisted of a field-laboratory exposure study (described in the next section) and a supporting field-based fishing effort. The field-based fishing was implemented by the Minto Mine, and focussed on lower Minto Creek with lower Big Creek serving as the reference area (Capstone 2017a).



2.5.1 Fish Collection

Fish communities of lower Minto Creek and lower Big Creek were sampled on June 8-9, July 6-7, August 5-6, and Sept 22-23, 2016 (Capstone 2017a). Fish were collected using minnow traps set in lower Minto Creek (17 to 20 traps per sampling event) between the mouth and just above of a natural fish barrier located approximately 1.2 km upstream (Figure 2.3). Similar habitat was sampled at Big Creek (Figure 2.3) using the same methodology as for lower Minto Creek (but four traps per sampling event). Fish were sampled using ¼" mesh cylindrical minnow traps baited with Yukon River Chinook salmon roe and set on the bottom for approximately 24 hours. Supporting information recorded for each minnow trap set included sampling effort (set duration based on deployment and retrieval date and time) and GPS coordinates in latitude and longitude. All captured fish were identified to species and enumerated to characterize the fish community. Juvenile chinook salmon were briefly retained in buckets prior to being processed on shore near the capture location.

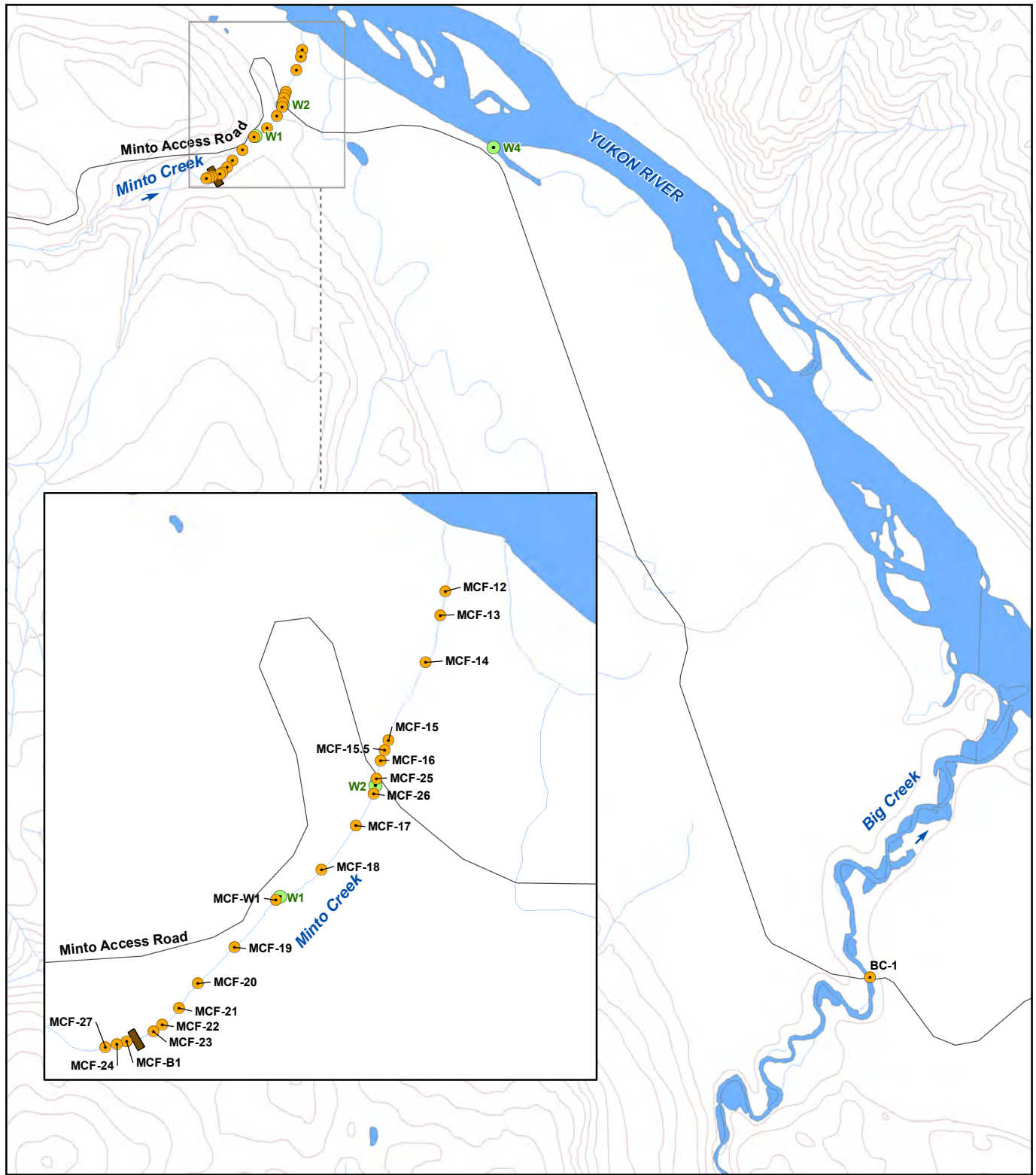
2.5.2 Fish Processing

All juvenile chinook salmon were measured for fork length using electronic calipers (± 1 mm precision) and for weight to the nearest 0.01 g (with $\pm 1\%$ precision) using a Scout-Pro Balance (Model HS-120; Ohaus Corp., Pine Brook, NJ). The presence of any external lesions, tumours, parasites or other abnormalities was also noted. Following processing, all fish were released near their capture location.






2.5.3 Data Analysis

All raw field data were transcribed from field sheets into an electronic spreadsheet and were checked for potential data entry errors as part of routine QA/QC procedures. Minnow trapping catch-per-unit-effort (CPUE) was calculated as the number of fish captured per minnow trap-day for each area and fish species. Consistent with EEM Technical Guidance (Environment Canada 2012), summary statistics including mean, median, minimum, maximum, standard deviation, standard error and sample size were calculated for length and weight of juvenile chinook salmon captured in lower Minto Creek and lower Big Creek. The field study provided confirmation of the appropriate life stage to use in the on-site laboratory exposure (i.e., 0+ age fry) and that the duration of the exposure study was sufficient to represent the short duration that chinook salmon fry spend in lower Minto Creek.

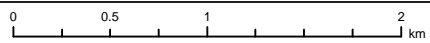




LEGEND

-  Direction of Flow
-  Fish Monitoring Station
-  Water Quality Monitoring Station
-  Fish Barrier
-  Minto Mine Site

Minto Creek and Big Creek Fish Monitoring Stations



Projection: North American Datum 1983 UTM Zone 8U
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Date December 2017
 Project 157202.0087



Figure 2.3

2.6 Laboratory Fish Exposure Study

2.6.1 Sentinel Fish Species

As described in the Phase 4 Study Design (Minnow 2016), naturally limited fish use of Minto Creek make a conventional EEM fish survey unfeasible (i.e., numbers are too low to support robust statistical contrasts). Therefore, an alternative approach - a controlled fish exposure study - was applied. Specifically, an on-site laboratory exposure was used to determine if combinations of Minto Mine effluent and reference water cause differences in survival, growth, and/or condition of fish reared over a 47-day period. This approach was similar to that applied in Phase 2 (Minnow and Access 2012), with some differences:

1. Kokanee salmon (*Oncorhynchus nerka*) were used as the sentinel species rather than Yukon River chinook salmon (*O. tshawytscha*) as the latter were unavailable.
2. The study was implemented at the Minto Mine rather than at a hatchery facility in Whitehorse.
3. Two concentrations of mine effluent were evaluated (i.e., two exposure groups) as opposed to just one (1 part effluent to 3 parts reference water [25% effluent] and 1 part effluent to 6 parts reference water [14% effluent]).
4. Yukon River water was used as reference water rather than Minto Creek water because Minto Creek flows were extremely low in 2016 (Capstone 2017b) and could not be relied upon as a water supply.

Because chinook salmon were not available from Yukon hatchery facilities in 2016, kokanee salmon (fry) were chosen as the surrogate sentinel species. Although kokanee salmon are not native to the Yukon River, they are native to the Yukon. Rationale for the selection of kokanee salmon for this exposure study included:

- Kokanee salmon are reared locally in the Yukon and were available in sufficient quantity for the study.
- The kokanee are from a group indigenous to the Yukon (Kathleen River system, Kluane National Park) and are fourth generation hatchery stock. Therefore, they are well adapted to artificial rearing systems and their behaviour and nutritional requirements are well known.
- The kokanee rearing program involves annual disease screening which indicates that the Whitehorse Rapids hatchery population is free of certain pathogens that are known to occur in other kokanee stocks.



- The Yukon reared kokanee have relatively high growth rates in cold water as they have adapted to cold water conditions in both their natural and hatchery environments. Therefore, it can be expected that their metabolic rate will be higher in colder creek water than might be the case for another surrogate species such as rainbow trout (and thus are more similar to chinook salmon).
- The kokanee present a very consistent growth rate among individuals.
- Kokanee are not aggressive towards each other in artificial rearing vessels and thus do not inflict harm on each other which could otherwise influence growth rates and overall fish health.

2.6.2 Exposure Facility and Conditions Overview

The rearing infrastructure for the exposure study was assembled inside the water treatment building at the Minto Mine site (Figure 2.4). The use of a shelter allowed for better control of critical variables such as temperature and light, and sheltered the system from wind and precipitation. The rearing infrastructure (Figure 2.4) consisted of three circular fibreglass rearing tanks 1.47 m in diameter and 0.30 m deep fitted with a centre stand-pipe system which provided a water depth of 0.225 m and approximately 0.38 m³ of wetted rearing volume. All three rearing tanks were configured identically and included an air stone connected to a supply of pure oxygen (compressed oxygen in 100 pound cylinders), a water re-circulator/aerator and a water supply inlet with a flow control valve. A plastic (polyethylene) cover was kept on top of each tank to avoid airborne contamination and to minimise visual disturbance to the fish (see photos in Appendix F).

Rearing tanks received water from three individual water supply tanks with a circular diameter of 2.2 m, height of 1.85 m providing a total volume of 5.0 m³ per tank. The water supply tanks were situated just outside of the water treatment facility and placed on top of a sand berm at a height that allowed water to gravity feed, via 2.5 cm (1") diameter polyvinyl chloride (PVC) and polyethylene pipe to the rearing tanks inside the building. The water supply tanks were wrapped in insulated tarps to reduce solar heating of the water stored in them (see photos in Appendix F).

As it was imperative that all fish groups were exposed to exactly the same water temperatures throughout the study, a passive heat exchange system was constructed to equalize water temperatures among the tanks and maintain cool temperatures independent from ambient air temperature. The exchanger consisted of an 8.0 metre long x 20 cm (8") diameter PVC pipe fitted internally with 3 runs of 2.5 cm (1") diameter PVC pipe and enclosed on both ends except for a water inlet and outlet at either end (see Figure 2.4). The three 2.5 cm pipes inside the larger pipe extended beyond both ends of the larger pipe allowing it to be connected to supply water, and allowing water to pass through the exchanger and then be delivered to the rearing tanks. Cooling



ENVIRONMENTAL EFFECTS
MONITORING PROGRAM
PHASE 4

FIGURE 2.4

FISH EXPOSURE
STUDY REARING
SYSTEM SCHEMATICS

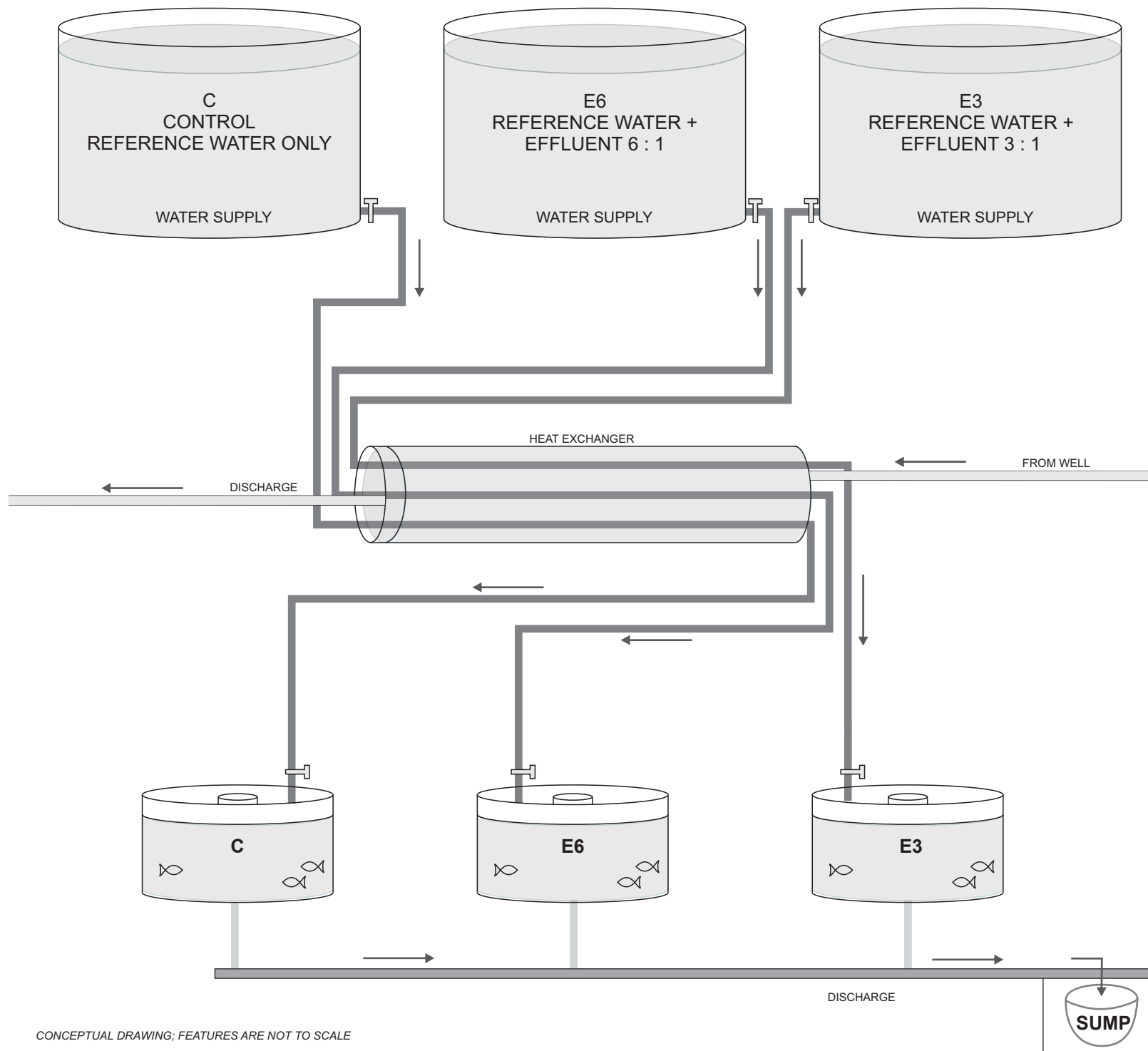


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water for the exchanger was supplied by a groundwater well (approximately 3°C) which flowed through the larger pipe continuously in a counter-current direction to the fish rearing water. This allowed for cooling and equilibration of the fish rearing water while being isolated from mixing with the water being delivered to the fish tanks.

Water temperature was monitored continuously every hour in each rearing tank using Tidbit temperature loggers. Temperatures were also taken manually twice/day using a mercury thermometer and/or a handheld water quality meter (YSI).

2.6.3 Fish Processing

On August 4th (pre-exposure) at the Whitehorse Rapids Fish Hatchery (located in Whitehorse, Yukon) 480 kokanee salmon fry were sedated in a dilute solution of MS222, measured (total length and fork length) using electronic calipers (to the nearest 0.01 mm), weighed to the nearest 0.01 g with a Mettler Toledo Balance (Model JS4002G), assessed for abnormalities, and divided into three groups (C [control], E6 [1 part effluent to 6 parts reference water] and E3 [1 part effluent to 3 parts reference water]) of 160 fish each. Fish were held until August 7th and then transported to the Minto Mine site. Fish were transported in 20 litre collapsible potable water jugs filled to one-third of capacity. After placing fish in each jug, the containers were collapsed by compressing the containers, forcing the air out of the top two-thirds of the container. This space was then filled with pure oxygen to ensure that fish were not oxygen deprived during their transport to site. Sealed jugs with fish, water, and pure oxygen were then placed in an insulated fish tote (approximately 1 m³ in volume) with approximately 10 centimeters of ice-water to keep containers and fish cool for transport to site. Fish were transported to the Minto Mine site on August 7th and then transferred to their respective rearing tanks for the study (Day 1 of exposure). Transit time from loading fish into the transport jugs to transfer to their rearing tanks was approximately five hours. One mortality occurred during the holding period subsequent to processing on August 4th. This mortality was part of the control group. Thus rearing at the mine site was initiated with 159 fish in the Control group (C) and 160 fish in each of the two exposure groups (E6 and E3).

At the approximate mid-point to of the exposure (September 1st 2016; Day 26), sub-samples of 50 fry were randomly collected from each tank, sedated in a dilute solution of MS222, measured (total length and fork length) and weighed as outlined above (with the exception that an A&D Balance [Model E5-610] was used at the Minto Mine site), and examined for abnormalities. All measurements and additional observations were recorded on data sheets and later transcribed to a spreadsheet which was cross-checked for accuracy. Following initial and mid-point processing, fish were placed in a recovery container (20 litre pail with 10 litres of water and aeration) and placed back in their respective tank once fully recovered. The average weight of the fish in each group was then used to adjust feed rations which are determined by water



temperature and biomass of fish in each tank. On the last day of the exposure (September 22nd 2016; Day 47), fish were removed from each tank and were exposed to a lethal dose of MS222 followed by measurement, weighing, and abnormality examination as described above. All carcasses were disposed of by incineration afterwards.

2.6.4 Water Quality and Flow Monitoring

Water was supplied to each tank at a flow rate ranging between 0.6 to 1.7 litres per minute, with higher flows required as the exposure study advanced in order to maintain dissolved oxygen (DO) concentrations and to manage ammonia concentrations². Water flow was measured twice daily using a graduated cylinder and stop-watch and adjusted when required. Dissolved oxygen levels were kept at 6.0 mg/L or higher (as recommended for salmonid hatcheries; Sigma 1983) by increasing flow rates, by aeration, and/or by direct input of oxygen. Aeration of the rearing tanks occurred from day one and continued throughout the study. When it was determined that water temperatures (and accompanying fish consumption of oxygen) were going to be higher than anticipated and that increasing flow rates and aeration would not keep DO levels in each tank above 6.0 mg/L, pure oxygen (bottled) was delivered to each rearing tank using air lines and stones.

Ammonia concentrations typically do not present an issue with flow-through fish rearing systems. However, because DO levels were not exclusively maintained by flow (i.e., were partially maintained by aeration and injection of pure oxygen to reduce demand on water supply), ammonia levels were monitored closely (daily) using a HACH spectrophotometer. When ammonia levels approached those that could potentially compromise fish health (Sigma 1983), water flows were increased. The toxicity of ammonia increases with increasing temperature and pH, which were both monitored closely along with ammonia. Flow rates were increased if ammonia levels started to approach those that could compromise the health of the fish (Sigma 1983). DO (mg/L and percent saturation), temperature, specific conductivity, and pH were monitored twice daily over the course of the exposures using a YSI Professional Plus field meter. Temperature was also measured and digitally recorded every hour with submersible TidbiT temperature loggers (Onset) UTBI-001.

Water from the Yukon River was delivered to the water supply tanks about once per week during the first part of the study. Delivery frequency increased to about once every two to three days towards the end of the study as flow rates to the rearing tanks were increased to manage DO and

² Ammonia, an excretion product, can become toxic to fish at high concentrations and was therefore carefully monitored, with water flow adjusted as required to maintain ammonia concentrations below those that could be harmful to salmonids (per Sigma 1983).



ammonia as outlined above. Concurrent with each water delivery from the Yukon River, effluent was also collected from the water storage pond. Rearing tank water was sampled weekly, for chemical analysis at a ALS Environmental (Burnaby BC). A total of seven samples were collected over the course of study starting on August 8th with the final sampling occurring on September 19th. Water quality samples were collected and handled as described in Section 2.3 and were analysed for required EEM analytes and additional supporting analytes as also described in Section 2.3.

2.6.5 Data Analysis

Raw laboratory data were transcribed from bench sheets into electronic spreadsheets and were checked by a separate individual for potential entry errors as part of routine QA/QC procedures. Scatterplots of body weight vs. fork length were used to identify potential measurement or recording errors. Summary statistics (mean, median, minimum, maximum, standard deviation, standard error, and sample size) were calculated for fork length, total length, and fresh body weight by exposure group.

Data were subject to detailed analyses required to satisfy the requirements of a non-lethal EEM fish population survey, with steps undertaken as follows. Body weight and fork length were plotted using boxplots by species and study area. The boxplots were defined using the minimum value, the first quartile (Q1), the median, the third quartile (Q3), and the maximum value. Extreme values in the boxplots were plotted as individual values and the whiskers of the box were truncated to the next value in the data set. Extreme values were defined as values more than 1.5 times the height of the box beyond Q1 or Q3 (i.e., less than $Q1 - 1.5(Q3 - Q1)$ or greater than $Q3 + 1.5(Q3 - Q1)$). Length-frequency distributions were plotted by exposure group using histograms. Scatterplots and linear regressions of body weight on fork length (both axes log₁₀-scaled) were also generated by exposure group. These plots were used to support the statistical analyses.

Detailed statistical analyses were performed using Minitab 17 software on fish endpoints representing three response categories: survival (length-frequency distribution), energy use (fork length and body weight), and energy storage (condition). The statistical analyses were consistent with procedures outlined in the Technical Guidance Document (Environment Canada 2012). Statistical analyses were conducted by comparing the effluent-exposed groups to reference separately (i.e., by pairwise comparison).

Length-frequency distributions were compared among exposures using two-sample Kolmogorov-Smirnov (K-S) tests. The K-S test is a non-parametric test of potential differences between two distributions (Zar 1984). The test is conducted as a comparison of the cumulative relative distribution functions of the two samples. The maximum difference in the cumulative relative



distributions at any given fish length is computed and tested to determine whether it is large enough to suggest that the two samples were generated from different statistical populations. The maximum difference in the cumulative relative distributions was reported as a measure of the magnitude of difference between the length frequency distributions between exposures. For example, if the maximum difference in the cumulative relative distribution functions between exposures was 0.25 at a fish length of 15 cm, then one exposure had 25% fewer fish smaller than 15 cm compared to the other exposure. A negative sign was applied to the magnitude of difference when the effluent-exposed fish were smaller than reference (e.g., when there were more fish < 15 cm) and a positive sign was applied to the magnitude of difference when the effluent-exposed fish were larger than reference (i.e., fewer fish < 15 cm).

Body weight and fork length were compared among exposures using two-sample t-tests or the non-parametric equivalent (Mann-Whitney test). The residuals from the tests were tested for normality (Shapiro-Wilks test, $\alpha = 0.05$) and equality of variances (Levene's test, $\alpha = 0.05$). When the assumptions of normality were not met, a log₁₀-transformation was conducted and the assumptions assessed again. When normality could not be achieved, the Mann-Whitney test was used. When the assumption of equal variances could not be achieved, the two-sample t-test for unequal variances was used.

Fish condition was compared among exposures using analysis of covariance (ANCOVA) with log₁₀(body weight) as the response variable and log₁₀(fork length) as the covariate. The ANCOVA was conducted by fitting a regression model with exposure, covariate, and the interaction between exposure and covariate as predictor variables (the interaction ANCOVA model). If the covariate term is significant, then the covariate is a significant predictor of the response variable and the ANCOVA analysis is needed. If the covariate term is not significant, then the analysis can proceed as an ANOVA (or t-test) on the response variable among exposures. Testing the significance of the interaction term (exposure×covariate) is equivalent to testing whether the regression slopes between exposures are equal. If the interaction term is not significant, then it can be dropped from the model and the ANCOVA can proceed using the parallel slope ANCOVA model (using only exposure and the covariate as predictor variables). In this case, a test for a difference in body weight among exposures (adjusted for fork length) is conducted by testing the significance of the exposure term in the parallel slope ANCOVA model. This test is equivalent to testing whether the intercepts between the two parallel slope regression lines are equal. The tests for significance of the covariate and interaction terms were conducted using $\alpha = 0.05$ and the tests for differences between exposures were conducted using $\alpha = 0.1$, consistent with the recommendations of Environment Canada (2012).



When regression slopes were not parallel (i.e., there was a significant interaction in the ANCOVA model), the scatterplots were examined to assess whether the regression lines appeared to be parallel. When there is low variability (i.e., high R^2 value), very small differences in regression slopes can be detected as being significant although the slopes are practically the same. To assess whether the difference in slopes is small enough to consider them to be parallel, the R^2 value of the interaction ANCOVA model was compared to the R^2 value of the parallel slope ANCOVA model. When the difference in R^2 between models was less than 2%, the ANCOVA proceeded assuming that the slopes are practically parallel (Environment Canada 2012).

Observations with studentized residuals of magnitude greater than four were removed from parametric tests (t-test and ANCOVA; Environment Canada 2012). The magnitude of difference for body weight, fork length, and condition among the exposures were calculated using the appropriate measure of central tendency depending on the statistical test used. The measure of central tendency was selected as the mean for t-test, geometric mean (i.e., mean on log₁₀-scale) when a log₁₀-transformation was used for a t-test, the median for the Mann-Whitney test, and the adjusted mean for an ANCOVA. The adjusted means for an ANCOVA are the predicted values on the parallel slope regression lines for each exposure at the average value of the covariate (i.e., the adjusted body weights at the average fish fork length). The ANCOVAs were conducted using log₁₀-transformed data so the adjusted means were back-transformed to the original data scale (i.e., antilogged). The magnitude of difference was calculated as a difference between the exposures (e.g., effluent-exposed and reference), expressed as a percentage of the reference area as:

$$\text{Magnitude of Difference} = \frac{Exp_{MCT} - Ref_{MCT}}{Ref_{MCT}} \times 100\%,$$

where MCT = measure of central tendency.

The magnitude of difference was compared to Critical Effect Sizes (CES) of 10% for condition and 25% for the other endpoints and was used to help identify statistically significant differences that may (or may not) be biologically meaningful.

When there was no significant difference detected between exposures, the minimum detectable difference (MDD) was estimated as a percent difference from the reference mean for ANOVA, or adjusted reference mean for ANCOVA. The MDD was estimated using the observed measure of variability (standard deviation of residuals), the average sample size between exposures, and assuming that differences in body weight and fork length would be tested using a t-test on log₁₀-transformed data (even if tested using another test). The probability of type I error (α) was set equal to the probability of Type II error (β) for the estimate of the MDD. The MDD was computed on the log₁₀-scale and transformed to a percent difference relative to reference in the



original data units. The MDD estimates were generated using the sample size and power calculator in Minitab 17.



3 EFFLUENT SUBLETHAL TOXICITY

Effluent sublethal toxicity tests conducted by the mine in 2015 and 2016 (data for 2017 have not yet been reported by the testing laboratory) showed no effects to the survival of rainbow trout embryos, the survival or reproduction of *Ceriodaphnia dubia* (a cladoceran invertebrate often referred to as a water flea), nor to the growth of *Pseudokirchneriella subcapitata* (a green algae) or *Lemna minor* (a plant; Table 3.1). This suggests a low probability of toxicity in the receiving environment, which is consistent with previous EEM Phases (Table 3.1).



Table 3.1: Minto Mine Effluent Sublethal Toxicity Test Results Collected at W3 (as % Effluent), 2007-2016

| EEM Cycle | Date | Rainbow trout embryo | <i>Ceriodaphnia dubia</i> | | <i>Pseudokirchneriella subcapitata</i> | <i>Lemna minor</i> | |
|-----------------------|---------------------|----------------------|---------------------------|-------------------|--|------------------------------|----------------------------------|
| | | EC25 Survival | LC50 Survival | IC25 Reproduction | IC25 Growth ^a | IC25 Dry Weight ^a | IC25 Frond Increase ^a |
| Cycle 1 | 5 & 7-Jun-07 | > 100% ^b | > 100% | > 100% | > 90.0% | > 97% | > 97% |
| | 29-Oct-07 | > 100% | > 100% | > 100% | > 90.0% | > 97% | > 97% |
| | 3-June-08 | 88% | > 100% | > 100% | > 90.9% | > 97% | > 97% |
| | 28-Oct-08 | > 100% | > 100% | 0.33% | > 90.9% | > 97% | > 97% |
| Geometric Mean | | 97% | > 100% | 24% | > 90.9% | > 97% | > 97% |
| Cycle 2 | 26-May-09 | > 100% | > 100% | > 100% | > 90.9% | > 97% | > 97% |
| | 15-Sep-09 | - | > 100% | > 100% | - | - | - |
| | 16-Nov-09 | > 100% | > 100% | > 100% | > 90.9% | > 97% | > 97% |
| | 11-May-10 | > 100% | > 100% | > 100% | > 90.9% | > 97% | > 97% |
| | 22-Nov-11 | > 100% | > 100% | > 100% | > 90.9% | > 97% | > 97% |
| Geometric Mean | | > 100% | > 100% | > 100% | > 90.9% | > 97% | > 97% |
| Cycle 3 | 16-Oct-12 | > 100% | > 100% | > 100% | > 90.9% | > 97% | > 97% |
| | 5-Nov-13 | > 100% | > 100% | 38.6% | > 90.9% | > 97% | > 97% |
| | 27-Oct-14 | > 100% | > 100% | >100% | > 90.9% | > 97% | > 97% |
| Geometric Mean | | > 100% | > 100% | 73% | > 90.9% | > 97% | > 97% |
| Cycle 4 | Oct-15 ^c | > 100% | > 100% | > 100% | > 90.9% | > 97% | > 97% |
| | 23-Oct-16 | > 100% | > 100% | > 100% | > 95.2% | > 97% | > 97% |
| | 9-Oct-17 | dp | dp | dp | dp | dp | dp |
| Geometric Mean | | > 100% | > 100% | > 100% | > 93.0% | > 97% | > 97% |

^a Highest concentration tested.

^b 2007 June Test invalid due to non-viable eggs - the quality control criteria for viability in controls were not met.

^c Rainbow trout test on sample collected October 5th; remaining tests on samples collected on October 13th.

dp = data pending

4 WATER QUALITY AND SUPPORTING MEASURES

Water quality has been routinely monitored by the Minto Mine at lower Minto Creek (Station W2) and a reference tributary (Station W7; Figure 2.2). Water quality was also characterized during the benthic invertebrate community survey in September 2016, when *in situ* measurements of water quality, water samples for laboratory chemical analysis, and supporting physical and biological measures were collected at all benthic invertebrate community sampling sites (Figure 2.1). Lastly, water quality samples were collected weekly from each of the on-site laboratory fish exposure tanks to characterize exposure conditions.

4.1 Routine Water Quality Monitoring

Water quality at effluent-exposed lower Minto Creek (Station W2) differed from reference (Station W7; Figure 2.2) primarily on the basis of conductivity, hardness, nitrate, total aluminum, total arsenic, total iron, and total selenium, which were the only analytes with mean concentrations in 2015, 2016, or 2017 greater than the upper 95% confidence limit of the reference mean (Table 4.1; Appendix Table C.1). Plots of these analytes indicate that nitrate was the only analyte with a clear pattern of higher concentrations at Station W2 during periods of discharge (including when discharge was under non-freshet conditions; Appendix Figure C.1). Of the analytes elevated in lower Minto Creek relative to reference, total aluminum and total iron occurred at mean concentrations greater than Canadian Water Quality Guidelines (CWQG) at the effluent-exposed area and the reference area (Table 4.1). Concentrations of copper were also greater than CWQG at the effluent-exposed and reference areas, but were not elevated at the effluent-exposed area to greater than the upper 95% confidence limit of the reference mean and did not exceed the site-specific water quality objective (SSWQO) of 0.013 mg/L applicable when dissolved organic carbon (DOC) is lower than 10 mg/L (Table 4.1). Concentrations of total aluminum, total iron, and total copper were positively related to concentrations of total suspended solids (TSS; Appendix Figure C.2), and dissolved concentrations of these metals (which better represent the bioavailable fraction and for which the SSWQO apply) were typically elevated only during freshet (Appendix Figure C.3).

4.2 Water Quality and Supporting Measures Collected during the Benthic Survey


4.2.1 *In situ* Water Quality Measures

During the Phase 4 EEM benthic survey, the mean temperature of upper Minto Creek (8.6 °C) was notably higher than at the reference creeks (mean 0.99 °C; Figure 4.1; Appendix Table C.2), presumably due to effluent discharge at the time of sampling. *In situ* dissolved oxygen concentrations measured at Minto Creek during the benthic invertebrate community survey were



Table 4.1: Summary of Routine Water Quality Monitoring under MMER, Minto Mine, 2015-2017^a

| Analyte | Units | Guideline ^b | SSWQO ^c | Station W7 (Reference) | | | | Station W2 (Exposure) | | |
|-----------------------------------|----------|------------------------|---------------------------|------------------------|-------------|---------------|------------------------|-----------------------|----------------|---------------|
| | | | | 2015 mean | 2016 mean | 2017 mean | Reference ^d | 2015 mean | 2016 mean | 2017 mean |
| Physical | | | | | | | | | | |
| Water Temperature | °C | - | - | 1.1 | 1.9 | 1.8 | -0.10 to 4.5 | 3.9 | 3.5 | 3.8 |
| Field Conductivity | µS/cm | - | - | 147 | 147 | 132 | 178 | 188 | 174 | 187 |
| Laboratory Conductivity | µS/cm | - | - | 269 | 253 | 230 | 302 | 319 | 331 | 309 |
| Dissolved Oxygen | mg/L | > 6.5 | - | 12.0 | 12.7 | 13.3 | 10.6 to 15.4 | 12.8 | 12.6 | 12.9 |
| pH | pH units | 6.5 - 9.0 | 6.0 - 9.0 | 7.64 | 7.71 | 7.70 | 7.50 to 8.13 | 7.87 | 7.92 | 7.73 |
| Ions, Nutrients and Solids | | | | | | | | | | |
| Total Hardness | mg/L | - | - | 142 | - | - | - | 160 | - | - |
| Dissolved Hardness | mg/L | - | - | 126 | 130 | 113 | 156 | 151 | 173 | 153 |
| Alkalinity | mg/L | - | - | 130 | 131 | 118 | 164 | 142 | 151 | 148 |
| Ammonia | mg/L | 0.41 ^e | 0.25 | 0.034 | 0.016 | 0.012 | 0.043 | 0.028 | 0.0054 | 0.0077 |
| Nitrate (as N) | mg/L | 3.0 | 9.1 | 0.11 | 0.10 | 0.096 | 0.20 | 0.19 | 0.63 | 0.15 |
| Total Suspended Solids | mg/L | narrative ^f | - | 60 | 9.0 | 13 | 161 | 39 | 4.5 | 18 |
| Total Metals | | | | | | | | | | |
| Aluminum | mg/L | 0.10 ^g | 0.10 | 0.24 | 0.22 | 0.42 | 0.74 | 0.74 | 0.061 | 0.28 |
| Arsenic | mg/L | 0.0050 | 0.0050 | 0.00054 | 0.00052 | 0.00064 | 0.00075 | 0.00093 | 0.00050 | 0.00070 |
| Cadmium | mg/L | 0.00016 ^h | 0.00021 | <0.000010 | 0.0000062 | 0.000011 | 0.000014 | <0.000021 | <0.0000060 | 0.000011 |
| Copper | mg/L | 0.0024 ^h | 0.013 / 0.02 ⁱ | 0.0026 | 0.0022 | 0.0035 | 0.0062 | 0.0057 | 0.0033 | 0.0045 |
| Iron | mg/L | 0.30 | 1.1 | 0.50 | 0.41 | 0.77 | 1.36 | 1.42 | 0.20 | 0.49 |
| Lead | mg/L | 0.0032 ^h | 0.0040 | <0.00022 | 0.00013 | 0.00021 | 0.00039 | <0.00054 | <0.000054 | 0.00013 |
| Mercury | mg/L | 0.000026 | - | <0.000010 | <0.0000068 | <0.0000050 | 0.000012 | <0.000010 | <0.0000063 | <0.0000050 |
| Molybdenum | mg/L | 0.073 | 0.073 | 0.0015 | 0.0013 | 0.0013 | 0.0019 | 0.0015 | 0.0016 | 0.0015 |
| Nickel | mg/L | 0.096 ^h | 0.11 | 0.0015 | 0.0015 | 0.0022 | 0.0028 | 0.0025 | 0.0012 | 0.0018 |
| Selenium | mg/L | 0.0010 | 0.0020 | 0.00014 | 0.00014 | 0.00014 | 0.00018 | <0.00018 | 0.00024 | 0.00015 |
| Zinc | mg/L | 0.030 | 0.030 | <0.0050 | <0.0030 | 0.0037 | 0.0055 | <0.0071 | <0.0030 | 0.0040 |

 Out of reference range.

Bold font Concentration greater than the lowest guideline or SSWQO.

^a If greater than 50% of samples were less than method detection limit, the mean was presented with a less than symbol (i.e., <).

^b Water quality guidelines for the protection of aquatic life (CCME 1999 with updates). Guideline for dissolved oxygen is for "Other life stages" of coldwater biota.

^c Site-specific water quality objectives for Station W2 per the Minto Mine Water Use Licence. For metals, the SSWQO are applicable on a dissolved basis.

^d Reference values are the 95th percentile of the 2015-2017 mean (Appendix Table C.1). Temperature, dissolved oxygen and pH are ranges from the 5th to 95th percentile.

^e At temperature 5°C and pH 8.5; values which are inclusive of all temperature and pH data recorded in this time period (maximum temperature = 4.5°C, maximum pH = 8.13; see Appendix Table C.1).

^f Maximum increase of 25 mg/L from background for short-term exposures (e.g., 24-h period) and maximum increase of 5 mg/L from background for longer term exposures.

^g At pH 8.5 (slightly conservative conditions).

^h At hardness of 100 mg/L (slightly conservative conditions).

ⁱ 0.013 mg/L copper at a dissolved organic carbon (DOC) concentration ≤10 mg/L and 0.02 mg/L copper at a DOC concentration >10 mg/L.

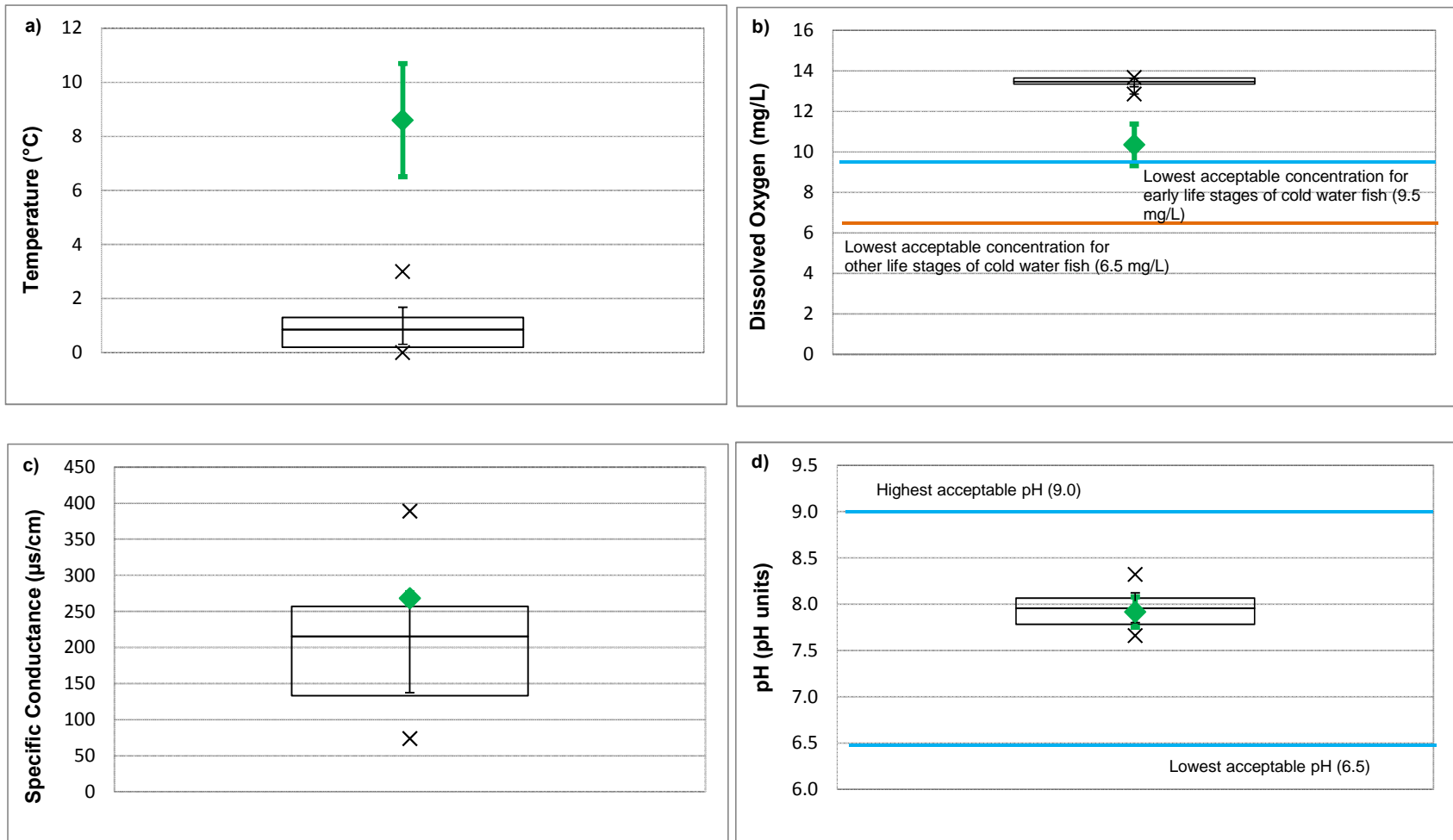


Figure 4.1: Supporting *In situ* Water Quality Measures, Minto Mine Phase 4 EEM, September 2016^a

a - box-and-whisker plot of reference site data (n=10; quartiles, 95% confidence limits of the mean, minimum, maximum) in black. Mean and 95% confidence limits of effluent exposed sites in green.

above the CWQG (i.e., within an acceptable range specified in the CWQG; mean 10.4 mg/L), but lower than at reference areas (Figure 4.1 and Appendix Table C.2). Specific conductance of upper Minto Creek (mean 268 $\mu\text{S}/\text{cm}$) was greater than at most reference sites (Figure 4.1), but lower than the highest specific conductance reported at a reference site (389 $\mu\text{S}/\text{cm}$; Figure 4.1 and Appendix Table C.2). Lastly, mean pH of Minto Creek was slightly alkaline (mean 7.96), but was similar to pH observed at the reference sites and was within the acceptable range specified in the CWQG (6.5 to 9.0; Figure 4.1).

4.2.2 Analytical Laboratory Measures

A Data Quality Review (DQR) indicated that the laboratory analytical data collected as part of the Phase 4 EEM benthic survey were of good quality and suitable for addressing the objectives of this study (Appendix B). During the survey, a total of five analytes in upper Minto Creek were present at concentrations outside the range of reference (nitrate, total Kjeldahl nitrogen [TKN], total phosphorus, copper, and molybdenum; Table 4.2). Of the analytes outside the range of reference, only copper was present at a concentration greater than CWQG. However, copper concentrations did not exceed the SSWQO of 0.013 mg/L applicable when DOC is lower than 10 mg/L (Table 4.2).

4.2.3 Other Supporting Measures

Water velocity and depth at the effluent-exposed upper Minto Creek sampling sites and at the reference sites had similar mean values and overlapping ranges (Figure 4.2; Appendix Table C.2). Median intermediate axis length of pebbles/cobbles cleaned for benthic invertebrate community sampling in upper Minto Creek (3.9 cm) was similar to reference (4.3 cm), as was the overall distribution of pebble/cobble size (Figure 4.2; Appendix Table C.3).

4.3 Water Quality Measures Collected During the Fish Exposures

4.3.1 *In situ* Water Quality Measures

During the on-site laboratory fish exposures, supporting measures were consistent among the exposure tanks, with only slightly greater dissolved oxygen, specific conductance, and ammonia in the exposure tanks than in the reference tank (Table 4.3). Dissolved oxygen (DO) levels were successfully maintained above 6.0 mg/L (as recommended for salmonid hatcheries; Sigma 1983) for most of the study, except for very slight excursions below this target for the effluent-exposed groups (5.94 mg/L for groups E6 [14% effluent; one part effluent to 6 parts reference water] and E3 [25% effluent; one part effluent to three parts reference water]; Table 4.3; Appendix Table C.4). Ammonia concentrations were successfully maintained below the threshold that would compromise fish health (Sigma 1983). Temperature data logging at hourly intervals throughout the exposures indicated that temperatures in the rearing tanks were



Table 4.2: Water Quality Data Collected during the Minto Mine EEM Phase 4, September 2016

| Analyte | Units | Guidelines ^a | SSWQO ^b | Reference | | | | | | | | | | | | | Effluent-Exposed | | |
|--|-------|------------------------------|--------------------|-------------|-------------|------------|---------------|------------|------------|------------|-------------|------------|------------|-------------------|-----------------------------|-------------------|------------------|---------------|---------------|
| | | | | REF-1 | REF-2 | REF-3 | REF-4 | REF-5 | REF-6 | REF-7 | REF-8 | REF-9 | REF-10 | Reference Minimum | Reference Mean ^c | Reference Maximum | UMC-1 | UMC-2 | UMC-3 |
| Ions, Nutrients and Solids | | | | | | | | | | | | | | | | | | | |
| Total Hardness (as CaCO ₃) | mg/L | - | - | 64 | 58 | 105 | 52 | 115 | 125 | 213 | 116 | 154 | 33 | 33 | 103 | 213 | 119 | 124 | 122 |
| Total Alkalinity (as CaCO ₃) | mg/L | - | - | 65 | 76 | 100 | 43 | 81 | 145 | 165 | 72 | 129 | 37 | 37 | 91 | 165 | 105 | 105 | 105 |
| Total Ammonia (as N) | mg/L | 0.28 ^d | 0.25 | 0.0051 | 0.0060 | <0.0050 | 0.019 | <0.0050 | 0.0054 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0065 | 0.019 | <0.0050 | 0.0051 | <0.0050 |
| Nitrate (as N) | mg/L | 3.0 | 9.1 | 0.040 | 0.021 | <0.0072 | 0.084 | 0.078 | 0.082 | 0.032 | 0.30 | 0.17 | 0.042 | 0.021 | 0.092 | 0.30 | 1.9 | 1.9 | 1.9 |
| Total Kjeldahl Nitrogen | mg/L | - | - | 0.37 | 0.41 | 0.42 | 0.48 | 0.19 | 0.43 | 0.41 | 0.22 | 0.16 | 0.13 | 0.13 | 0.32 | 0.48 | 0.81 | 2.2 | 0.28 |
| Total Phosphorus (P) | mg/L | - | - | 0.016 | 0.012 | 0.011 | 0.040 | 0.0073 | 0.024 | 0.011 | 0.010 | 0.0076 | 0.0073 | 0.0073 | 0.015 | 0.040 | 0.013 | 0.049 | 0.016 |
| Total Suspended Solids | mg/L | narrative ^e | - | <3.0 | 3.9 | 21 | 21 | <3.0 | <3.0 | <3.0 | 4.1 | <3.0 | <3.0 | <3.0 | <6.9 | 21 | 6.3 | 8.7 | 4.1 |
| Total Dissolved Solids | mg/L | - | - | 125 | 122 | 175 | 101 | 171 | 202 | 299 | 170 | 181 | 75 | 75 | 162 | 299 | 196 | 188 | 188 |
| Organic / Inorganic Carbon | | | | | | | | | | | | | | | | | | | |
| Dissolved Organic Carbon | mg/L | narrative ^f | - | 15 | 15 | 15 | 13 | 6.6 | 14 | 15 | 6.6 | 4.3 | 4.2 | 4.2 | 11 | 15 | 5.5 | 5.4 | 5.5 |
| Total Metals | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | 0.10 ^g | - | 0.050 | 0.063 | 0.092 | 0.52 | 0.022 | 0.029 | 0.047 | 0.12 | 0.021 | 0.066 | 0.021 | 0.10 | 0.52 | 0.093 | 0.32 | 0.085 |
| Antimony (Sb) | mg/L | 0.0090 | - | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Arsenic (As) | mg/L | 0.0050 | - | 0.00055 | <0.00050 | 0.00058 | 0.00070 | <0.00050 | 0.00066 | <0.00050 | <0.00050 | 0.00099 | <0.00050 | <0.00050 | 0.00060 | 0.00099 | <0.00050 | <0.00050 | <0.00050 |
| Barium (Ba) | mg/L | 1.0 | - | 0.033 | <0.020 | 0.070 | 0.057 | 0.051 | 0.039 | 0.056 | 0.079 | 0.058 | 0.033 | <0.020 | 0.050 | 0.079 | 0.048 | 0.053 | 0.048 |
| Beryllium (Be) | mg/L | 0.0013 | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Boron (B) | mg/L | 1.5 | - | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Cadmium (Cd) | mg/L | 0.00016 ^h | - | <0.0000050 | <0.0000050 | 0.0000057 | 0.000015 | 0.0000074 | <0.0000050 | 0.0000062 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000065 | 0.000015 | <0.0000050 | 0.0000071 | <0.0000050 |
| Calcium (Ca) | mg/L | - | - | 19 | 13 | 29 | 14 | 29 | 29 | 53 | 30 | 33 | 9.9 | 9.9 | 26 | 53 | 31 | 31 | 31 |
| Chromium (Cr) | mg/L | 0.0010 / 0.0090 ⁱ | - | <0.0010 | <0.0010 | <0.0010 | 0.0012 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0012 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt (Co) | mg/L | 0.0040 | - | <0.00030 | <0.00030 | <0.00030 | 0.00083 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00035 | 0.00083 | <0.00030 | <0.00030 | <0.00030 |
| Copper (Cu) | mg/L | 0.0024 ^h | - | 0.0015 | 0.0013 | 0.0018 | 0.0035 | <0.0010 | 0.0012 | 0.0014 | 0.0016 | <0.0010 | <0.0010 | <0.0010 | 0.0015 | 0.0035 | 0.0057 | 0.0068 | 0.0057 |
| Iron (Fe) | mg/L | 0.30 | - | 0.48 | 0.45 | 0.28 | 1.7 | 0.13 | 0.19 | 0.24 | 0.16 | 0.092 | 0.20 | 0.092 | 0.39 | 1.7 | 0.15 | 0.47 | 0.18 |
| Lead (Pb) | mg/L | 0.0032 ^h | - | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Lithium (Li) | mg/L | - | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0052 | <0.0010 | 0.0013 | <0.0010 | 0.0012 | <0.0010 | <0.0010 | <0.0015 | 0.0052 | <0.0010 | <0.0010 | <0.0010 |
| Magnesium (Mg) | mg/L | - | - | 5.7 | 7.5 | 7.1 | 5.2 | 11 | 13 | 20 | 8.1 | 17 | 2.5 | 2.5 | 9.6 | 20 | 11 | 11 | 11 |
| Manganese (Mn) | mg/L | 1.0 | - | 0.030 | 0.032 | 0.036 | 0.13 | 0.027 | 0.017 | 0.028 | 0.019 | 0.036 | 0.0033 | 0.0033 | 0.036 | 0.13 | 0.025 | 0.048 | 0.024 |
| Mercury (Hg) | mg/L | 0.000026 | - | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| Molybdenum (Mo) | mg/L | 0.073 | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0016 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0011 | 0.0016 | 0.0023 | 0.0023 | 0.0024 |
| Nickel (Ni) | mg/L | 0.096 ^h | - | 0.0012 | <0.0010 | 0.0014 | 0.0015 | <0.0010 | 0.0018 | 0.0032 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0014 | 0.0032 | <0.0010 | 0.0012 | <0.0010 |
| Potassium (K) | mg/L | - | - | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | 3.1 | <2.0 | <2.0 | <2.0 | <2.0 | <2.1 | 3.1 | <2.0 | <2.0 | <2.0 |
| Selenium (Se) | mg/L | 0.0010 | - | 0.00026 | 0.00012 | 0.000079 | 0.00011 | 0.00051 | 0.00041 | 0.00015 | 0.00015 | 0.00025 | 0.000063 | 0.000063 | 0.00021 | 0.00051 | 0.00051 | 0.00050 | 0.00050 |
| Silver (Ag) | mg/L | 0.00025 | - | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| Sodium (Na) | mg/L | - | - | 4.2 | 9.7 | 6.5 | 4.1 | 4.8 | 18 | 4.9 | 3.8 | <2.0 | 3.0 | <2.0 | 6.1 | 18 | 12 | 12 | 12 |
| Thallium (Tl) | mg/L | 0.00080 | - | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Tin (Sn) | mg/L | - | - | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Titanium (Ti) | mg/L | - | - | <0.010 | <0.010 | <0.010 | 0.032 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.012 | 0.032 | <0.010 | 0.021 | <0.010 |
| Uranium (U) | mg/L | 0.015 | - | 0.00033 | 0.00036 | 0.00039 | <0.00020 | 0.00085 | 0.00082 | 0.00059 | 0.00070 | 0.00090 | 0.00030 | <0.00020 | 0.00054 | 0.00090 | 0.00069 | 0.00070 | 0.00068 |
| Vanadium (V) | mg/L | - | - | 0.00073 | 0.0025 | 0.0011 | 0.0027 | <0.00050 | 0.0014 | 0.00064 | 0.00070 | <0.00050 | <0.00050 | <0.00050 | 0.0011 | 0.0027 | 0.00079 | 0.0013 | 0.00067 |
| Zinc (Zn) | mg/L | 0.030 | - | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |

Bold text Concentration greater than the lowest guideline or SSWQO.

Out reference range.

^b Site-specific water quality objectives for Station W2 per the Minto Mine Water Use Licence. For metals, the SSWQO are applicable on a dissolved basis.

^c If greater than 50% of samples were less than method detection limit than the mean was presented with a less than symbol.

^d At temperature 10°C and pH 8.5; values that are inclusive of *in situ* temperature and pH data associated with these water samples (maximum temperature = 9.1°C, maximum pH = 8.32; see Appendix Table C.2).

^e Maximum increase of 25 mg/L from background for short-term exposures (e.g., 24-h period) and maximum increase of 5 mg/L from background for longer term exposures.

^f 30-day median ± 20% of median background concentration.

^g At pH 8.5 (slightly conservative conditions).

^h At hardness of 100 mg/L (conservative conditions for Minto Creek).

ⁱ 0.001 for hexavalent chromium (CrVI); 0.009 for trivalent chromium (CrIII).

^j 0.013 mg/L copper at a dissolved organic carbon (DOC) concentration ≤10 mg/L and 0.02 mg/L copper at a DOC concentration >10 mg/L.

Table 4.2: Water Quality Data Collected during the Minto Mine EEM Phase 4, September 2016

| Analyte | Units | Guidelines ^a | SSWQO ^b | Reference | | | | | | | | | | | | | Effluent-Exposed | | |
|-------------------------|-------|-------------------------|---------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------------|-----------------------------|-------------------|------------------|------------|------------|
| | | | | REF-1 | REF-2 | REF-3 | REF-4 | REF-5 | REF-6 | REF-7 | REF-8 | REF-9 | REF-10 | Reference Minimum | Reference Mean ^c | Reference Maximum | UMC-1 | UMC-2 | UMC-3 |
| Dissolved Metals | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | - | 0.10 | 0.031 | 0.034 | 0.020 | 0.05 | 0.009 | 0.012 | 0.018 | 0.02 | 0.009 | 0.023 | 0.0090 | 0.023 | 0.052 | <0.0050 | <0.0050 | <0.0050 |
| Antimony (Sb) | mg/L | - | - | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Arsenic (As) | mg/L | - | 0.0050 | 0.00051 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00064 | <0.00050 | <0.00050 | 0.00098 | <0.00050 | <0.00050 | <0.00056 | 0.00098 | <0.00050 | <0.00050 | <0.00050 |
| Barium (Ba) | mg/L | - | - | 0.029 | <0.020 | 0.063 | 0.043 | 0.046 | 0.035 | 0.052 | 0.075 | 0.055 | 0.029 | <0.020 | 0.045 | 0.075 | 0.042 | 0.044 | 0.044 |
| Beryllium (Be) | mg/L | - | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Boron (B) | mg/L | - | - | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Cadmium (Cd) | mg/L | - | 0.00021 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000056 | <0.0000050 | 0.0000053 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000051 | 0.0000056 | <0.0000050 | <0.0000050 | <0.0000050 |
| Calcium (Ca) | mg/L | - | - | 17 | 12 | 32 | 13 | 30 | 31 | 56 | 34 | 37 | 9.5 | 9.5 | 27 | 56 | 32 | 33 | 32 |
| Chromium (Cr) | mg/L | - | 0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt (Co) | mg/L | - | - | <0.00030 | <0.00030 | <0.00030 | 0.00048 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | 0.00032 | 0.00048 | <0.00030 | <0.00030 | <0.00030 |
| Copper (Cu) | mg/L | - | 0.013 / 0.02 ^j | 0.0016 | 0.0011 | 0.0014 | 0.0021 | <0.0010 | 0.0011 | 0.0013 | 0.0014 | <0.0010 | <0.0010 | <0.0010 | 0.0013 | 0.0021 | 0.0046 | 0.0047 | 0.0046 |
| Iron (Fe) | mg/L | - | 1.1 | 0.33 | 0.33 | 0.14 | 0.6 | 0.08 | 0.15 | 0.15 | <0.030 | 0.056 | 0.04 | <0.030 | 0.19 | 0.57 | <0.030 | <0.030 | <0.030 |
| Lead (Pb) | mg/L | - | 0.0040 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Lithium (Li) | mg/L | - | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0051 | <0.0010 | 0.0015 | <0.0010 | 0.0014 | <0.0010 | <0.0010 | 0.0015 | 0.0051 | <0.0010 | <0.0010 | <0.0010 |
| Magnesium (Mg) | mg/L | - | - | 5.0 | 6.7 | 6.5 | 4.5 | 10 | 12 | 18 | 7.6 | 15 | 2.3 | 2.3 | 8.7 | 18 | 10 | 10 | 10 |
| Manganese (Mn) | mg/L | - | - | 0.026 | 0.029 | 0.025 | 0.11 | 0.024 | 0.014 | 0.023 | 0.013 | 0.032 | 0.0021 | 0.0021 | 0.030 | 0.11 | 0.012 | 0.013 | 0.013 |
| Mercury (Hg) | mg/L | - | - | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| Molybdenum (Mo) | mg/L | - | 0.073 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0016 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0011 | 0.0016 | 0.0022 | 0.0022 | 0.0022 |
| Nickel (Ni) | mg/L | - | 0.11 | 0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0013 | 0.0028 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0012 | 0.0028 | <0.0010 | <0.0010 | <0.0010 |
| Potassium (K) | mg/L | - | - | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | 2.9 | <2.0 | <2.0 | <2.0 | <2.0 | 2.1 | 2.9 | <2.0 | <2.0 | <2.0 |
| Selenium (Se) | mg/L | - | 0.0020 | 0.00026 | 0.00012 | 0.000077 | 0.00009 | 0.00046 | 0.00039 | 0.00014 | 0.00012 | 0.00026 | 0.00006 | 0.000060 | 0.00020 | 0.00046 | 0.00049 | 0.00052 | 0.00052 |
| Silver (Ag) | mg/L | - | - | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| Sodium (Na) | mg/L | - | - | 4.1 | 9.5 | 6.3 | 3.9 | 4.6 | 17 | 4.7 | 3.6 | <2.0 | 2.8 | <2.0 | 5.9 | 17 | 11 | 12 | 12 |
| Thallium (Tl) | mg/L | - | - | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Tin (Sn) | mg/L | - | - | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Titanium (Ti) | mg/L | - | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Uranium (U) | mg/L | - | - | 0.00031 | 0.00033 | 0.00036 | <0.00020 | 0.00079 | 0.00081 | 0.00057 | 0.00065 | 0.00088 | 0.00028 | <0.00020 | 0.00052 | 0.00088 | 0.00064 | 0.00063 | 0.00064 |
| Vanadium (V) | mg/L | - | - | 0.00051 | 0.0019 | 0.0007 | 0.0009 | <0.00050 | 0.0012 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00076 | 0.0019 | <0.00050 | <0.00050 | <0.00050 |
| Zinc (Zn) | mg/L | - | 0.030 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |

Bold text Concentration greater than the lowest guideline or SSWQO.

Out reference range.

^a Water quality guidelines for the protection of aquatic life. Black text are Canadian Environmental Quality Guidelines (CCME 2017); blue text are BC Water Quality Guidelines (BCMOE 2017a,b).

^b Site-specific water quality objectives for Station W2 per the Minto Mine Water Use Licence. For metals, the SSWQO are applicable on a dissolved basis.

^c If greater than 50% of samples were less than method detection limit than the mean was presented with a less than symbol.

^d At temperature 10°C and pH 8.5; values that are inclusive of *in situ* temperature and pH data associated with these water samples (maximum temperature = 9.1°C, maximum pH = 8.32; see Appendix Table C.2).

^e Maximum increase of 25 mg/L from background for short-term exposures (e.g., 24-h period) and maximum increase of 5 mg/L from background for longer term exposures.

^f 30-day median ± 20% of median background concentration.

^g At pH 8.5 (slightly conservative conditions).

^h At hardness of 100 mg/L (conservative conditions for Minto Creek).

ⁱ 0.001 for hexavalent chromium (CrVI); 0.009 for trivalent chromium (CrIII).

^j 0.013 mg/L copper at a dissolved organic carbon (DOC) concentration ≤10 mg/L and 0.02 mg/L copper at a DOC concentration >10 mg/L.

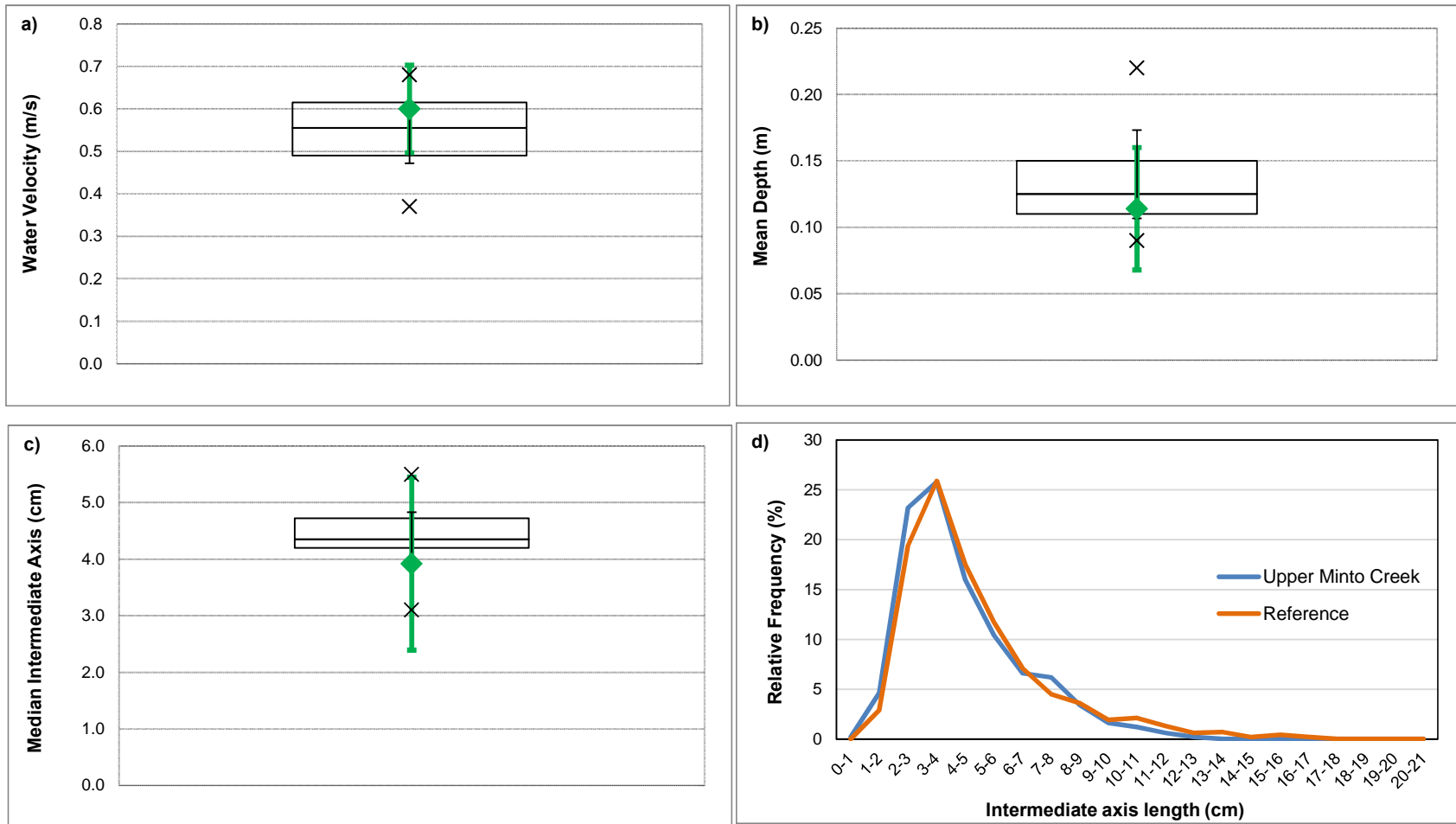


Figure 4.2: Additional Supporting Measures, Minto Mine Phase 4 EEM, September 2016 ^a

a - box-and-whisker plot of reference site data (n=10; quartiles, 95% confidence limits of the mean, minimum, maximum) in black. Mean and 95% confidence limits of effluent exposed sites in green.

Table 4.3: *In situ* Water Quality Measures for the Fish Exposure Study, August 8 to September 22, 2016 ^a.

| Analyte | Statistic | Reference | E6 ^b | E3 ^c |
|-------------------------------------|------------------|------------------|------------------------|------------------------|
| Temperature (°C) | Mean | 10.8 | 10.5 | 10.7 |
| | Minimum | 8.0 | 7.7 | 7.7 |
| | Maximum | 15.6 | 15.5 | 15.5 |
| Dissolved Oxygen (mg/L) | Mean | 8.48 | 9.37 | 9.19 |
| | Minimum | 6.09 | 5.94 | 5.94 |
| | Maximum | 12.20 | 15.56 | 15.56 |
| pH (pH units) | Mean | 7.37 | 7.33 | 7.36 |
| | Minimum | 6.45 | 6.71 | 6.71 |
| | Maximum | 8.29 | 8.01 | 8.01 |
| Specific Conductance (µS/cm) | Mean | 183 | 244 | 249 |
| | Minimum | 156 | 232 | 233 |
| | Maximum | 292 | 337 | 337 |
| Ammonia (mg/L) | Mean | 0.45 | 0.65 | 0.63 |
| | Minimum | 0.06 | 0.11 | 0.11 |
| | Maximum | 0.74 | 1.02 | 1.02 |

^a based on a minimum of 94 measurements, with the exception of ammonia, which was based on a minimum of 43 measurements.

^b E6 = 1 part effluent to 6 parts reference water.

^c E3 = 1 part effluent to 3 parts reference water.

maintained at an average of 10.6 °C for the three groups, fluctuating between a minimum temperature of 7.7 °C and maximum temperature of 14.4 °C (Figure 4.3).

4.3.2 Analytical Laboratory Measures

A Data Quality Review (DQR) indicated that the laboratory analytical data collected as part of the fish exposures were of good quality and suitable for addressing the objectives of this study (Appendix B). Water quality of the exposure tanks confirmed the expected greater concentrations of mine-related analytes with greater effluent concentrations (Table 4.4; Appendix Table C.5). Of the analytes identified as elevated relative to reference in routine water quality monitoring or during the EEM benthic survey (conductivity, hardness, nitrate, phosphorus, aluminum, arsenic, copper, iron, molybdenum, and selenium), all except for aluminum and arsenic increased in proportion to effluent concentration (Table 4.4). Mean water quality of the exposure tanks met CWQGs and SSWQOs for all analytes except for ammonia, copper, and chromium (Table 4.4). Ammonia, which was elevated due to fish excretion rather than mine-effluent, was present at concentrations slightly greater than the SSWQO, and was higher in the 25% effluent exposure (E3) than in the 14% effluent exposure (E6) and the reference exposure (Table 4.4; Appendix Table C.5). However, although average ammonia concentrations were greater than the conservative CWQG used to screen mean concentrations (based on the highest individual temperature and pH values observed through the exposures), no ammonia concentrations exceeded CWQG based on concurrent temperature and pH values (Appendix Table C.5).



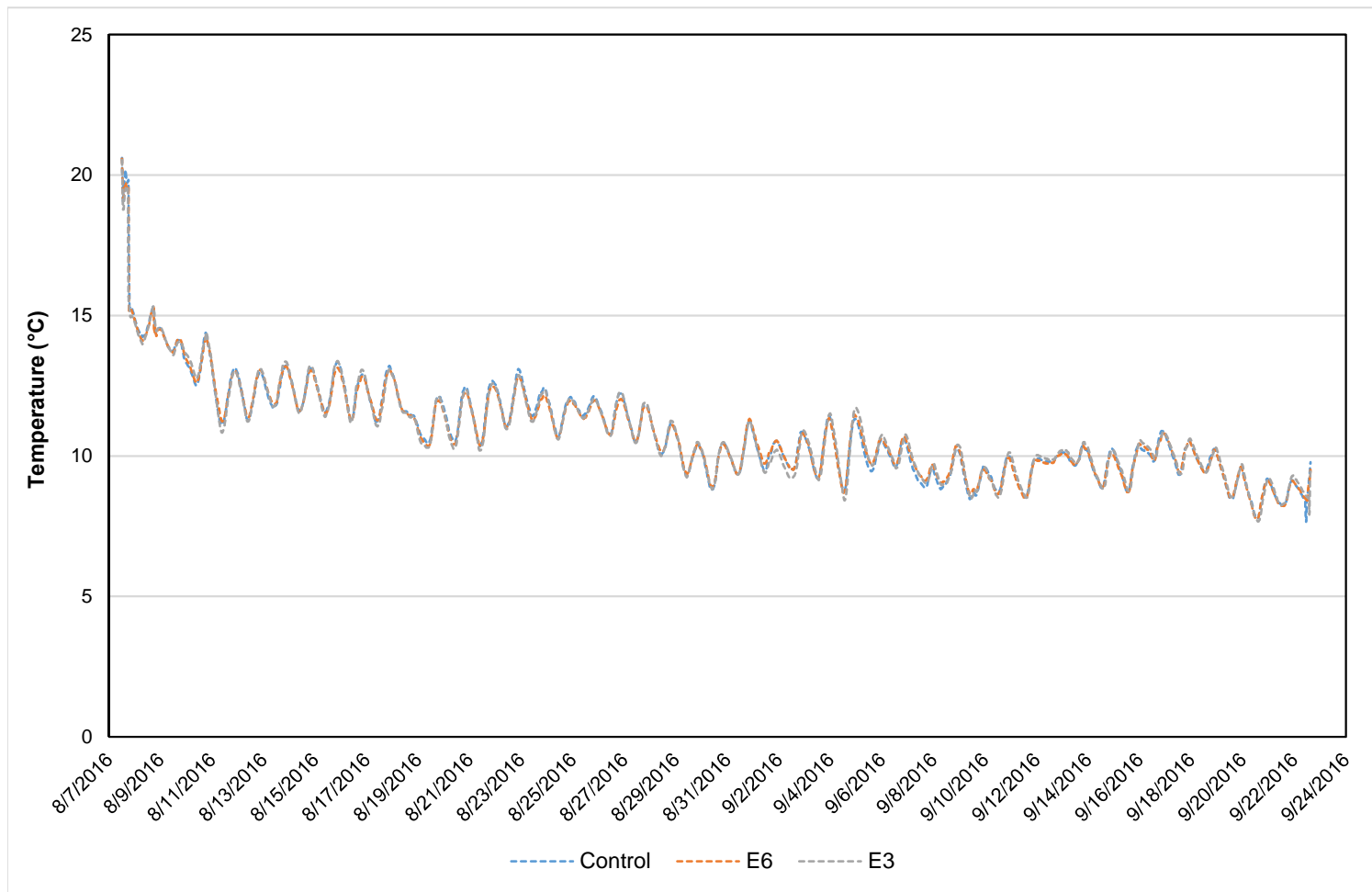


Figure 4.3: Water Temperature in the Fish Exposure Tanks, August 7 to September 22, 2016

Table 4.4: Mean Water Quality during the Minto Mine EEM Phase 4 Fish Exposure Study, August 7 to September 22, 2016

| Analyte | Units | Guideline ^a | SSWQO | Reference | E6 | E3 |
|-----------------------------------|----------|------------------------------|---------------------------|-----------|-----------|-----------|
| Physical | | | | | | |
| Water Temperature | °C | - | - | 11 | 11 | 11 |
| Specific Conductance | µS/cm | - | - | 177 | 228 | 256 |
| Cond-F | µS/cm | - | - | 159 | 191 | 205 |
| Cond-L | µS/cm | - | - | 178 | 224 | 250 |
| Dissolved Oxygen | mg/L | > 6.5 | - | 8.6 | 8.6 | 9.0 |
| Dissolved Oxygen | % | - | - | 78 | 77 | 81 |
| pH-F | pH units | 6.5 - 9.0 | 6.0 - 9.0 | 7.51 | 7.46 | 7.37 |
| pH-L | pH units | | | 7.82 | 7.88 | 7.86 |
| Ions, Nutrients and Solids | | | | | | |
| Dissolved Hardness | mg/L | - | - | 83 | 103 | 118 |
| Alkalinity | mg/L | - | - | 78 | 90 | 98 |
| Sulphate | mg/L | 309 ^b | - | 11 | 18 | 23 |
| Chloride | mg/L | 120 | - | <4.1 | 5.2 | 4.9 |
| Ammonia (as N) | mg/L | 0.20 ^c | 0.25 | 0.33 | 0.33 | 0.50 |
| Nitrite (as N) | mg/L | 0.060 | 0.060 | <0.001 | 0.0055 | 0.011 |
| Nitrate (as N) | mg/L | 3.0 | 9.1 | <0.065 | 0.85 | 1.4 |
| Total Suspended Solids | mg/L | narrative ^d | - | <3.2 | 3.9 | <4.6 |
| Total Dissolved Solids | mg/L | - | - | 97 | 126 | 145 |
| Total Metals | | | | | | |
| Aluminum (Al) | mg/L | 0.10 ^e | - | 0.066 | 0.067 | 0.068 |
| Antimony (Sb) | mg/L | 0.0090 | - | 0.000113 | 0.000101 | 0.000100 |
| Arsenic (As) | mg/L | 0.0050 | - | 0.00076 | 0.00072 | 0.00074 |
| Barium (Ba) | mg/L | - | - | 0.042 | 0.047 | 0.049 |
| Beryllium (Be) | mg/L | - | - | <0.00002 | <0.00002 | <0.00002 |
| Bismuth (Bi) | mg/L | - | - | <0.00005 | <0.00005 | <0.00005 |
| Boron (B) | mg/L | 1.5 | - | <0.01 | 0.0104 | 0.015 |
| Cadmium (Cd) | mg/L | 0.00016 ^b | - | 0.0000084 | 0.0000094 | 0.000011 |
| Calcium (Ca) | mg/L | - | - | 23 | 29 | 33 |
| Chromium (Cr) | mg/L | 0.0010 / 0.0090 ^f | - | 0.00028 | 0.00026 | 0.0015 |
| Cobalt (Co) | mg/L | 0.0040 | - | <0.00011 | <0.00011 | <0.00011 |
| Copper (Cu) | mg/L | 0.0024 ^b | - | 0.0021 | 0.0053 | 0.0077 |
| Iron (Fe) | mg/L | 0.30 | - | 0.13 | 0.14 | 0.15 |
| Lead (Pb) | mg/L | 0.0032 ^b | - | 0.00013 | 0.00016 | 0.00015 |
| Lithium (Li) | mg/L | - | - | <0.0010 | <0.0010 | <0.0010 |
| Magnesium (Mg) | mg/L | - | - | 6.0 | 7.5 | 8.5 |
| Manganese (Mn) | mg/L | 1.0 | - | 0.0067 | 0.014 | 0.019 |
| Mercury (Hg) | mg/L | 0.000026 | - | <0.000005 | <0.000005 | <0.000005 |
| Molybdenum (Mo) | mg/L | 0.073 | - | 0.0014 | 0.0019 | 0.0022 |
| Nickel (Ni) | mg/L | 0.096 ^b | - | 0.00073 | 0.00077 | 0.00089 |
| Phosphorus (P) | mg/L | - | - | 0.074 | 0.088 | 0.12 |
| Potassium (K) | mg/L | - | - | 1.0 | 1.5 | 1.7 |
| Selenium (Se) | mg/L | 0.0010 | - | 0.00015 | 0.00035 | 0.00046 |
| Silicon (Si) | mg/L | - | - | 3.8 | 3.7 | 3.5 |
| Silver (Ag) | mg/L | 0.00025 | - | <0.00001 | <0.00001 | <0.00001 |
| Sodium (Na) | mg/L | - | - | 4.2 | 6.1 | 7.2 |
| Strontium (Sr) | mg/L | - | - | 0.15 | 0.23 | 0.27 |
| Sulphur (S) | mg/L | - | - | 3.9 | 6.7 | 8.3 |
| Thallium (Tl) | mg/L | 0.00080 | - | <0.00001 | <0.00001 | <0.00001 |
| Tin (Sn) | mg/L | - | - | <0.0001 | <0.0001 | <0.0001 |
| Titanium (Ti) | mg/L | - | - | 0.0023 | 0.0022 | 0.0023 |
| Uranium (U) | mg/L | 0.015 | - | 0.0011 | 0.0012 | 0.0012 |
| Vanadium (V) | mg/L | - | - | 0.00076 | 0.00075 | 0.00073 |
| Zinc (Zn) | mg/L | 0.030 | - | 0.0061 | 0.010 | 0.013 |
| Zirconium (Zr) | mg/L | - | - | <0.0003 | <0.0003 | <0.0003 |
| Dissolved Metals | | | | | | |
| Aluminum (Al) | mg/L | - | 0.10 | 0.014 | 0.016 | 0.014 |
| Antimony (Sb) | mg/L | - | - | <0.0001 | <0.0001 | <0.0001 |
| Arsenic (As) | mg/L | - | 0.0050 | 0.00059 | 0.00056 | 0.00054 |
| Barium (Ba) | mg/L | - | - | 0.041 | 0.046 | 0.049 |
| Beryllium (Be) | mg/L | - | - | <0.00002 | <0.00002 | <0.00002 |
| Bismuth (Bi) | mg/L | - | - | <0.00005 | <0.00005 | <0.00005 |
| Boron (B) | mg/L | - | - | <0.01 | <0.010 | <0.010 |
| Cadmium (Cd) | mg/L | - | 0.00021 | 0.0000060 | 0.0000063 | 0.0000065 |
| Calcium (Ca) | mg/L | - | - | 24 | 29 | 33 |
| Chromium (Cr) | mg/L | - | 0.0010 | 0.00014 | 0.00012 | 0.00013 |
| Cobalt (Co) | mg/L | - | - | <0.00010 | <0.00010 | <0.00010 |
| Copper (Cu) | mg/L | - | 0.013 / 0.02 ^h | 0.0013 | 0.0042 | 0.0059 |
| Iron (Fe) | mg/L | - | 1.1 | 0.029 | 0.031 | 0.030 |
| Lead (Pb) | mg/L | - | 0.0040 | <0.000052 | <0.000053 | <0.000050 |
| Lithium (Li) | mg/L | - | - | <0.0010 | <0.0010 | <0.0010 |
| Magnesium (Mg) | mg/L | - | - | 6.0 | 7.4 | 8.4 |
| Manganese (Mn) | mg/L | - | - | 0.0021 | 0.0047 | 0.0051 |
| Mercury (Hg) | mg/L | - | - | <0.000005 | <0.000005 | <0.000005 |
| Molybdenum (Mo) | mg/L | - | 0.073 | 0.0013 | 0.0017 | 0.0021 |
| Nickel (Ni) | mg/L | - | 0.11 | 0.00058 | 0.00055 | 0.00061 |
| Phosphorus (P) | mg/L | - | - | 0.056 | <0.056 | 0.089 |
| Potassium (K) | mg/L | - | - | 0.99 | 1.4 | 1.7 |
| Selenium (Se) | mg/L | - | 0.0020 | 0.00013 | 0.00034 | 0.00049 |
| Silicon (Si) | mg/L | - | - | 3.7 | 3.5 | 3.4 |
| Silver (Ag) | mg/L | - | 0.00010 | <0.00001 | <0.00001 | <0.00001 |
| Sodium (Na) | mg/L | - | - | 4.1 | 5.9 | 7.1 |
| Strontium (Sr) | mg/L | - | - | 0.15 | 0.22 | 0.28 |
| Sulphur (S) | mg/L | - | - | 3.7 | 6.3 | 8.1 |
| Thallium (Tl) | mg/L | - | - | <0.00001 | <0.00001 | <0.00001 |
| Tin (Sn) | mg/L | - | - | <0.0001 | <0.0001 | <0.0001 |
| Titanium (Ti) | mg/L | - | - | <0.00032 | <0.00038 | <0.00031 |
| Uranium (U) | mg/L | - | - | 0.0011 | 0.0011 | 0.0011 |
| Vanadium (V) | mg/L | - | - | <0.00052 | <0.00051 | <0.00050 |
| Zinc (Zn) | mg/L | - | 0.030 | 0.0050 | 0.0082 | 0.011 |
| Zirconium (Zr) | mg/L | - | - | <0.0003 | <0.0003 | <0.0003 |

Notes: Means are represented with a "<" symbol if greater than 50% of data used in their calculation were below the Method Detection Limit (MDL).

Mean concentration greater than the lowest guideline or SSWQO (lower in the case of dissolved oxygen, or outside the guideline or SSWQO range in the case of pH).

^a Water quality guidelines for the protection of aquatic life. Black text are Canadian Environmental Quality Guidelines (CCME 2017); blue text are BC Water Quality Guidelines (BCMOE 2017a,b). Guideline for dissolved oxygen is for "Other life stages" of coldwater biota.

^b At hardness of 100 mg/L (conservative conditions for Minto Creek).

^c At temperature 10°C and pH 8.5; values that are inclusive of all *in situ* temperature and pH data associated with these water samples (maximum temperature = 14.5°C, maximum pH = 8.28; see Appendix Table C.4).

^d Maximum increase of 25 mg/L from background for short-term exposures (e.g., 24-h period) and maximum increase of 5 mg/L from background for longer term exposures.

^e At pH 8.5 (slightly conservative conditions).

^f 0.001 for hexavalent chromium (CrVI); 0.009 for trivalent chromium (CrIII).

^g 0.013 mg/L copper at a dissolved organic carbon (DOC) concentration ≤10 mg/L and 0.02 mg/L copper at a DOC concentration >10 mg/L.

5 BENTHIC INVERTEBRATE COMMUNITY

Benthic invertebrate community samples were collected at five upper Minto Creek effluent-exposed sites and 10 reference sites (Figure 2.1). The effluent-exposed sites were evaluated relative to reference using a Reference Condition Approach (RCA). At the request of ECCC, the effluent-exposed area mean was also evaluated using a Control-Impact (CI) approach³. All benthic invertebrate samples were collected using a Surber sampler outfitted with a 500- μ m mesh net. In the laboratory, samples were identified and enumerated to the lowest practical level; however, this evaluation is based on family level taxonomic results (Appendix Tables D.1 to D.4). Benthic invertebrate community data were subject to a Data Quality Review and were of good quality (Appendix B).

5.1 Primary EEM Metrics

The benthic invertebrate community of the mine-exposed sites on upper Minto Creek was compared to the reference condition (defined by 10 reference sites) for the four primary EEM metrics: density, taxon richness, Simpson's evenness, and Bray-Curtis (BC) distance. All effluent exposed sites (UMC-1 to UMC-5) were within reference condition ($ncP > 0.9$) for all four primary metrics (Figure 5.1; Appendix Table D.5; Appendix Figure D.1). Based on CI comparison, mean density at the effluent-exposed area (990 organisms/m²) was lower than the reference mean (2,671 organisms/m²), whereas mean taxon richness, Simpson's evenness, and Bray-Curtis (BC) distance did not differ significantly from the reference mean (Table 5.1; Figure 5.2; Appendix Table D.6). Despite statistical significance, the difference in density was modest (-1.2 standard deviations) and below the ± 2 standard deviation Critical Effect Size (CES⁴) for benthic invertebrate density.

5.2 Community Composition

The average reference community was composed of 45% Chironomidae (non-biting midge larvae), 39% EPT taxa (Ephemeroptera, Plecoptera, and Trichoptera or mayflies, stoneflies, and caddisflies), 11% Diptera (true flies) excluding Chironomidae, and 4% oligochaetae (worms; Figure 5.3; Appendix Table D.4). Proportions of Chironomidae and EPT were within reference condition ($ncP > 0.9$) at all effluent-exposed sites except for UMC-4 which had a slightly lower proportion of EPT taxa than the other effluent-exposed sites and was within a range that was inconclusive with respect to potential difference from reference condition (i.e., $0.1 < ncP < 0.9$;

³ It is noted that this requested comparison assumes that within-area variability (upper Minto Creek) and among-area variability (reference sites) are comparable, which may not be true.

⁴ The critical effect size is a threshold above which an effect may be indicative of a higher risk to the environment (Environment Canada 2012).



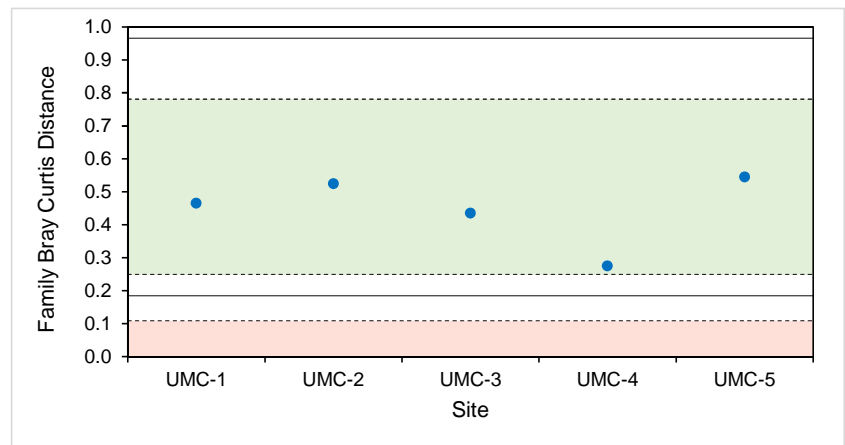
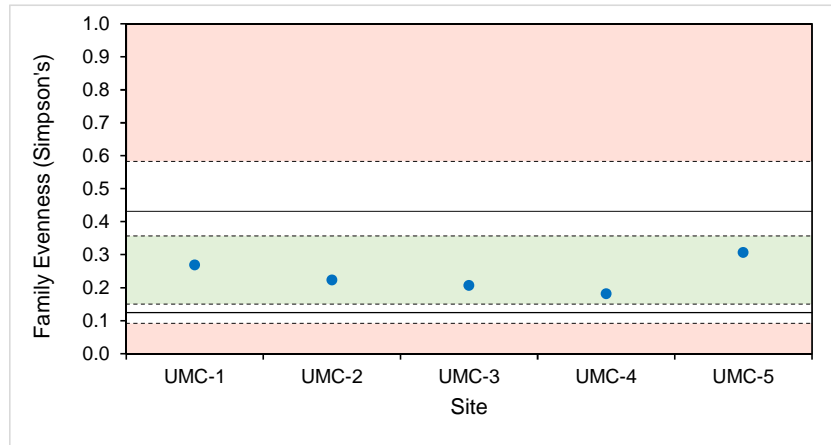
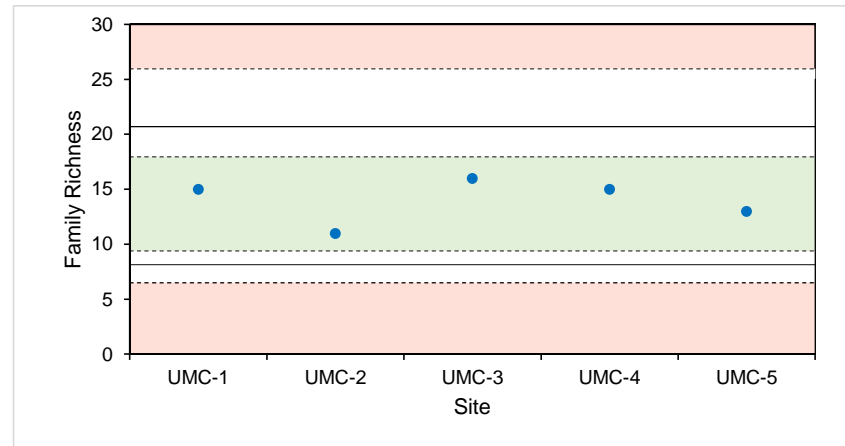
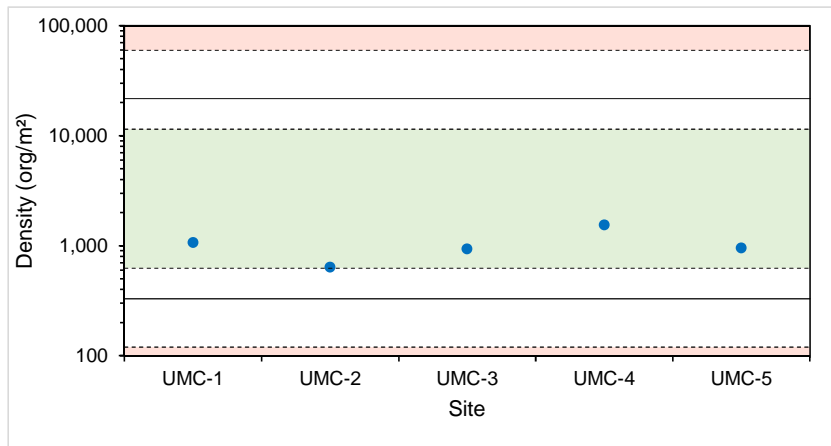



Figure 5.1: Individual Value Plot of Primary EEM Benthic Invertebrate Community Endpoints for Exposed Sites (n = 5) Relative to the Reference Condition (n = 10), September 2016

Notes: solid lines = 2.5th and 97.5th percentiles, dashed lines = 90% confidence limits on the percentiles.
 green shading = within reference condition; pink shading = out of reference condition; no shading = inconclusive

Table 5.1: Summary of Statistical Comparisons in Benthic Invertebrate Community Endpoints between Reference (n = 10) and Exposed (n = 5) Sites, 2016

| Endpoint | Data Transformation | Test | Test P-value | Mean or Median ¹ | | Observed ES ² (Exposed - Reference)/SD |
|------------------------------------|---------------------|----------|--------------|-----------------------------|---------|--|
| | | | | Reference | Exposed | |
| Density | log | T | 0.059 | 2,671 | 990 | -1.2 |
| Family Richness | log | T | 0.567 | 13 | 14 | 0.33 |
| Family Evenness (Simpson's) | log | T | 0.955 | 0.23 | 0.23 | 0.033 |
| Family BC Distance | square root | T | 0.795 | 0.47 | 0.44 | -0.15 |
| % EPT | fourth root | Tunequal | 0.009 | 37 | 22 | -1.3 |
| % Ephemeroptera | log(X+1) | T | 0.942 | 9.8 | 10 | 0.042 |
| % Plecoptera | log | Tunequal | 0.018 | 17 | 8.2 | -1.2 |
| % Trichoptera | fourth root | Tunequal | 0.019 | 0.5 | 4.30 | 1.1 |
| % Chironomidae | none | T | 0.451 | 45 | 51 | 0.44 |
| % Diptera (excluding Chironomidae) | fourth root | Tunequal | 0.746 | 9.1 | 9.9 | 0.14 |
| % Oligochaeta | fourth root | T | 0.006 | 2.8 | 14.0 | 1.9 |

 P-value < 0.1.

¹ For transformed data, the mean was calculated on the transformed scale, and back-transformed to original data units; the median is reported for the Mann-Whitney test.

² The observed effect size is calculated on the transformed scale when the data were transformed for analysis. An effect size is not reported with the data were analyzed using the Mann-Whitney test.

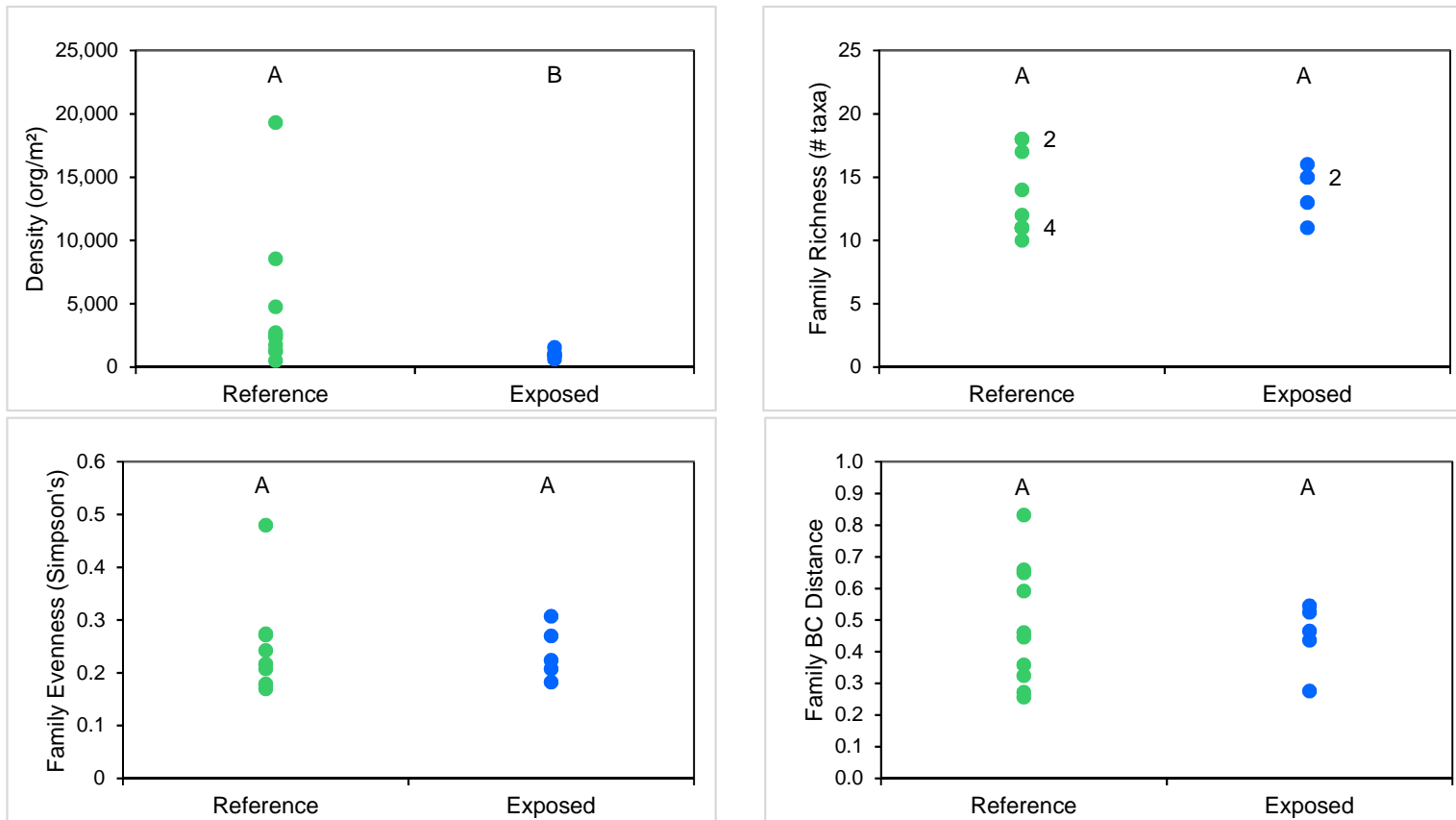


Figure 5.2: Individual Value Plot of Primary EEM Benthic Invertebrate Community Endpoints for Reference (n = 10) and Exposed (n = 5) Sites, 2016

Notes: The letter B above the exposed group indicates a significant difference relative to reference (A) $\alpha = 0.1$. The letter A above the exposed group indicates no significant difference relative to reference (A) $\alpha = 0.1$.

Numbers next to individual points represent the number of overlapping points at that value.

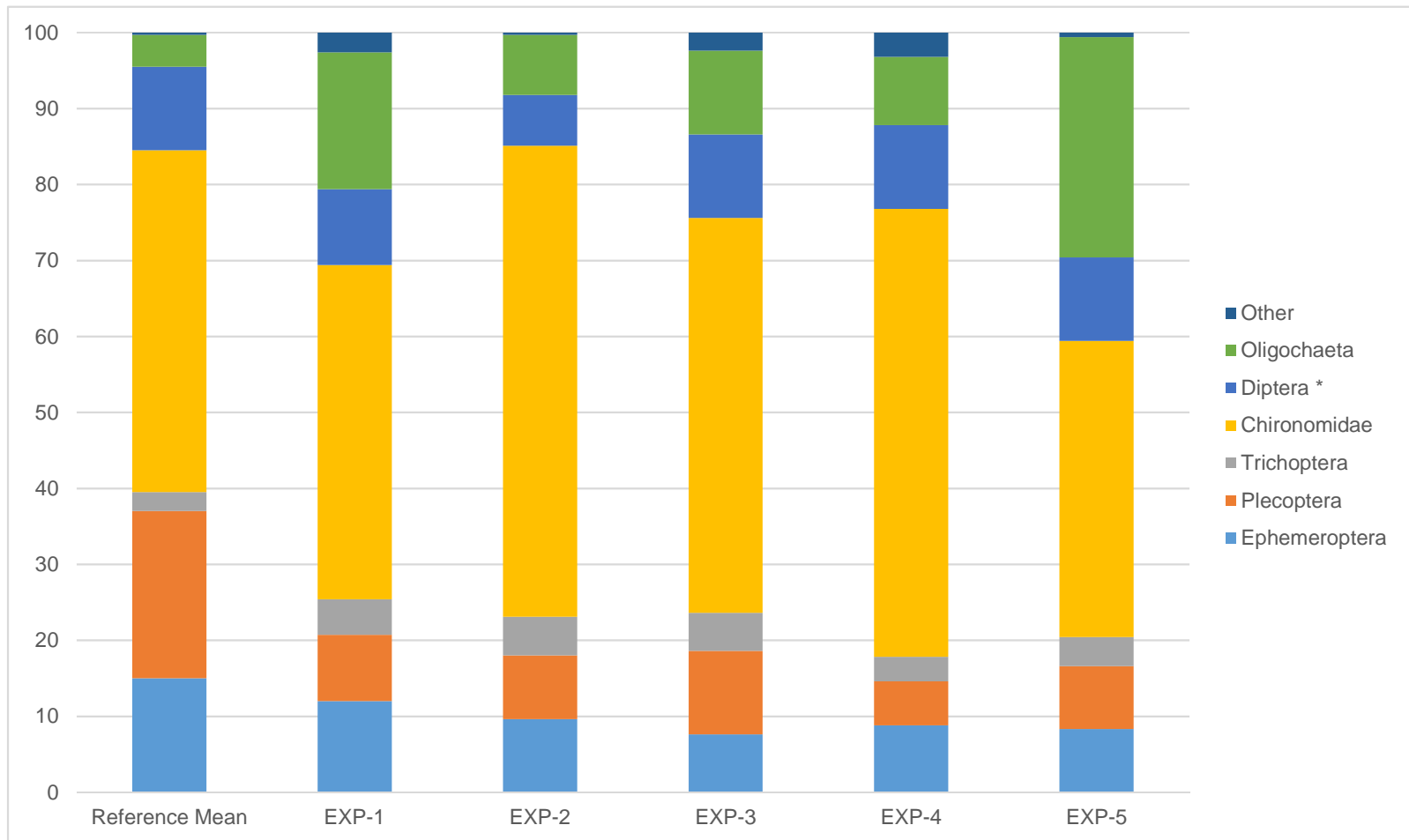


Figure 5.3: Benthic Invertebrate Community Composition of Reference (mean; n=10) and Effluent-Exposed Sites

* Diptera excluding Chironomidae.

Figure 5.4; Appendix Figure D.1). Proportions of Ephemeroptera, Plecoptera, and Trichoptera, evaluated individually, were within reference condition at all effluent-exposed sites (Figure 5.4; Appendix Table D.5). Similarly, the proportion of Diptera (excluding Chironomidae) was within reference condition at all effluent-exposed sites (Figure 5.4). The proportion of oligochaetes (worms) was in reference condition at two of the five effluent-exposed sites, and at the remaining three (UMC-1, UMC-3, and UMC-5), was within a range that was inconclusive with respect to potential difference from reference condition (i.e., $0.1 < nCP < 0.9$; Figure 5.4).

Based on CI comparison, the effluent-exposed area differed significantly from reference on the basis of lower mean relative abundances of EPT taxa and Plecoptera, and higher mean relative abundances of Trichoptera and oligochaetes (Table 5.1; Figure 5.5; Appendix Figure D.2). Effect sizes associated with these significant differences were modest in all cases (from 1.3 to 1.9 reference standard deviations; Table 5.1). Ephemeroptera, Plecoptera, and Trichoptera are generally considered to be sensitive taxa (e.g., Kiffney and Clements 1994; Resh et al. 1996; Rosenberg and Resh 1996; Taylor and Bailey 1997; Barbour et al. 1999; Mandaville 2002) and oligochaetes are typically considered to be tolerant taxa (e.g., Chapman et al. 1982; Taylor and Bailey 1997; Barbour et al. 1999; Mandaville 2002). The lower abundance of Plecoptera (stoneflies) at the effluent-exposed area was associated with the absence of the families *Leuctridae*, *Perlodidae*, and *Taeniopterygidae*, and the notably lower abundance of *Nemouridae* (Appendix Table D.2). All of these stoneflies are considered pollution sensitive (Resh et al. 1996). The greater abundance of Trichoptera at the effluent-exposed area was associated with *Lemnephilidae* (Appendix Table D.2), which are also considered to be pollution sensitive (Resh et al. 1996; Barbour et al. 1999). Lastly, the greater abundance of oligochaetes at the effluent-exposed area was associated with *Lumbriculidae* (Appendix Table D.2), which are considered to be pollution tolerant (Barbour et al. 1999; Bode et al. 2002). Symmetric representation of Correspondence Analysis (CA) results confirm the association of *Lumbriculidae* with effluent-exposed sites and the lack of association of *Nemouridae* with effluent-exposed sites (Appendix Figure D.3).

5.3 Correlation Analysis

Correlation analysis was applied to evaluate potential causes of differences in effluent-exposed and reference benthic invertebrate communities. Correlations included all *in situ* measures of water and habitat quality, water quality analytes identified as elevated at effluent-exposed sites relative to reference (Section 4), and other supporting water quality and habitat data. The latter (other supporting water quality and habitat data) were first reduced by Principal Component Analysis (PCA) to extract the main gradients of site separation (Appendix Tables D.7 to D.11; Appendix Figures D.4 and D.5). Consideration of the benthic invertebrate community metrics that



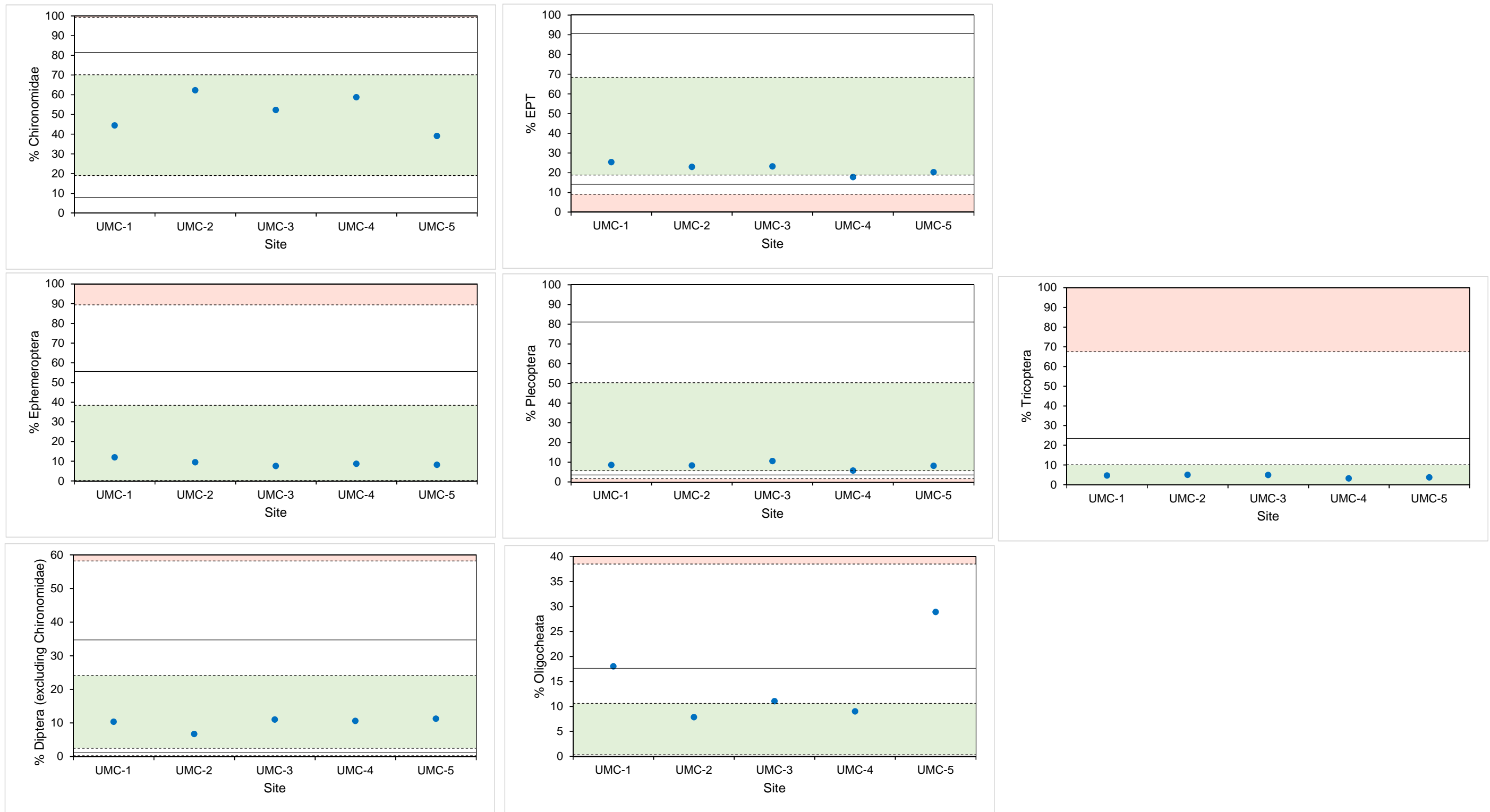


Figure 5.4: Individual Value Plot of Benthic Invertebrate Community Taxon Proportions for Exposed Sites (n = 5), Relative to the Reference Condition (n = 10), September 2016

Notes: solid lines = 2.5th and 97.5th percentiles, dashed lines = 90% confidence limits on the percentiles.
 green shading = within reference condition; pink shading = out of reference condition; no shading = inconclusive

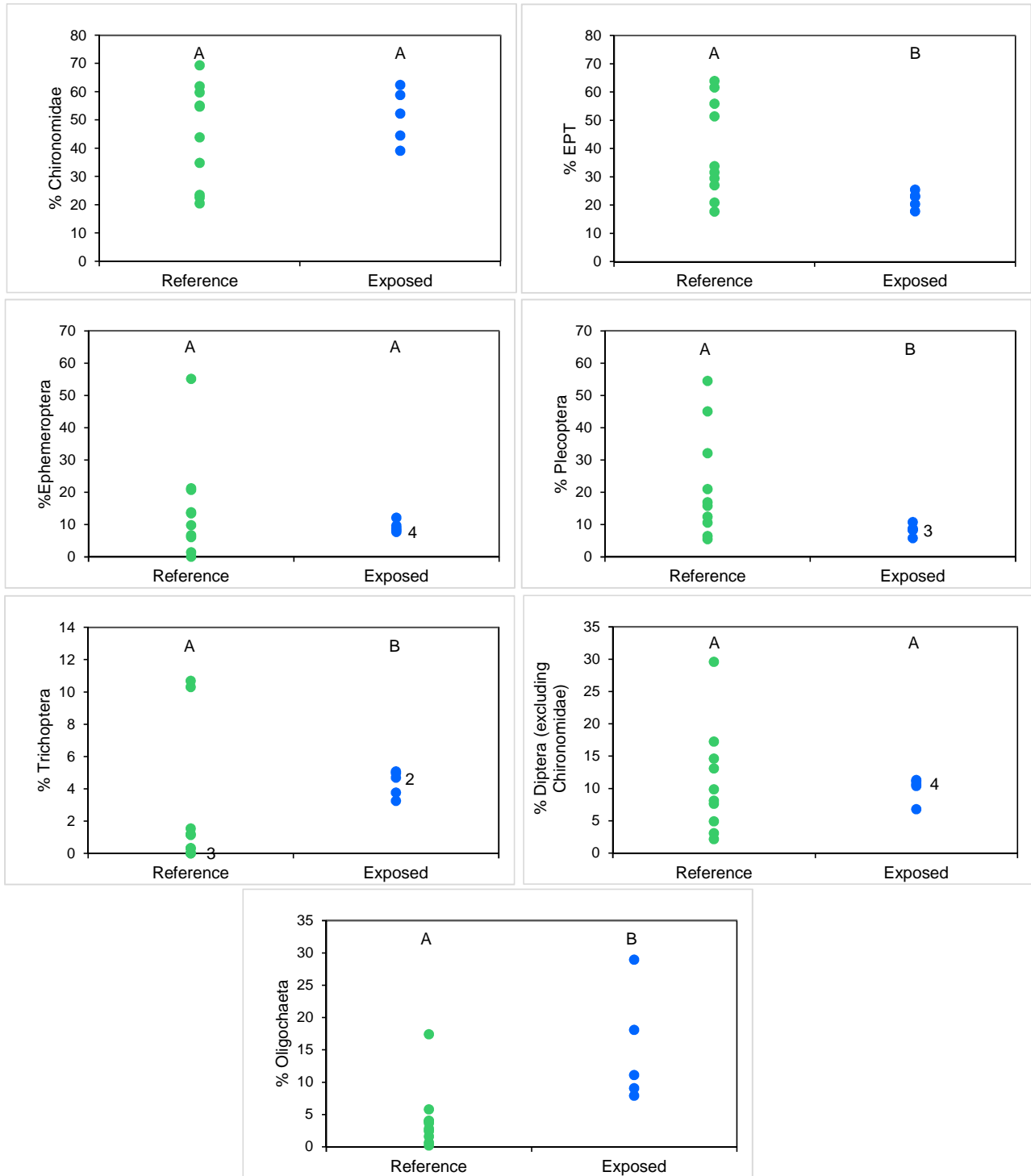


Figure 5.5: Individual Value Plot of Benthic Invertebrate Community Taxon Proportions for Reference (n = 10) and Exposed (n = 5) Sites, 2016

Notes: The letter B above the exposed group indicates a significant difference relative to reference (A) $\alpha = 0.1$. The letter A above the exposed group indicates no significant difference relative to reference (A) $\alpha = 0.1$.

Numbers next to individual points represent the number of overlapping points at that value.

were either out of reference condition (none) or inconclusive with respect to reference condition (RCA), or had effluent-exposed area means that differed significantly from reference (CI comparison), indicated 12 statistically significant correlations at $p < 0.05$ and $r > 0.6$ (Table 5.2; correlations with all benthic invertebrate community metrics are provided in Appendix Table D.12). Benthic invertebrate density was positively related to median cobble size and negatively related to several analytes that were elevated in Minto Creek relative to reference (total Kjeldahl nitrogen, phosphorus, aluminum, copper, and water quality PC-2; Table 5.2; Appendix Figure D.6). The consistent negative correlations with water chemistry suggest a mine-related influence of benthic invertebrate density and one of the relationships (a negative relationship between density and total Kjeldahl nitrogen) was observed previously (Minnow 2015). In addition to the relationships with benthic invertebrate density, the proportion of Plecoptera (stoneflies) was negatively correlated with hardness and nitrate, the proportion of Trichoptera (caddisflies) was negatively correlated with dissolved oxygen and positively correlated with selenium, and the proportion of oligochaetes was negatively correlated with dissolved oxygen and positively correlated with copper (Table 5.2). Plots of these relationships are leveraged or inconsistent with typical response mechanisms (e.g., a decrease in Trichoptera would not be expected with increasing dissolved oxygen and an increase in Trichoptera would not be expected with increasing selenium concentration; Appendix Figure D.6). However, a negative relationship between dissolved oxygen and percent oligochaetes (Appendix Figure D.6) is a typical response (e.g., Chapman et al. 1982; Brinkhurst et al. 1983; Reynoldson 1987), and suggests that the greater proportion of oligochaetes observed at the effluent-exposed sites may be related to moderately lower dissolved oxygen than at the reference sites (which, in turn, may be related to the higher temperature at the effluent-exposed sites).

5.4 Summary and Comparison to Previous EEM

In summary, mine-exposed benthic invertebrate communities of upper Minto Creek were within reference condition for all four primary EEM metrics (density, taxon richness, Simpson's evenness, and BC distance). Evaluation by control-impact comparison indicated that mean taxon richness, mean Simpson's evenness, and mean BC distance did not differ from the reference mean, whereas mean density at effluent-exposed upper Minto Creek area was significantly lower than reference, but at a magnitude lower than the CES of ± 2 standard deviations (which suggests that the difference may not be ecologically meaningful). Examination of taxon proportions indicated lower relative abundances of EPT taxa and Plecoptera, and higher relative abundances of Trichoptera and oligochaetes at effluent-exposed upper Minto Creek. As Plecoptera and Trichoptera are considered to be sensitive organisms, and oligochaetes are considered to be tolerant organisms, these results are equivocal with respect to a potential effluent-related influence. Correlation analysis indicated a negative relationship between benthic invertebrate



Table 5.2: Spearman Correlation of Benthic Invertebrate Endpoints vs. Principal Components Results, *In situ* Measures, and Water Quality Results, Minto Mine Phase 4 EEM, 2016

| Endpoint | <i>In situ</i> Measures | | | | | | | | | | | | | | Water Quality | | | | | | | | |
|------------------|-------------------------|---------|------------------------------|---------|-------------------------|---------|----------------------|---------|---------------|---------|----------------------|---------|----------------|---------|-------------------------------|---------|--|---------|----------------------|---------|--------------------------------|---------|-------|
| | Temperature (°C) | | Specific Conductance (µs/cm) | | Dissolved Oxygen (mg/L) | | Dissolved Oxygen (%) | | pH (pH units) | | Water Velocity (m/s) | | Mean Depth (m) | | Median Intermediate Axis (cm) | | Hardness (as CaCO ₃ , mg/L) | | Nitrate (as N, mg/L) | | Total Kjeldahl Nitrogen (mg/L) | | |
| | n=15 | | n=15 | | n=15 | | n=15 | | n=15 | | n=15 | | n=15 | | n=15 | | n=13 | | n=13 | | n=13 | | |
| | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | |
| Density * | -0.453 | 0.090 | -0.179 | 0.524 | 0.525 | 0.044 | 0.481 | 0.070 | 0.252 | 0.365 | 0.159 | 0.571 | -0.052 | 0.853 | 0.652 | 0.008 | -0.181 | 0.553 | -0.514 | 0.072 | -0.764 | 0.002 | |
| Relative Density | EPT (%) * | -0.397 | 0.142 | -0.314 | 0.254 | 0.143 | 0.612 | 0.304 | 0.271 | -0.118 | 0.675 | -0.478 | 0.072 | 0.300 | 0.278 | -0.122 | 0.664 | -0.170 | 0.578 | -0.492 | 0.087 | -0.011 | 0.972 |
| | Plecoptera (%) * | -0.288 | 0.297 | -0.564 | 0.028 | 0.200 | 0.475 | 0.372 | 0.172 | -0.341 | 0.213 | 0.007 | 0.980 | -0.090 | 0.749 | 0.241 | 0.386 | -0.632 | 0.021 | -0.627 | 0.022 | -0.060 | 0.845 |
| | Trichoptera (%) * | 0.199 | 0.476 | 0.043 | 0.879 | -0.591 | 0.020 | -0.782 | <0.001 | -0.425 | 0.114 | 0.223 | 0.425 | -0.074 | 0.792 | -0.249 | 0.370 | 0.000 | 1.000 | 0.357 | 0.231 | -0.160 | 0.601 |
| | Oligocheata (%) * | 0.358 | 0.190 | 0.275 | 0.321 | -0.554 | 0.032 | -0.810 | <0.001 | -0.023 | 0.934 | 0.052 | 0.854 | -0.213 | 0.446 | -0.227 | 0.416 | 0.253 | 0.405 | 0.556 | 0.049 | 0.511 | 0.074 |

| Endpoint | Water Quality (continued) | | | | | | | | | | | | Principal Components | | | | | | | | | | |
|------------------|---------------------------|---------|-----------------------|---------|----------------------|---------|---------------------|---------|-------------------|---------|-------------------------|---------|-----------------------|---------|----------------------------|---------|----------------------------|---------|----------------------|---------|----------------------|---------|-------|
| | Total Phosphorus (mg/L) | | Total Aluminum (mg/L) | | Total Arsenic (mg/L) | | Total Copper (mg/L) | | Total Iron (mg/L) | | Total Molybdenum (mg/L) | | Total Selenium (mg/L) | | Water Quality PC-1 (30.0%) | | Water Quality PC-2 (23.7%) | | Habitat PC-1 (45.0%) | | Habitat PC-2 (28.0%) | | |
| | n=13 | | n=13 | | n=13 | | n=13 | | n=13 | | n=13 | | n=13 | | n=13 | | n=13 | | n=14 | | n=14 | | |
| | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | |
| Density | -0.847 | <0.001 | -0.604 | 0.029 | 0.025 | 0.935 | -0.805 | <0.001 | -0.401 | 0.174 | -0.599 | 0.031 | -0.357 | 0.231 | -0.220 | 0.471 | -0.758 | 0.003 | 0.279 | 0.334 | -0.495 | 0.072 | |
| Relative Density | EPT (%) | 0.168 | 0.584 | -0.495 | 0.086 | 0.442 | 0.131 | -0.451 | 0.122 | 0.264 | 0.384 | -0.424 | 0.149 | 0.011 | 0.972 | 0.110 | 0.721 | -0.313 | 0.297 | -0.244 | 0.401 | 0.130 | 0.659 |
| | Plecoptera (%) | -0.050 | 0.872 | 0.011 | 0.972 | 0.147 | 0.631 | -0.089 | 0.774 | 0.544 | 0.055 | -0.326 | 0.277 | -0.456 | 0.117 | 0.495 | 0.086 | -0.434 | 0.138 | 0.200 | 0.493 | -0.244 | 0.401 |
| | Trichoptera (%) | 0.058 | 0.850 | -0.055 | 0.858 | -0.387 | 0.191 | 0.120 | 0.697 | -0.204 | 0.503 | 0.257 | 0.397 | 0.707 | 0.007 | -0.243 | 0.424 | -0.044 | 0.886 | 0.210 | 0.472 | 0.581 | 0.029 |
| | Oligocheata (%) | 0.501 | 0.081 | 0.544 | 0.055 | -0.269 | 0.373 | 0.808 | <0.001 | 0.027 | 0.929 | 0.575 | 0.040 | 0.484 | 0.094 | 0.071 | 0.817 | 0.571 | 0.041 | -0.068 | 0.817 | 0.226 | 0.436 |

statistically significant correlation at a p-value < 0.05.

strong relationship at r > 0.6 or r < -0.6.

* = benthic invertebrate community endpoint that was one or more of: 1) out of reference condition (no instances); 2) inconclusive with respect to the reference condition; and/or 3) statistically different from reference following the Control-Impact comparison.

Notes: All correlations were calculated using data < Method Detection Limit (MDL) at the MDL value. N = 13 for all analyses of water quality (n = 10 for reference, n = 3 for exposed). N = 14 for all habitat analyses (n = 9 for reference due to exclusion of REF-1 and n = 5 for the effluent-exposed area).

density and water quality, and a negative relationship between the proportion of oligochaetes and dissolved oxygen.

The results of the Phase 4 EEM, as evaluated using the RCA approach, were consistent with the result of the Phase 3 EEM (Minnow 2015). In Phase 3, two of three effluent exposed sites were within reference condition for all EEM effect metrics (density, taxon richness, Simpson's evenness, and BC distance), with the one remaining site having higher density than reference condition and a BC distance that could not be categorized as either within reference condition or out of reference condition (i.e., $0.1 < nCP < 0.9$). Thus, RCA analysis in two consecutive EEM Phases has indicated no effect. However, a supporting CI comparison in this study (Phase 4) suggested lower density at the effluent-exposed area, but this result was opposite from the apparent greater density observed at one of three sites evaluated by RCA in Phase 3. In terms of the supporting metrics, a greater proportion of Trichoptera and lower proportion of Plecoptera was observed in Phase 3 and in Phase 4, whereas other differences observed in Phases 3 and/or 4 (e.g., lower EPT taxa, more oligochaetes, and more diptera excluding chironomidae) were not consistent between phases. As Trichoptera and Plecoptera are both considered to be sensitive taxa, the opposite differences in their proportions (i.e., more Trichoptera and fewer Plecoptera) at effluent-exposed areas, as observed in successive EEM Phases, are equivocal with respect to an effluent-related influence.



6 SUPPORTING FIELD-BASED FISH STUDY

6.1 Fish Community

Fish sampling was conducted monthly during the Phase 4 EEM from June through September 2016 in order to verify fish presence, abundance, and life-stage in lower Minto Creek and to relate this information to the on-site laboratory study. The only fish species captured in lower Minto Creek was chinook salmon (*Oncorhynchus tshawytscha*), all captures (6 fish) occurred in September, and all were juveniles (Table 6.1). This result is consistent with results from previous EEM (Minnow and Access 2012) and confirms the limited usage of lower Minto Creek by fish and the fact that a conventional EEM fish survey was not practicable (e.g., a non-lethal survey requires 100 individuals from each exposed and reference area). No fish were captured upstream of a small cascade located approximately 1.2 km upstream of the Minto Creek confluence with the Yukon River (Figure 2.3), indicating that this structure continues to be a barrier to upstream fish movement in Minto Creek (Capstone 2017a). In lower Big Creek (reference), juvenile chinook salmon were captured in all months (June to September) and at higher catch-per-unit-effort (CPUE) than in lower Minto Creek (Table 6.1). Slimy sculpin (*Cottus cognatus*) were also captured in lower Big Creek at lower CPUE than juvenile chinook salmon, and only in June and July (Table 6.1).

6.2 Fish Population Data

Chinook salmon captured in lower Minto Creek in September 2016 were all 0+ fry. Mean fork length was 72.8 ± 9.5 mm and mean body weight was 4.73 ± 1.57 g, which was similar to those captured in lower Big Creek (Figure 6.1; Appendix Tables E.1 and E.2). No statistically significant differences were observed in fork length or body weight of the juvenile chinook salmon captured in lower Minto Creek and lower Big Creek in September 2016, and weight-length relationships overlapped (Figure 6.1).



Table 6.1: Summary of Minnow Trapping in Minto Creek (Exposed) and Big Creek (Reference) in 2016

A) Minto Creek

| Month | Effort (trap-hours) | Effort(trap-days) | Juvenile Chinook Salmon (<i>Onchoryhnchus tshawytscha</i>) | |
|--------------|---------------------|-------------------|--|-------------------|
| | | | Catch | CPUE ¹ |
| June | 424 | 17.7 | 0 | 0 |
| July | 391 | 16.3 | 0 | 0 |
| August | 424 | 17.7 | 0 | 0 |
| September | 424 | 17.7 | 6 | 0.339 |
| Total | 1,663 | 69.4 | 6 | 0.085 |

B) Big Creek

| Month | Effort (trap-hours) | Effort(trap-days) | Juvenile Chinook Salmon (<i>Onchoryhnchus tshawytscha</i>) | | Slimy Sculpin (<i>Cottus cognatus</i>) | |
|-------------------|---------------------|-------------------|--|-------------------|--|-------------------|
| | | | Catch | CPUE ¹ | Catch | CPUE ¹ |
| June ² | 58 | 2.4 | 2 | 0.83 | 7 | 2.92 |
| July | 97 | 4.0 | 21 | 5.22 | 2 | 0.50 |
| August | 92 | 3.8 | 16 | 4.17 | 0 | 0 |
| September | 92 | 3.8 | 12 | 3.13 | 0 | 0 |
| Total | 338 | 14 | 51 | 3.62 | 9 | 0.639 |

¹ CPUE = fish/trap-day (for actual 24-hr period).

² Several small fish (10-25 mm in length) were observed near one of the minnow traps but not captured.

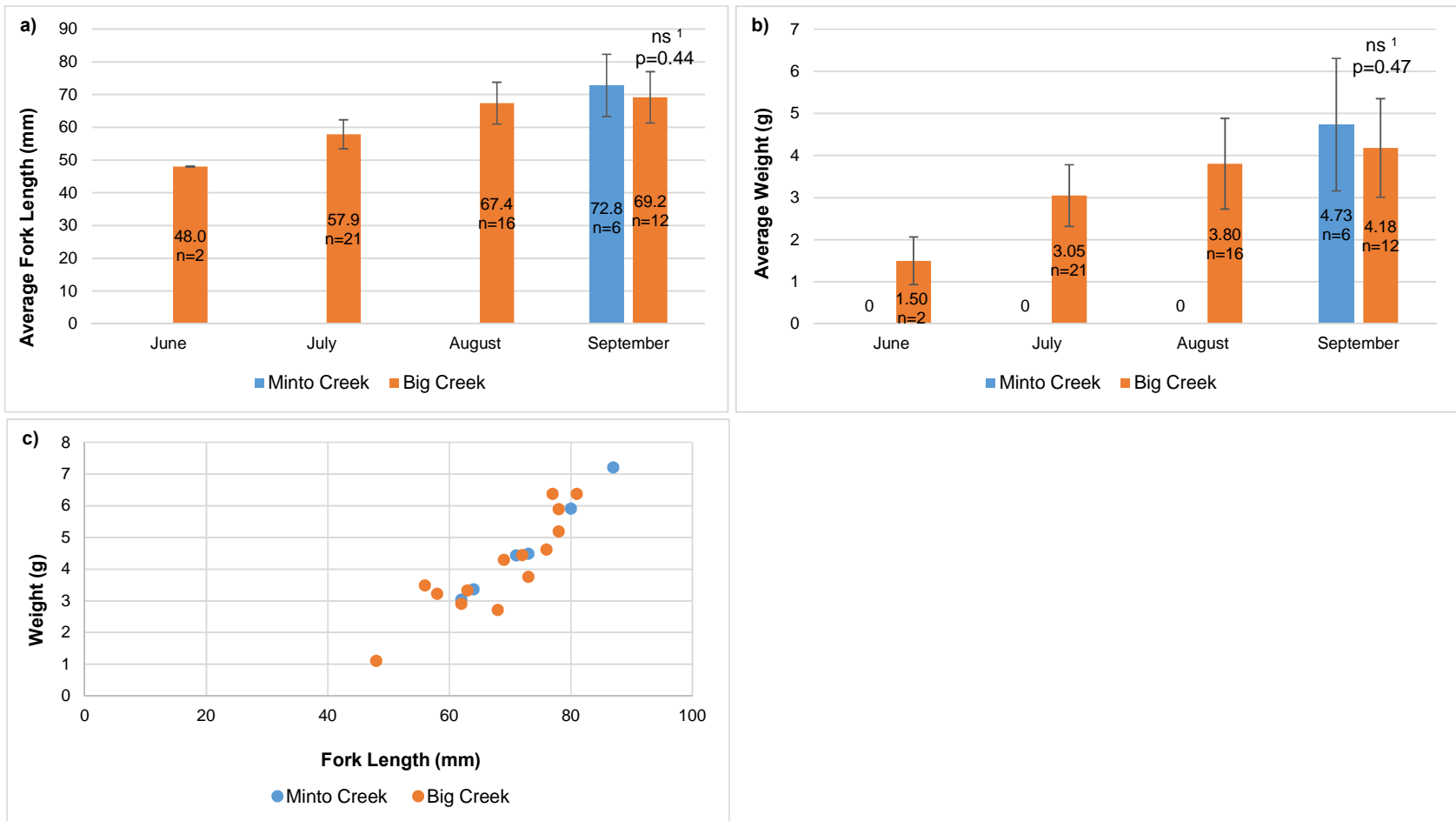


Figure 6.1: Juvenile Chinook Salmon Meristic Data (mean ± standard deviation), June-September 2016. A) Mean Fork Length; B) Mean Body Weight; and C) Body Weight at Fork Length in September 2016.

¹ ns = non-significant as determined by T-test following verification of normality and equal variance

7 LABORATORY FISH EXPOSURE STUDY

7.1 Fish Population Health

A total of 160 kokanee fry were used for each of the on-site laboratory exposures (reference water, E6 [14% effluent; one part effluent to 6 parts reference water], and E3 [25% effluent; one part effluent to 3 parts reference water]). Very few mortalities occurred over the course of the field laboratory exposure study. One mortality occurred in the reference group just prior to transport to site and another was recorded approximately two weeks after the study was initiated. No additional mortalities were observed in any of the groups. However, a small number of fish could not be accounted for at the end of the study (and presumably escaped over the side of the exposure vessel or down the stand-pipe to the sump). Thus, meristic data from a total of 153, 156, and 159 kokanee fry from reference, E6 and E3, respectively (Appendix Tables E.3 to E.6), were used for the analysis of population health.

No statistically significant differences between the fish assigned to the two exposure groups and reference were observed pre-exposure (Appendix Table E.7; Appendix Figures E.1 and E.2). At the termination of the exposure (Day 47), kokanee fry exposed to the highest effluent concentration (25% effluent) differed from the reference group on the basis of length-frequency distribution, with a slightly greater proportion of larger fish (Table 7.1; Figure 7.1). The maximum difference from reference was evident for fish with fork length of less than approximately 9.8 cm, which made up 17% less of the highest exposure group than reference. This is consistent with greater mean fork length and mean body weight of kokanee in the highest exposure group relative to reference (Table 7.1; Figure 7.2). Despite statistical significance, the differences in fork length and body weight were very small (1.6% and 6.9%, respectively; Table 7.1). Kokanee exposed to the lower effluent concentration (14% effluent) did not differ from reference on the basis of length-frequency distribution, mean fork length, or mean body weight (Table 7.1; Figure 7.1, and Figure 7.2). Condition (weight-at-length) differed from reference in both exposure groups, with the lower exposure group (14% effluent) having a slightly lower condition than reference and the higher exposure group (25% effluent) having a slightly greater condition than reference (Table 7.1; Figure 7.2). Despite statistical significance, the differences in condition were small (-2.7% and +2.3%, respectively) and were well below the 10% Critical Effect Size (CES⁵) for fish condition.

⁵ The critical effect size is a threshold above which an effect may be indicative of a higher risk to the environment (Environment Canada 2012).



Table 7.1: Statistical Differences on Day 47 between Exposure and Reference Kokanee Used in the Hatchery Exposure, Minto Mine Phase 4 EEM, 2016

| Indicator | Endpoint | Variables | | Comparison | Sample Size | | Test | ANCOVA Statistics | | | Summary Statistics | | | Test P-value | Magnitude of Difference Relative to Control (%) | Estimated Minimum Detectable Difference Between Groups (%) with $\alpha=\beta=0.1$ | |
|----------------|-------------------------------|-------------------------|--------------------------|------------|------------------|-----|--------------|---------------------|-------------------|--|---------------------------|------|------|--------------|---|--|--------------|
| | | Response | Covariate | | Ref | Exp | | Interaction P-value | Covariate P-value | Covariate Value for Comparisons ^a | Statistic | Ref | Exp | | | Decrease (%) | Increase (%) |
| Survival | Length Frequency Distribution | Fork Length (cm) | - | E6 vs. Ref | 153 | 156 | 2-sample K-S | - | - | - | - | - | - | 0.160 | 1.0 ^b | - | - |
| | | | | E3 vs. Ref | 153 | 159 | 2-sample K-S | - | - | - | - | - | - | 0.024 | -8.0 ^b | - | - |
| Energy Usage | Fork Length | Fork Length (cm) | - | E6 vs. Ref | 153 | 156 | T-test | - | - | - | Mean | 9.59 | 9.61 | 0.709 | - | -2.2 | 2.2 |
| | | | | E3 vs. Ref | 153 | 159 | T-test | - | - | - | Mean | 9.59 | 9.75 | 0.005 | 1.6 | - | - |
| | Body Weight | Body Weight (g) | - | E6 vs. Ref | 153 | 156 | T-test | - | - | - | Mean | 8.56 | 8.36 | 0.162 | - | -5.8 | 5.8 |
| | | | | E3 vs. Ref | 153 | 159 | T-test | - | - | - | Mean | 8.56 | 9.15 | <0.001 | 6.9 | - | - |
| Energy Storage | Condition | Log10 [Body Weight (g)] | Log10 [Fork Length (cm)] | E6 vs. Ref | 152 ^c | 156 | ANCOVA | 0.490 | <0.001 | 9.59 | Adjusted Mean (Geometric) | 8.47 | 8.24 | <0.001 | -2.7 | - | - |
| | | | | E3 vs. Ref | 152 ^c | 159 | ANCOVA | 0.614 | <0.001 | 9.66 | Adjusted Mean (Geometric) | 8.65 | 8.84 | <0.001 | 2.3 | - | - |

Notes:

 P-value < 0.05.

Bold text Magnitude of Difference > 25% (10% if compared to Condition).

^a Mean for all data with outliers removed. For log-transformed data, the geometric mean is reported.

^b Magnitude of difference is the largest difference (as a percentage) between the cumulative relative frequency distributions for the two sampling areas. A negative difference implies the exposure area has smaller fish compared to reference.

^c One fish was identified as an outlier (Control Fish #90) with a Studentized residual of 4.847.

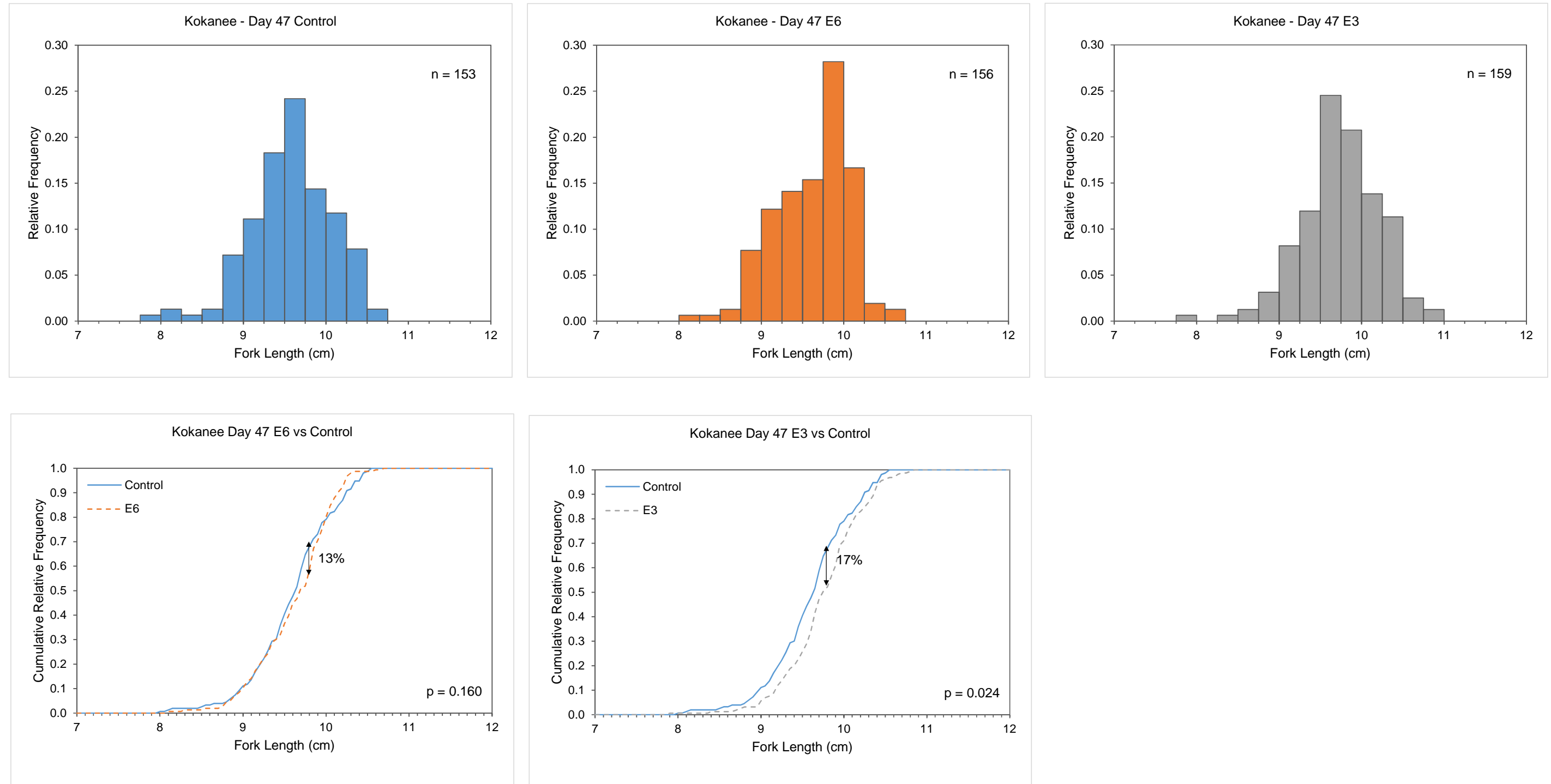


Figure 7.1: Length-frequency Distributions and Cumulative Length-frequency Distributions for Day 47 Kokanee in Control, E6, and E3 Treatments for Minto Mine Fish Hatchery Exposure, August 2016

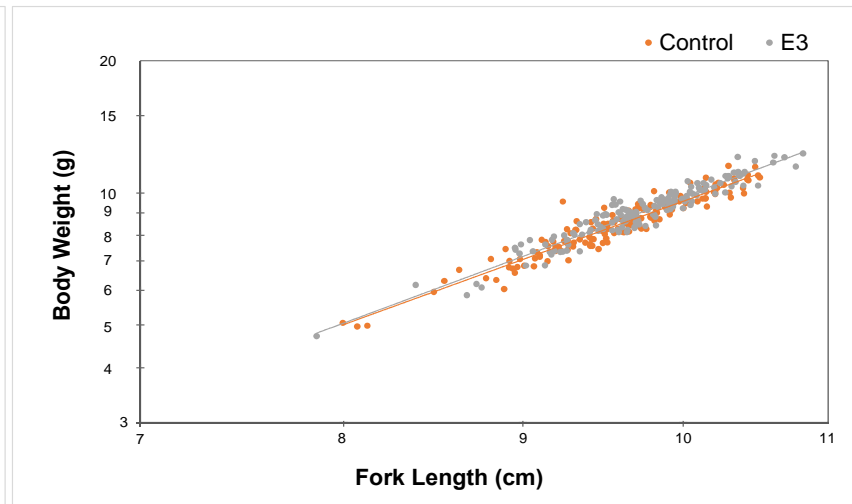
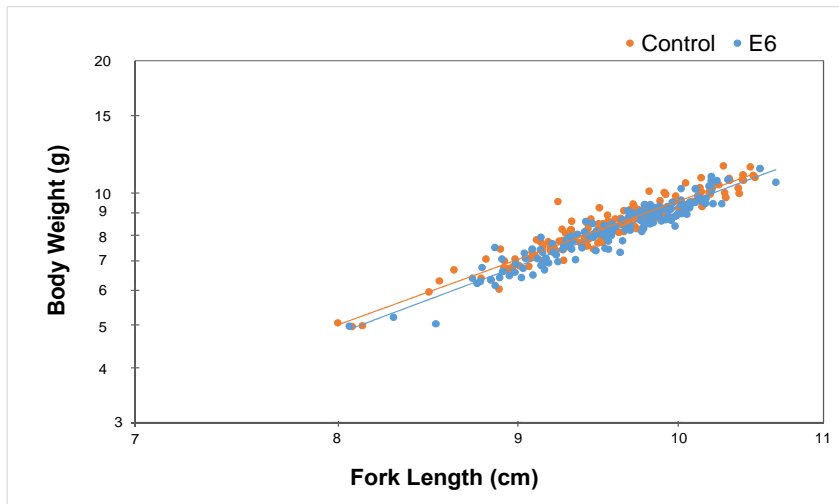
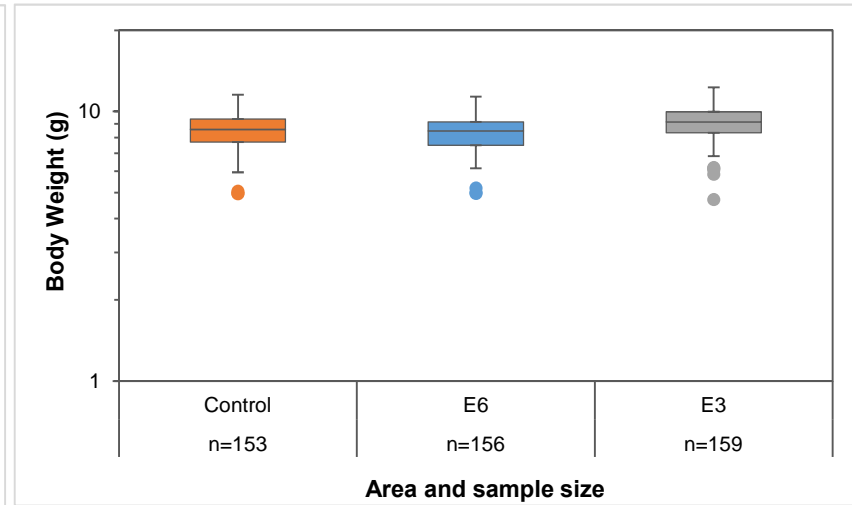
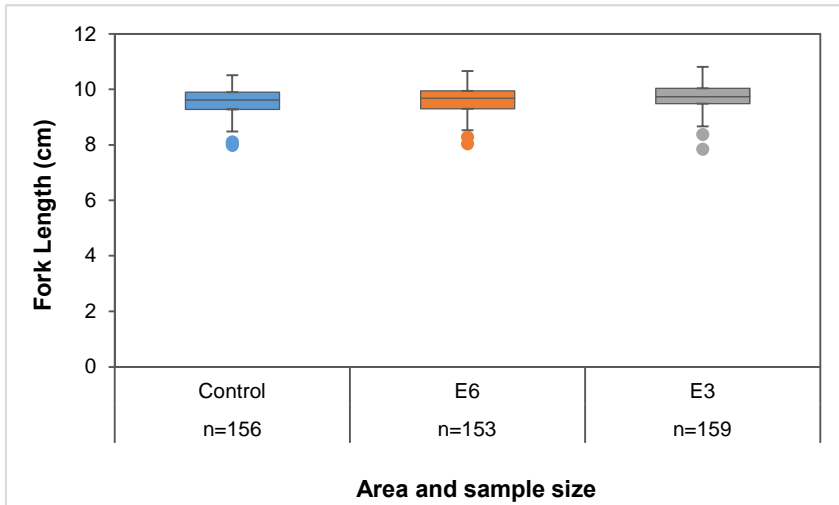


Figure 7.2: Boxplots of Fork Length, Body Weight, and Regression (Body Weight on Fork Length) for Day 47 Kokanee in Control, E6, and E3 Treatments, Minto Mine Fish Hatchery Exposure, August 2016

Note: Boxplots for body weight and regressions are plotted on a log scale.

7.2 Summary and Comparison to Previous EEM

In summary, the on-site laboratory exposure study indicated that fish exposed to the highest effluent concentration (25%) for 47 days were slightly larger and of better condition than those exposed to reference water. Fish exposed to the lower effluent concentration (14%) for 47 days did not differ on the basis of size, but had slightly lower condition than reference fish. In all cases, the magnitudes of the observed differences were very small, and were presumably detected due to the high power associated with large sample size (minimum 152 fish) and uniform fish size. In the case of the condition - the key effect endpoint evaluated in this fish survey - the magnitudes of difference (-2.7% and +2.3% for 14% effluent and 25% effluent, respectively) were well below the CES of 10%. These differences are therefore not considered to be ecologically meaningful.

The results of the Phase 4 EEM fish study were similar to those of the Phase 2 EEM fish study (no fish study was completed in association with the Phase 3 Investigation of Cause of differences in benthic invertebrate communities). Specifically, the Phase 2 fish study (hatchery-based exposure of juvenile chinook salmon) also documented slight increase in size (maximum 5%) and condition (maximum 3%) in association with effluent exposure. Thus, the difference in condition through two consecutive EEM Phases is a confirmed response, albeit at magnitudes well below the CES.



8 CONCLUSIONS

The Minto Mine Phase 4 EEM conducted between June and September 2016 provided sublethal toxicity testing of Minto Mine effluent, an assessment of the influence of Minto Mine effluent discharge on water chemistry and benthic invertebrate community condition of Minto Creek relative to reference sites, and an assessment of the controlled exposure of a sentinel fish (kokanee as a surrogate for chinook salmon) to Minto Mine effluent. Conclusions of this EEM, by monitoring component, are provided below.

Effluent sublethal toxicity tests conducted by the Minto Mine in 2015 and 2016 (data for 2017 have not yet been reported) showed no effects to rainbow trout embryos, the invertebrate *Ceriodaphnia dubia*, the green alga *Pseudokirchneriella subcapitata*, or the plant *Lemna minor*.

Routine water quality monitoring indicated an influence of the Minto Mine on Minto Creek evident in conductivity, hardness, nitrate, aluminum, arsenic, iron, and selenium that were greater than reference. Of these, concentrations of nitrate were most strongly associated with release of water from the water storage pond, but remained below the CWQG. Aluminum and arsenic had mean concentrations greater CWQG, but this occurred at both the effluent-exposed and reference stations. During the Phase 4 EEM benthic survey (in September 2016) water of upper Minto Creek had concentrations of nitrate, total Kjeldahl nitrogen, total phosphorus, copper, and molybdenum greater than the range of reference. Of these, only copper was present at a concentration greater than CWQG, but did not exceed the applicable SSWQO. Of the analytes identified as elevated relative to reference in routine water quality monitoring or during the EEM benthic survey (conductivity, hardness, nitrate, phosphorus, aluminum, arsenic, copper, iron, molybdenum, and selenium), all except for aluminum and arsenic increased in proportion to effluent concentration in the fish exposure vessels.

Mine-exposed benthic invertebrate communities of upper Minto Creek were within reference condition for all four primary EEM metrics (density, taxon richness, Simpson's evenness, and BC distance). Evaluation by control-impact comparison indicated that mean taxon richness, mean Simpson's evenness, and mean BC distance did not differ from the reference mean, whereas mean density of the effluent-exposed upper Minto Creek area was significantly lower than reference. The difference in density was at a magnitude of -1.2 standard deviations, which is below the CES of ± 2 standard deviations and therefore may not be ecologically meaningful. Supplementary examination of taxon proportions indicated lower relative abundances of EPT taxa (Ephemeroptera, Plecoptera, and Trichoptera; mayflies, stoneflies, and caddisflies) at effluent-exposed upper Minto Creek than reference, which was primarily due to lower relative abundance of Plecoptera (individually), and also indicated higher relative abundances of Trichoptera and



oligochaetes. As Plecoptera and Trichoptera are considered to be sensitive organisms and oligochaetes are considered to be tolerant organisms, these results are equivocal with respect to a potential effluent-related influence. Correlation analysis indicated negative relationships between benthic invertebrate density and water quality, and a negative relationship between the proportion of oligochaetes and dissolved oxygen.

The fish survey (an on-site laboratory exposure) indicated that fish exposed to the highest effluent concentration (25%) for 47 days were slightly larger and of better condition than those exposed to reference water. Fish exposed to a lower effluent concentration (14%) for 47 days did not differ on the basis of size, but had slightly lower condition than reference fish. In all cases, the magnitudes of the observed differences were very small, and were presumably detected due to the high power associated with large sample size (minimum 152 fish) and uniform fish size. In the case of the condition - the key effect endpoint evaluated in this fish survey - the magnitudes of difference (-2.7% and +2.3% for 14% effluent and 25% effluent, respectively) were well below the CES of 10%. These differences are therefore not considered to be ecologically meaningful.

The results of the Phase 4 EEM were generally consistent with those of the previous EEM (i.e., the Phase 3 benthic invertebrate community survey and the Phase 2 fish survey). Specifically, the results of the Phase 4 EEM benthic invertebrate community survey were consistent with the results of the Phase 3 EEM - RCA analysis in two consecutive EEM Phases has indicated no effect. A supporting CI comparison in this study (Phase 4) suggested lower density at the effluent-exposed area, but this result was opposite from the apparent greater density observed at one of three sites evaluated by RCA in Phase 3. The results of the Phase 4 EEM fish study were similar to those of the Phase 2 EEM fish study (no fish study was completed in association with the Phase 3 Investigation of Cause study of differences in benthic invertebrate communities). These two consecutive EEM Phases have indicated slightly greater fish size and condition associated with effluent exposure. However, the associated magnitudes of difference for the EEM-effect endpoint (condition) was less than 3%, well below the CES of 10%.

Based on the findings of the Phase 4 EEM and the prescribed EEM frequency under the MMER, the Minto Mine will be required to submit a fifth EEM interpretive report in three years (January 10th 2021). A Phase 5 EEM Study Design, informed by the results of this Phase 4 EEM, must be submitted to Environment and Climate Change Canada (ECCC) no later than six months prior to implementing field collections in 2019 or 2020. Under the current EEM framework (Environment Canada 2012), the next phase of biological monitoring (Phase 5) will require an investigation of confirmed effects to fish. However, proposed amendments to the MMER (ECCC 2016; Government of Canada 2017b) could alter the framework, particularly in cases where observed differences are below applicable CES as observed in this Minto Phase 4 EEM.



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APPENDIX A
MINTO MINE EFFLUENT DATA

Table A.1: Minto Mine Effluent Discharge, 2015 to August 2017

| 2015 | |
|--------------------|------------------------|
| Days of Discharge: | 59 |
| Date | Flow (m ³) |
| 4/3/2015 | 277 |
| 4/4/2015 | 6,599 |
| 4/5/2015 | 7,157 |
| 4/6/2015 | 7,001 |
| 4/7/2015 | 7,025 |
| 4/8/2015 | 7,348 |
| 4/9/2015 | 7,348 |
| 4/10/2015 | 6,745 |
| 4/11/2015 | 5,893 |
| 4/12/2015 | 4,428 |
| 4/13/2015 | 6,724 |
| 4/14/2015 | 7,067 |
| 4/15/2015 | 7,025 |
| 4/16/2015 | 7,395 |
| 4/17/2015 | 7,256 |
| 4/18/2015 | 4,177 |
| 4/19/2015 | 12,200 |
| 4/20/2015 | 11,566 |
| 4/21/2015 | 10,454 |
| 4/22/2015 | 12,614 |
| 4/23/2015 | 9,072 |
| 4/24/2015 | 9,677 |
| 4/25/2015 | 8,133 |
| 4/26/2015 | 7,576 |
| 4/27/2015 | 6,978 |
| 4/28/2015 | 4,870 |
| 4/29/2015 | 5,511 |
| 4/30/2015 | 5,384 |
| 5/1/2015 | 5,407 |
| 5/2/2015 | 4,570 |
| 5/3/2015 | 6,239 |
| 5/4/2015 | 5,918 |
| 5/5/2015 | 2,203 |
| 5/6/2015 | 2,259 |
| 5/7/2015 | 3,774 |
| 5/8/2015 | 4,035 |
| 5/9/2015 | 4,334 |
| 5/10/2015 | 6,353 |
| 5/11/2015 | 6,706 |
| 5/12/2015 | 6,698 |
| 5/13/2015 | 6,542 |
| 5/14/2015 | 6,819 |
| 5/15/2015 | 6,646 |
| 5/16/2015 | 5,247 |
| 5/17/2015 | 6,533 |
| 5/18/2015 | 1,231 |
| 5/19/2015 | 6,399 |
| 5/20/2015 | 6,883 |
| 5/21/2015 | 2,360 |
| 5/22/2015 | 2,840 |
| 5/23/2015 | 2,329 |
| 5/24/2015 | 1,725 |
| 5/25/2015 | 1,710 |
| 5/26/2015 | 1,821 |
| 5/27/2015 | 1,760 |
| 5/28/2015 | 1,770 |
| 5/29/2015 | 1,363 |
| 5/30/2015 | 1,849 |
| 5/31/2015 | 705 |
| TOTAL | 328,526 |

| 2016 | |
|--------------------|------------------------|
| Days of Discharge: | 167 |
| Date | Flow (m ³) |
| 4/7/2016 | 407 |
| 4/8/2016 | 834 |
| 4/9/2016 | 1,233 |
| 4/10/2016 | 1,960 |
| 4/11/2016 | 1,871 |
| 4/12/2016 | 2,163 |
| 4/13/2016 | 2,284 |
| 4/14/2016 | 2,270 |
| 4/15/2016 | 2,277 |
| 4/16/2016 | 1,712 |
| 4/17/2016 | 2,247 |
| 4/18/2016 | 2,275 |
| 4/19/2016 | 1,124 |
| 4/20/2016 | 1,711 |
| 4/21/2016 | 2,287 |
| 4/22/2016 | 2,271 |
| 4/23/2016 | 2,292 |
| 4/24/2016 | 2,264 |
| 4/25/2016 | 2,331 |
| 4/26/2016 | 2,253 |
| 4/27/2016 | 1,321 |
| 4/28/2016 | 633 |
| 4/29/2016 | 643 |
| 4/30/2016 | 936 |
| 5/1/2016 | 801 |
| 5/2/2016 | 706 |
| 5/3/2016 | 718 |
| 5/4/2016 | 720 |
| 5/5/2016 | 771 |
| 5/6/2016 | 925 |
| 5/7/2016 | 896 |
| 5/8/2016 | 110 |
| 5/9/2016 | 35 |
| 5/10/2016 | 4 |
| 5/11/2016 | 963 |
| 5/12/2016 | 659 |
| 5/13/2016 | 1,081 |
| 5/14/2016 | 1,224 |
| 5/15/2016 | 1,673 |
| 5/16/2016 | 1,776 |
| 5/17/2016 | 1,188 |
| 5/18/2016 | 925 |
| 5/19/2016 | 870 |
| 5/20/2016 | 807 |
| 5/21/2016 | 590 |
| 5/22/2016 | 580 |
| 5/23/2016 | 715 |
| 5/24/2016 | 731 |
| 5/25/2016 | 630 |
| 5/26/2016 | 582 |
| 5/27/2016 | 809 |
| 5/28/2016 | 1,118 |
| 5/29/2016 | 1,213 |
| 5/30/2016 | 929 |
| 5/31/2016 | 780 |
| 6/1/2016 | 294 |
| 6/2/2016 | 0 |
| 6/3/2016 | 434 |
| 6/4/2016 | 589 |
| 6/5/2016 | 915 |

| 2016 - cont | |
|-------------|------------------------|
| Date | Flow (m ³) |
| 6/16/2016 | 731 |
| 6/17/2016 | 522 |
| 6/18/2016 | 396 |
| 6/19/2016 | 101 |
| 6/20/2016 | 304 |
| 6/21/2016 | 129 |
| 6/22/2016 | 382 |
| 6/23/2016 | 201 |
| 6/24/2016 | 419 |
| 6/25/2016 | 363 |
| 6/26/2016 | 330 |
| 6/27/2016 | 87 |
| 7/7/2016 | 490 |
| 7/8/2016 | 597 |
| 7/9/2016 | 439 |
| 7/10/2016 | 388 |
| 7/11/2016 | 236 |
| 7/12/2016 | 538 |
| 7/13/2016 | 926 |
| 7/14/2016 | 398 |
| 7/15/2016 | 289 |
| 7/16/2016 | 490 |
| 7/17/2016 | 232 |
| 7/18/2016 | 363 |
| 7/19/2016 | 352 |
| 7/20/2016 | 358 |
| 7/21/2016 | 360 |
| 7/22/2016 | 631 |
| 7/23/2016 | 1,005 |
| 7/24/2016 | 1,288 |
| 7/25/2016 | 943 |
| 7/26/2016 | 1,759 |
| 7/27/2016 | 2,106 |
| 7/28/2016 | 1,252 |
| 7/29/2016 | 1,215 |
| 7/30/2016 | 1,088 |
| 7/31/2016 | 653 |
| 8/1/2016 | 579 |
| 8/2/2016 | 617 |
| 8/3/2016 | 650 |
| 8/4/2016 | 678 |
| 8/5/2016 | 504 |
| 8/6/2016 | 886 |
| 8/7/2016 | 1,058 |
| 8/8/2016 | 711 |
| 8/9/2016 | 1,742 |
| 8/10/2016 | 2,001 |
| 8/11/2016 | 1,203 |
| 8/12/2016 | 1,008 |
| 8/13/2016 | 885 |
| 8/14/2016 | 628 |
| 8/15/2016 | 538 |
| 8/16/2016 | 550 |
| 8/17/2016 | 548 |
| 8/18/2016 | 622 |
| 8/19/2016 | 1,058 |
| 8/20/2016 | 1,022 |
| 8/21/2016 | 683 |
| 8/22/2016 | 686 |
| 8/23/2016 | 605 |


| 2016 - cont | |
|--------------|------------------------|
| Date | Flow (m ³) |
| 8/24/2016 | 567 |
| 8/25/2016 | 734 |
| 8/26/2016 | 1,328 |
| 8/27/2016 | 1,519 |
| 8/28/2016 | 1,242 |
| 8/29/2016 | 1,222 |
| 8/30/2016 | 1,179 |
| 8/31/2016 | 1,230 |
| 9/1/2016 | 1,119 |
| 9/2/2016 | 1,649 |
| 9/3/2016 | 893 |
| 9/4/2016 | 480 |
| 9/5/2016 | 1,663 |
| 9/6/2016 | 1,328 |
| 9/7/2016 | 1,650 |
| 9/8/2016 | 2,205 |
| 9/9/2016 | 1,222 |
| 9/10/2016 | 1,840 |
| 9/11/2016 | 1,484 |
| 9/12/2016 | 1,639 |
| 9/13/2016 | 1,426 |
| 9/14/2016 | 1,225 |
| 9/15/2016 | 1,742 |
| 9/16/2016 | 1,410 |
| 9/17/2016 | 1,697 |
| 9/18/2016 | 1,504 |
| 9/19/2016 | 1,594 |
| 9/20/2016 | 1,437 |
| 9/21/2016 | 1,340 |
| 9/22/2016 | 1,213 |
| 9/23/2016 | 1,205 |
| 9/24/2016 | 1,180 |
| 9/25/2016 | 1,179 |
| 9/26/2016 | 1,166 |
| 9/27/2016 | 1,168 |
| 9/28/2016 | 1,139 |
| 9/29/2016 | 1,138 |
| 9/30/2016 | 879 |
| 10/1/2016 | 475 |
| 10/2/2016 | 728 |
| 10/3/2016 | 745 |
| 10/4/2016 | 357 |
| 10/5/2016 | 510 |
| 10/6/2016 | 787 |
| 10/7/2016 | 773 |
| 10/8/2016 | 765 |
| 10/9/2016 | 747 |
| TOTAL | 166,897 |

| 2017 (data to August 5th only) | |
|--------------------------------|------------------------|
| Days of Discharge: | 72 |
| Date | Flow (m ³) |
| 4/16/2017 | 7 |
| 5/1/2017 | 818 |
| 5/2/2017 | 1,070 |
| 5/3/2017 | 1,068 |
| 5/4/2017 | 1,066 |
| 5/5/2017 | 1,070 |
| 5/6/2017 | 1,074 |
| 5/7/2017 | 1,076 |
| 5/8/2017 | 838 |
| 5/9/2017 | 1,084 |
| 5/10/2017 | 1,085 |
| 5/11/2017 | 1,094 |
| 5/12/2017 | 1,095 |
| 5/13/2017 | 1,091 |
| 5/14/2017 | 1,096 |
| 5/15/2017 | 1,101 |
| 5/16/2017 | 1,107 |
| 5/17/2017 | 1,100 |
| 5/18/2017 | 1,118 |
| 5/19/2017 | 1,118 |
| 5/20/2017 | 1,134 |
| 5/21/2017 | 1,142 |
| 5/22/2017 | 1,159 |
| 5/23/2017 | 1,161 |
| 5/24/2017 | 1,165 |
| 5/25/2017 | 1,116 |
| 5/26/2017 | 1,161 |
| 5/27/2017 | 1,153 |
| 5/28/2017 | 1,152 |
| 5/29/2017 | 1,623 |
| 5/30/2017 | 1,653 |
| 5/31/2017 | 1,550 |
| 6/1/2017 | 676 |
| 6/2/2017 | 483 |
| 6/3/2017 | 1,677 |
| 6/4/2017 | 3,516 |
| 6/5/2017 | 3,909 |
| 6/6/2017 | 2,516 |
| 6/7/2017 | 1,812 |
| 6/8/2017 | 717 |
| 6/9/2017 | 261 |
| 6/10/2017 | 619 |
| 6/11/2017 | 291 |
| 6/12/2017 | 3,459 |
| 6/13/2017 | 4,411 |
| 6/14/2017 | 2,095 |
| 6/15/2017 | 1,777 |
| 6/16/2017 | 1,499 |
| 6/17/2017 | 1,666 |
| 6/18/2017 | 1,277 |
| 6/19/2017 | 960 |
| 6/20/2017 | 1,096 |
| 6/21/2017 | 778 |
| 6/22/2017 | 474 |
| 6/23/2017 | 663 |
| 6/24/2017 | 672 |
| 6/25/2017 | 628 |
| 6/26/2017 | 223 |
| 7/1/2017 | 631 |
| 7/12/2017 | 977 |

| 2017 (data to August 5th only) - cont | |
|---------------------------------------|------------------------|
| Date | Flow (m ³) |
| 7/13/2017 | 296 |
| 7/26/2017 | 333 |
| 7/27/2017 | 955 |
| 7/28/2017 | 772 |
| 7/29/2017 | 660 |
| 7/30/2017 | 673 |
| 7/31/2017 | 662 |
| 8/1/2017 | 658 |
| 8/2/2017 | 434 |
| 8/3/2017 | 313 |
| 8/4/2017 | 310 |
| 8/5/2017 | 137 |
| TOTAL | 81,311 |

Table A.2: Minto Mine Weekly MMER Effluent Quality Data, 2015-2017


| Date | | pH | Total Suspended Solids | Arsenic | Copper | Lead | Nickel | Zinc | Radium-226 |
|-------------------------|-------------------|-----------|------------------------|---------|--------|----------|---------|---------|------------|
| | | pH units | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Bq/L |
| MMER limit (grab) | | 6.0 - 9.5 | 30 | 1.0 | 0.60 | 0.40 | 1.0 | 1.0 | 1.11 |
| 2-Jan-15 | Grab | 8.11 | 3.6 | 0.00025 | 0.0031 | <0.00020 | 0.0012 | <0.0050 | |
| 6-Jan-15 | Grab | 8.04 | | 0.00027 | 0.0024 | <0.00020 | <0.0010 | <0.0050 | |
| 13-Jan-15 | Grab | 8.26 | 1.5 | 0.00024 | 0.0023 | <0.00020 | <0.0010 | <0.0050 | |
| 21-Jan-15 | Grab | 8.28 | 1.7 | 0.00023 | 0.0019 | <0.00020 | <0.0010 | <0.0050 | |
| 29-Jan-15 | Grab | 8.29 | 1.2 | 0.00024 | 0.0023 | <0.00020 | <0.0010 | <0.0050 | |
| 3-Feb-15 | Grab | 8.19 | 2.9 | 0.00042 | 0.0034 | <0.00020 | 0.0016 | <0.0050 | |
| 11-Feb-15 | Grab | 7.91 | <1.0 | 0.00023 | 0.0033 | <0.00020 | 0.0011 | <0.0050 | |
| 18-Feb-15 | Grab | 7.88 | <1.0 | 0.00022 | 0.0021 | <0.00020 | 0.0011 | <0.0050 | |
| 26-Feb-15 | Grab | 8.08 | <1.0 | 0.00021 | 0.0018 | <0.00020 | 0.0012 | <0.0050 | |
| 3-Mar-15 | Grab | 7.88 | <1.0 | 0.00021 | 0.0038 | <0.00020 | 0.0012 | 0.032 | |
| 9-Mar-15 | Grab | 8.06 | <1.0 | 0.00023 | 0.0033 | <0.00020 | <0.0010 | <0.0050 | |
| 16-Mar-15 | Grab | 8.11 | <1.0 | 0.00021 | 0.0034 | <0.00020 | 0.0011 | 0.021 | <0.010 |
| 25-Mar-15 | Grab | 8.09 | <1.0 | 0.00022 | 0.0017 | <0.00020 | 0.0011 | <0.0050 | |
| 30-Mar-15 | Grab | 8.45 | <1.0 | 0.00023 | 0.0046 | <0.00020 | 0.0012 | 0.16 | |
| 6-Apr-15 | Grab | 8.11 | 2.8 | 0.00048 | 0.011 | <0.00020 | <0.0010 | 0.014 | |
| 14-Apr-15 | Grab | 8.22 | 4.3 | 0.00041 | 0.015 | 0.00058 | <0.0010 | <0.0050 | <0.010 |
| 21-Apr-15 | Grab | 8.13 | 9.4 | 0.00049 | 0.019 | 0.00021 | <0.0010 | <0.0050 | |
| 27-Apr-15 | Grab | 8.14 | 4.2 | 0.00035 | 0.023 | <0.00020 | <0.0010 | <0.0050 | |
| 10-May-15 | Grab | 8.16 | <1.0 | 0.00033 | 0.010 | <0.00020 | <0.0010 | 0.016 | |
| 14-May-15 | Grab | 8.06 | 11 | 0.00043 | 0.021 | <0.00020 | <0.0010 | <0.0050 | |
| 20-May-15 | Grab | 8.07 | 5.4 | 0.00049 | 0.024 | <0.00020 | 0.0012 | <0.0050 | |
| 29-May-15 | Grab | 8.13 | 1.4 | 0.00035 | 0.012 | <0.00020 | <0.0010 | <0.0050 | |
| 31-May-15 | Grab | 8.24 | 2.0 | 0.00041 | 0.013 | <0.00020 | <0.0010 | <0.0050 | |
| 4-Jun-15 | Grab | 8.15 | <1.0 | 0.00025 | 0.0030 | <0.00020 | <0.0010 | 0.051 | |
| 9-Jun-15 | Grab | 8.19 | <1.0 | 0.00025 | 0.0029 | <0.00020 | <0.0010 | <0.0050 | |
| 15-Jun-15 | Grab | 8.21 | 13 | 0.00053 | 0.020 | 0.00028 | 0.0018 | <0.0050 | |
| 22-Jun-15 | Grab | 8.32 | <1.0 | 0.00026 | 0.0024 | <0.00020 | <0.0010 | <0.0050 | |
| 29-Jun-15 | Grab | 8.32 | <1.0 | 0.00022 | 0.0030 | <0.00020 | <0.0010 | <0.0050 | |
| 7-Jul-15 | Grab | 8.31 | 8.3 | 0.00027 | 0.0027 | <0.00020 | <0.0010 | <0.0050 | |
| 14-Jul-15 | Grab | 8.16 | <1.0 | 0.00023 | 0.0026 | <0.00020 | <0.0010 | <0.0050 | |
| 20-Jul-15 | Grab | 8.26 | <1.0 | 0.00028 | 0.0024 | <0.00020 | <0.0010 | <0.0050 | |
| 29-Jul-15 | Grab | 8.22 | <1.0 | 0.00029 | 0.0025 | <0.00020 | <0.0010 | <0.0050 | |
| 5-Aug-15 | Grab | 8.34 | <1.0 | 0.00027 | 0.0021 | <0.00020 | <0.0010 | <0.0050 | |
| 14-Aug-15 | Grab | 8.18 | <1.0 | 0.00028 | 0.0029 | <0.00020 | <0.0010 | <0.0050 | |
| 18-Aug-15 | Grab | 8.32 | <1.0 | 0.00032 | 0.0033 | <0.00020 | <0.0010 | <0.0050 | |
| 24-Aug-15 | Grab | 8.04 | <1.0 | 0.00025 | 0.0022 | <0.00020 | <0.0010 | <0.0050 | |
| 31-Aug-15 | Grab | 8.19 | 4.6 | 0.00033 | 0.0053 | <0.00020 | 0.0012 | <0.0050 | <0.010 |
| 8-Sep-15 | Grab | 8.27 | 17 | 0.00029 | 0.0058 | <0.00020 | 0.0011 | <0.0050 | |
| 15-Sep-15 | Grab | 8.34 | <1.0 | 0.00029 | 0.0030 | <0.00020 | <0.0010 | <0.0050 | |
| 23-Sep-15 | Grab | 8.43 | <1.0 | 0.00026 | 0.0026 | <0.00020 | <0.0010 | <0.0050 | |
| 30-Sep-15 | Grab | 8.42 | <1.0 | 0.00030 | 0.0026 | <0.00020 | <0.0010 | <0.0050 | |
| 5-Oct-15 | Grab | 8.38 | <1.0 | 0.00025 | 0.0021 | <0.00020 | <0.0010 | <0.0050 | <0.010 |
| 13-Oct-15 | Grab | 8.28 | <1.0 | 0.00021 | 0.0027 | <0.00020 | <0.0010 | <0.0050 | |
| 22-Oct-15 | Grab | 8.16 | <1.0 | 0.00028 | 0.0025 | <0.00020 | <0.0010 | <0.0050 | |
| 28-Oct-15 | Grab | 8.12 | <1.0 | 0.00026 | 0.0025 | <0.00020 | <0.0010 | <0.0050 | |
| 2-Nov-15 | Grab | 8.15 | <1.0 | 0.00017 | 0.0021 | <0.00020 | <0.0010 | <0.0050 | |
| 9-Nov-15 | Grab | 8.20 | <1.0 | 0.00023 | 0.0025 | <0.00020 | <0.0010 | <0.0050 | |
| 16-Nov-15 | Grab | 8.42 | <1.0 | 0.00030 | 0.0031 | <0.00020 | <0.0010 | <0.0050 | |
| 23-Nov-15 | Grab | 8.23 | <1.0 | 0.00024 | 0.0020 | <0.00020 | <0.0010 | <0.0050 | |
| 6-Dec-15 | Grab | 8.25 | <1.0 | 0.00031 | 0.0020 | <0.00020 | 0.0029 | <0.0050 | |
| 8-Dec-15 | Grab | 8.46 | <1.0 | 0.00017 | 0.0021 | <0.00020 | 0.0015 | <0.0050 | |
| 19-Dec-15 | Grab | 8.10 | 5.6 | 0.00023 | 0.0023 | <0.00020 | <0.0010 | 0.0083 | |
| 26-Dec-15 | Grab | 8.22 | 6.1 | 0.00022 | 0.0033 | <0.00020 | 0.0010 | 0.0094 | |
| 2015 Summary Statistics | Count | 53 | 52 | 53 | 53 | 53 | 53 | 53 | 4 |
| | Count < MDL | 0 | 33 | 0 | 0 | 50 | 37 | 45 | 4 |
| | Count > MDL | 53 | 19 | 53 | 53 | 3 | 16 | 8 | 0 |
| | Mean ¹ | 8.20 | <2.7 | 0.00029 | 0.0054 | <0.00021 | <0.0011 | <0.010 | <0.010 |
| | Median | 8.19 | <1 | 0.00026 | 0.0029 | <0.00020 | <0.0010 | <0.0050 | <0.010 |
| | Maximum | 8.46 | 17 | 0.00053 | 0.024 | 0.00058 | 0.0029 | 0.16 | <0.010 |

 Highlight indicates a result greater than the applicable MMER limit.

¹ If greater than 50% of samples were less than method detection limit than the mean was presented with a less than symbol.

Table A.2: Minto Mine Weekly MMER Effluent Quality Data, 2015-2017


| Date | | pH | Total Suspended Solids | Arsenic | Copper | Lead | Nickel | Zinc | Radium-226 |
|-------------------------|-------------------|-----------|------------------------|---------|--------|-----------|----------|---------|------------|
| | | pH units | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Bq/L |
| MMER limit (grab) | | 6.0 - 9.5 | 30 | 1.0 | 0.60 | 0.40 | 1.0 | 1.0 | 1.11 |
| 1-Jan-16 | Grab | 8.19 | <1.0 | 0.00026 | 0.0022 | <0.00020 | <0.0010 | <0.0050 | |
| 8-Jan-16 | Grab | 8.22 | 1.0 | 0.00027 | 0.0032 | <0.00020 | 0.0011 | <0.0050 | |
| 14-Jan-16 | Grab | 8.16 | 3.1 | 0.00026 | 0.0037 | <0.00020 | <0.0010 | 0.0068 | |
| 19-Jan-16 | Grab | 8.23 | 1.1 | 0.00031 | 0.0020 | <0.00020 | 0.0011 | <0.0050 | |
| 25-Jan-16 | Grab | 8.10 | 1.1 | 0.00029 | 0.0022 | <0.00020 | <0.0010 | <0.0050 | |
| 1-Feb-16 | Grab | 8.43 | 1.1 | 0.00031 | 0.0033 | <0.00020 | <0.0010 | <0.0050 | |
| 14-Feb-16 | Grab | 8.01 | 4.1 | 0.00037 | 0.011 | 0.00021 | <0.0010 | <0.0050 | |
| 20-Feb-16 | Grab | 8.35 | 18 | 0.00024 | 0.0021 | <0.00020 | <0.0010 | <0.0050 | |
| 28-Feb-16 | Grab | 8.21 | 4.7 | 0.00031 | 0.0029 | <0.00020 | <0.0010 | <0.0050 | |
| 1-Mar-16 | Grab | 8.39 | 2.6 | 0.00037 | 0.0022 | <0.00020 | <0.0010 | <0.0050 | |
| 8-Mar-16 | Grab | 8.11 | 5.1 | 0.00029 | 0.0040 | <0.00020 | 0.0011 | <0.0050 | |
| 19-Mar-16 | Grab | 8.23 | 2.8 | 0.00028 | 0.0019 | <0.00020 | <0.0010 | <0.0050 | |
| 24-Mar-16 | Grab | 8.12 | 2.5 | 0.00031 | 0.0045 | <0.00020 | <0.0010 | 0.0095 | |
| 30-Mar-16 | Grab | 7.84 | 30 | 0.00056 | 0.014 | 0.00021 | 0.0015 | 0.0034 | |
| 4-Apr-16 | Grab | 8.14 | 6.7 | 0.00036 | 0.0049 | 0.000074 | 0.0011 | <0.0030 | |
| 12-Apr-16 | Grab | 7.99 | 7.3 | 0.00052 | 0.020 | 0.00021 | 0.0020 | 0.0035 | |
| 19-Apr-16 | Grab | 8.28 | <3.0 | 0.00033 | 0.012 | <0.000050 | 0.0011 | <0.0030 | |
| 26-Apr-16 | Grab | 8.08 | <3.0 | 0.00032 | 0.012 | 0.000053 | 0.0010 | <0.0030 | |
| 2-May-16 | Grab | 8.32 | 5.3 | 0.00027 | 0.0089 | <0.000050 | 0.0010 | <0.0030 | |
| 12-May-16 | Grab | 8.24 | <3.0 | 0.00029 | 0.0072 | <0.000050 | 0.0015 | <0.0030 | |
| 17-May-16 | Grab | 8.15 | 4.0 | 0.00035 | 0.015 | <0.000050 | 0.0013 | <0.0030 | |
| 24-May-16 | Grab | 7.99 | <3.0 | 0.00029 | 0.014 | <0.000050 | 0.0011 | <0.0030 | |
| 31-May-16 | Grab | 8.09 | <3.0 | 0.00030 | 0.012 | <0.000050 | 0.0011 | <0.0030 | |
| 7-Jun-16 | Grab | 8.15 | <3.0 | 0.00029 | 0.012 | <0.000050 | 0.0012 | <0.0030 | |
| 14-Jun-16 | Grab | 8.06 | <3.0 | 0.00030 | 0.0097 | <0.000050 | 0.0010 | <0.0030 | |
| 21-Jun-16 | Grab | 8.03 | <3.0 | 0.00028 | 0.0071 | <0.000050 | 0.0012 | <0.0030 | |
| 28-Jun-16 | Grab | 8.13 | <3.0 | 0.00023 | 0.0035 | <0.000050 | 0.00096 | <0.0030 | |
| 5-Jul-16 | Grab | 8.39 | <3.0 | 0.00026 | 0.0029 | <0.000050 | 0.0011 | <0.0030 | |
| 12-Jul-16 | Grab | 8.01 | <3.0 | 0.00028 | 0.0039 | <0.000050 | 0.0011 | <0.0030 | |
| 19-Jul-16 | Grab | 8.20 | <3.0 | 0.00027 | 0.0059 | <0.000050 | 0.0011 | <0.0030 | |
| 26-Jul-16 | Grab | 7.98 | 4.7 | 0.00040 | 0.012 | <0.000050 | 0.0014 | <0.0030 | |
| 2-Aug-16 | Grab | 8.05 | <3.0 | 0.00032 | 0.0096 | <0.000050 | 0.0010 | <0.0030 | |
| 9-Aug-16 | Grab | 8.16 | <3.0 | 0.00035 | 0.0095 | <0.000050 | 0.0010 | <0.0030 | |
| 15-Aug-16 | Grab | 8.09 | <3.0 | 0.00029 | 0.0086 | <0.000050 | 0.00095 | <0.0030 | |
| 17-Aug-16 | Grab | 7.93 | <3.0 | 0.00031 | 0.0082 | <0.000050 | 0.0010 | <0.0030 | |
| 23-Aug-16 | Grab | 8.13 | <3.0 | 0.00035 | 0.0087 | <0.000050 | 0.00092 | <0.0030 | |
| 30-Aug-16 | Grab | 8.31 | <3.0 | 0.00033 | 0.012 | <0.000050 | 0.00092 | <0.0030 | |
| 6-Sep-16 | Grab | 8.10 | <3.0 | 0.00025 | 0.0083 | <0.000050 | 0.00050 | <0.0030 | |
| 13-Sep-16 | Grab | 7.86 | <3.0 | 0.00022 | 0.0072 | 0.000081 | 0.00054 | <0.0030 | |
| 20-Sep-16 | Grab | 7.87 | <3.0 | 0.00022 | 0.0074 | <0.000050 | 0.00056 | <0.0030 | |
| 27-Sep-16 | Grab | 7.99 | <3.0 | 0.00020 | 0.0063 | 0.000067 | 0.00056 | <0.0030 | |
| 3-Oct-16 | Grab | 7.96 | <3.0 | 0.00016 | 0.0048 | <0.000050 | <0.00050 | <0.0030 | |
| 4-Oct-16 | Grab | 8.15 | <3.0 | 0.00023 | 0.0067 | <0.000050 | 0.00070 | <0.0030 | |
| 11-Oct-16 | Grab | 8.22 | <3.0 | 0.00029 | 0.0094 | <0.000050 | 0.0010 | <0.0030 | |
| 18-Oct-16 | Grab | 8.20 | <3.0 | 0.00036 | 0.013 | 0.000052 | 0.00088 | <0.0030 | |
| 23-Oct-16 | Grab | 8.27 | <3.0 | 0.00034 | 0.013 | 0.000050 | 0.00076 | <0.0030 | |
| 25-Oct-16 | Grab | 8.23 | <3.0 | 0.00030 | 0.013 | 0.00031 | 0.00078 | 0.0031 | |
| 1-Nov-16 | Grab | 8.46 | <3.0 | 0.00024 | 0.0041 | <0.000050 | 0.00088 | <0.0030 | |
| 8-Nov-16 | Grab | 8.25 | <3.0 | 0.00026 | 0.0033 | <0.000050 | 0.00099 | <0.0030 | |
| 15-Nov-16 | Grab | 8.13 | 3.7 | 0.00027 | 0.0029 | <0.000050 | 0.00095 | <0.0030 | |
| 22-Nov-16 | Grab | 7.88 | 3.5 | 0.00028 | 0.0027 | <0.000050 | 0.0010 | <0.0030 | |
| 29-Nov-16 | Grab | 8.14 | <3.0 | 0.00027 | 0.0035 | <0.000050 | 0.0011 | <0.0030 | |
| 6-Dec-16 | Grab | 8.35 | <3.0 | 0.00026 | 0.0056 | <0.000050 | 0.00094 | <0.0030 | |
| 13-Dec-16 | Grab | 8.05 | <3.0 | 0.00024 | 0.0022 | <0.000050 | 0.00090 | <0.0030 | |
| 20-Dec-16 | Grab | 8.00 | 6.5 | 0.00024 | 0.0083 | 0.000052 | 0.0012 | 0.0030 | |
| 27-Dec-16 | Grab | 7.81 | <3.0 | 0.00025 | 0.0030 | <0.000050 | 0.00086 | <0.0030 | |
| 2016 Summary Statistics | Count | 56 | 56 | 56 | 56 | 56 | 56 | 56 | - |
| | Count < MDL | 0 | 35 | 0 | 0 | 45 | 11 | 50 | - |
| | Count > MDL | 56 | 21 | 56 | 56 | 11 | 45 | 6 | - |
| | Mean ¹ | 8.13 | <3.1 | 0.00030 | 0.0072 | <0.000065 | 0.0010 | <0.0032 | - |
| | Median | 8.14 | 2.5 | 0.00029 | 0.0069 | <0.000050 | 0.0010 | <0.0030 | - |
| | Maximum | 8.46 | 30 | 0.00056 | 0.020 | 0.00031 | 0.0020 | 0.0095 | - |

 Highlight indicates a result greater than the applicable MMER limit.

¹ If greater than 50% of samples were less than method detection limit than the mean was presented with a less than symbol.

Table A.2: Minto Mine Weekly MMER Effluent Quality Data, 2015-2017

| Date | | pH | Total Suspended Solids | Arsenic | Copper | Lead | Nickel | Zinc | Radium-226 |
|---|--------------------------|-------------|------------------------|----------------|---------------|---------------------|---------------|-------------------|---------------|
| | | pH units | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Bq/L |
| MMER limit (grab) | | 6.0 - 9.5 | 30 | 1.0 | 0.60 | 0.40 | 1.0 | 1.0 | 1.11 |
| 3-Jan-17 | Grab | 7.92 | <3.0 | 0.00027 | 0.0027 | <0.000050 | 0.00088 | <0.0030 | |
| 10-Jan-17 | Grab | 7.97 | <3.0 | 0.00024 | 0.0039 | <0.000050 | 0.00091 | <0.0030 | |
| 17-Jan-17 | Grab | 8.17 | <3.0 | 0.00027 | 0.0031 | <0.000050 | 0.0010 | <0.0030 | |
| 24-Jan-17 | Grab | 8.01 | 18 | 0.00057 | 0.0099 | 0.00030 | 0.0023 | 0.0061 | |
| 31-Jan-17 | Grab | 8.12 | <3.0 | 0.00035 | 0.0034 | <0.000050 | 0.00086 | <0.0030 | |
| 7-Feb-17 | Grab | 8.16 | 9.3 | 0.00037 | 0.0037 | 0.00011 | 0.0014 | 0.0056 | |
| 14-Feb-17 | Grab | 8.24 | <3.0 | 0.00033 | 0.011 | <0.000050 | 0.00091 | 0.0037 | |
| 21-Feb-17 | Grab | 8.16 | <3.0 | 0.00023 | 0.0039 | <0.000050 | 0.00085 | <0.0030 | |
| 28-Feb-17 | Grab | 8.10 | 3.0 | 0.00030 | 0.0036 | 0.000061 | 0.0010 | <0.0030 | |
| 7-Mar-17 | Grab | 8.14 | <3.0 | 0.00024 | 0.0029 | <0.000050 | 0.00093 | <0.0030 | |
| 14-Mar-17 | Grab | 8.00 | <3.0 | 0.00029 | 0.0062 | <0.000050 | 0.0013 | 0.010 | 0.070 |
| 21-Mar-17 | Grab | 8.30 | <3.0 | 0.00029 | 0.0028 | <0.000050 | 0.0012 | <0.0030 | |
| 28-Mar-17 | Grab | 8.09 | <3.0 | 0.00024 | 0.0029 | <0.000050 | 0.0013 | <0.0030 | |
| 4-Apr-17 | Grab | 8.03 | <3.0 | 0.00027 | 0.0019 | <0.000050 | 0.0018 | <0.0030 | |
| 6-Apr-17 | Grab | 8.27 | <3.0 | 0.00036 | 0.0067 | <0.000050 | 0.0012 | <0.0030 | |
| 11-Apr-17 | Grab | 8.25 | <3.0 | 0.00026 | 0.0078 | <0.000050 | 0.00093 | <0.0030 | |
| 18-Apr-17 | Grab | 8.24 | <3.0 | 0.00024 | 0.0090 | <0.000050 | 0.00092 | <0.0030 | |
| 25-Apr-17 | Grab | 8.30 | <3.0 | 0.00022 | 0.0043 | <0.000050 | 0.00086 | <0.0030 | |
| 2-May-17 | Grab | 8.04 | 10 | 0.00039 | 0.030 | 0.00018 | 0.0015 | <0.0030 | |
| 9-May-17 | Grab | 8.08 | <3.0 | 0.00037 | 0.013 | <0.000050 | 0.00094 | 0.0030 | |
| 16-May-17 | Grab | 8.32 | <3.0 | 0.00030 | 0.014 | <0.000050 | 0.00090 | <0.0030 | |
| 23-May-17 | Grab | 8.13 | 9.4 | 0.00038 | 0.016 | 0.00011 | 0.0013 | <0.0030 | |
| 23-May-17 | Grab | 8.13 | 11 | 0.00037 | 0.016 | 0.00011 | 0.0013 | <0.0030 | |
| 30-May-17 | Grab | 8.18 | 3.4 | 0.00038 | 0.015 | 0.00012 | 0.0013 | 0.0050 | |
| 30-May-17 | Grab | 8.29 | <3.0 | 0.00049 | 0.024 | 0.00023 | 0.0016 | 0.0039 | |
| 6-Jun-17 | Grab | 8.21 | 5.7 | 0.00039 | 0.027 | 0.000078 | 0.0012 | <0.0030 | 0.0082 |
| 13-Jun-17 | Grab | 8.03 | <3.0 | 0.00043 | 0.026 | 0.000074 | 0.0014 | <0.0030 | |
| 20-Jun-17 | Grab | 8.20 | <3.0 | 0.00036 | 0.017 | <0.000050 | 0.0012 | <0.0030 | |
| 20-Jun-17 | Grab | 8.19 | <3.0 | 0.00040 | 0.016 | <0.000050 | 0.0012 | <0.0030 | |
| 27-Jun-17 | Grab | 8.19 | 3.4 | 0.00027 | 0.0053 | <0.000050 | 0.0011 | <0.0030 | |
| 4-Jul-17 | Grab | 8.31 | <3.0 | 0.00025 | 0.0035 | <0.000050 | 0.00093 | <0.0030 | |
| 11-Jul-17 | Grab | 8.33 | <3.0 | 0.00029 | 0.0036 | <0.000050 | 0.00098 | <0.0030 | |
| 18-Jul-17 | Grab | 8.19 | 5.4 | 0.00035 | 0.0090 | 0.000092 | 0.0014 | 0.0037 | |
| 25-Jul-17 | Grab | 8.11 | <3.0 | 0.00034 | 0.0049 | <0.000050 | 0.0012 | <0.0030 | |
| 1-Aug-17 | Grab | 8.05 | 3.0 | 0.00044 | 0.014 | <0.000050 | 0.0012 | <0.0030 | <0.0096 |
| 8-Aug-17 | Grab | 8.09 | <3.0 | 0.00029 | 0.0050 | <0.000050 | 0.0011 | <0.0030 | |
| 15-Aug-17 | Grab | 8.34 | <3.0 | 0.00029 | 0.0035 | <0.000050 | 0.0010 | <0.0030 | |
| 22-Aug-17 | Grab | 8.38 | <3.0 | 0.00025 | 0.0029 | <0.000050 | 0.0011 | <0.0030 | |
| 23-Aug-17 | Grab | 8.46 | 8.0 | 0.00036 | 0.0061 | 0.00011 | 0.0013 | <0.0030 | |
| 29-Aug-17 | Grab | 8.25 | <3.0 | 0.00026 | 0.0029 | <0.000050 | 0.00093 | <0.0030 | |
| 5-Sep-17 | Grab | 8.35 | <3.0 | 0.00027 | 0.0030 | <0.000050 | 0.0010 | <0.0030 | |
| 12-Sep-17 | Grab | 8.50 | <3.0 | 0.00025 | 0.0032 | <0.000050 | 0.0010 | <0.0030 | |
| 2017 Summary Statistics (Till 12-Sep-17) | Count | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 3 |
| | Count < MDL | 0 | 30 | 0 | 0 | 30 | 0 | 34 | 1 |
| | Count > MDL | 42 | 12 | 42 | 42 | 12 | 42 | 8 | 2 |
| | Mean ¹ | 8.19 | <4.3 | 0.00032 | 0.0088 | <0.000073 | 0.0012 | <0.0034 | 0.029 |
| | Median | 8.19 | <3.0 | 0.00030 | 0.0052 | <0.000050 | 0.0011 | <0.0030 | 0.0082 |
| | Maximum | 8.50 | 18 | 0.00057 | 0.030 | 0.00030 | 0.0023 | 0.010 | 0.070 |

 Highlight indicates a result greater than the applicable MMER limit.

¹ If greater than 50% of samples were less than method detection limit than the mean was presented with a less than symbol.

Table A.3: Acute Toxicity Test Results for Minto Mine Effluent (Station W3), 2015-2017

| Year | Sample Date | Discharge ¹ | Rainbow Trout | | <i>Daphnia magna</i> |
|------|-------------|------------------------|---------------------------|-----------|---------------------------|
| | | | Survival at 100% effluent | Pass/Fail | Survival at 100% effluent |
| 2015 | 9-Mar-15 | ND | 100 | pass | 100 |
| | 22-Jun-15 | ND | 100 | pass | 100 |
| | 31-Aug-15 | ND | 100 | pass | 100 |
| | 5-Oct-15 | ND | 100 | pass | 100 |
| 2016 | 24-Mar-16 | ND | 100 | pass | 100 |
| | 23-Jun-16 | D | test missed | - | 100 |
| | 12-Jul-16 | D | 100 | pass | 100 |
| | 6-Sep-16 | D | 100 | pass | 100 |
| | 23-Oct-16 | D | 90 | pass | 100 |
| 2017 | 14-Mar-17 | ND | 100 | pass | 100 |
| | 6-Jun-17 | D | 100 | pass | 100 |

 Indicates a test failure.

¹ D = discharge; ND = non-discharge.

Table A.4: Minto Mine MMER Effluent Characterization Data, 2015-2017

| Date | | Temperature | Field Conductivity | Laboratory Conductivity | Total Hardness | Dissolved Hardness | Alkalinity | Ammonia | Nitrate | Aluminum | Cadmium | Iron | Mercury | Molybdenum | Selenium |
|--------------------------------|--------------------------|-------------|--------------------|-------------------------|----------------|--------------------|------------|---------------|-------------|--------------|----------------------|--------------|----------------------|---------------|----------------|
| | | °C | µS/cm | µS/cm | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| 10-May-15 | Grab | 2.6 | 315 | 558 | 223 | 241 | 184 | 0.10 | 2.8 | 0.020 | <0.000010 | 0.061 | <0.000010 | 0.0059 | 0.0011 |
| 15-Jun-15 | Grab | 5.4 | 232 | 533 | 305 | 247 | 217 | 0.025 | 0.37 | 0.57 | 0.000018 | 0.88 | <0.000010 | 0.0058 | 0.00037 |
| 5-Aug-15 | Grab | 1.1 | 307 | 527 | 246 | 245 | 224 | 0.018 | 0.23 | 0.0099 | <0.000010 | 0.025 | <0.000010 | 0.0045 | 0.00031 |
| 13-Oct-15 | Grab | 0.50 | 282 | 515 | 252 | 230 | 222 | 0.028 | 0.19 | 0.0076 | <0.000010 | 0.036 | <0.000010 | 0.0046 | 0.00037 |
| 2015 Summary Statistics | Count | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | Count < MDL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 4 | 0 | 0 |
| | Count > MDL | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 1 | 4 | 0 | 4 | 4 |
| | Mean ¹ | 2.4 | 284 | 533 | 257 | 241 | 212 | 0.043 | 0.89 | 0.15 | <0.000012 | 0.25 | <0.000010 | 0.0052 | 0.00054 |
| | Median | 1.8 | 295 | 530 | 249 | 243 | 220 | 0.027 | 0.30 | 0.015 | <0.000010 | 0.049 | <0.000010 | 0.0052 | 0.00037 |
| | Maximum | 5.4 | 315 | 558 | 305 | 247 | 224 | 0.10 | 2.8 | 0.57 | 0.000018 | 0.88 | <0.000010 | 0.0059 | 0.0011 |
| 26-Apr-16 | Grab | 1.7 | 266 | 474 | - | 223 | 187 | 0.096 | 0.77 | 0.055 | <0.0000050 | 0.12 | <0.0000050 | 0.0036 | 0.00037 |
| 23-Jun-16 | Grab | 5.8 | 280 | 439 | - | 217 | 180 | <0.0050 | 1.3 | 0.011 | <0.0000050 | 0.030 | <0.0000050 | 0.0046 | 0.00052 |
| 17-Aug-16 | Grab | 7.9 | 310 | 449 | - | 227 | 183 | 0.0066 | 2.0 | 0.018 | <0.0000050 | 0.039 | <0.0000050 | 0.0046 | 0.00065 |
| 23-Oct-16 | Grab | 2.7 | 265 | 466 | - | 231 | 180 | 0.030 | 4.5 | 0.014 | <0.0000050 | 0.072 | <0.0000050 | 0.0040 | 0.0013 |
| 2016 Summary Statistics | Count | 4 | 4 | 4 | - | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | Count < MDL | 0 | 0 | 0 | - | 0 | 0 | 1 | 0 | 0 | 4 | 0 | 4 | 0 | 0 |
| | Count > MDL | 4 | 4 | 4 | - | 4 | 4 | 3 | 4 | 4 | 0 | 4 | 0 | 4 | 4 |
| | Mean ¹ | 4.5 | 280 | 457 | - | 225 | 183 | 0.034 | 2.1 | 0.025 | <0.0000050 | 0.065 | <0.0000050 | 0.0042 | 0.00070 |
| | Median | 4.3 | 273 | 458 | - | 225 | 182 | 0.018 | 1.6 | 0.016 | <0.0000050 | 0.056 | <0.0000050 | 0.0043 | 0.00059 |
| | Maximum | 7.9 | 310 | 474 | - | 231 | 187 | 0.096 | 4.5 | 0.055 | <0.0000050 | 0.12 | <0.0000050 | 0.0046 | 0.0013 |
| 16-May-17 | Grab | 6.6 | 252 | 367 | - | 170 | 143 | 0.0069 | 1.6 | 0.021 | <0.0000050 | 0.069 | <0.0000050 | 0.0034 | 0.00054 |
| 27-Jun-17 | Grab | 5.2 | 315 | 490 | - | 234 | 214 | 0.0078 | 0.23 | 0.011 | <0.0000050 | 0.026 | <0.0000050 | 0.0047 | 0.00028 |
| 1-Aug-17 | Grab | 11 | 339 | 451 | - | 223 | 185 | 0.0069 | 1.3 | 0.013 | <0.0000050 | 0.053 | <0.0000050 | 0.0041 | 0.00044 |
| 3-Oct-17 | Grab | 1 | 291 | 541 | - | 261 | 242 | 0.0053 | 0.18 | 0.0051 | <0.0000050 | 0.026 | <0.0000050 | 0.0047 | 0.00037 |
| 2017 Summary Statistics | Count | 4 | 4 | 4 | - | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | Count < MDL | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 4 | 0 | 0 |
| | Count > MDL | 4 | 4 | 4 | - | 4 | 4 | 4 | 4 | 4 | 0 | 4 | 0 | 4 | 4 |
| | Mean ¹ | 6.0 | 299 | 462 | - | 222 | 196 | 0.0067 | 0.82 | 0.012 | <0.0000050 | 0.044 | <0.0000050 | 0.0042 | 0.00041 |
| | Median | 5.9 | 303 | 471 | - | 229 | 200 | 0.0069 | 0.78 | 0.012 | <0.0000050 | 0.040 | <0.0000050 | 0.0044 | 0.00040 |
| | Maximum | 11 | 339 | 541 | - | 261 | 242 | 0.0078 | 1.6 | 0.021 | <0.0000050 | 0.069 | <0.0000050 | 0.0047 | 0.00054 |

¹ If greater than 50% of samples were less than method detection limit than the mean was presented with a less than symbol.

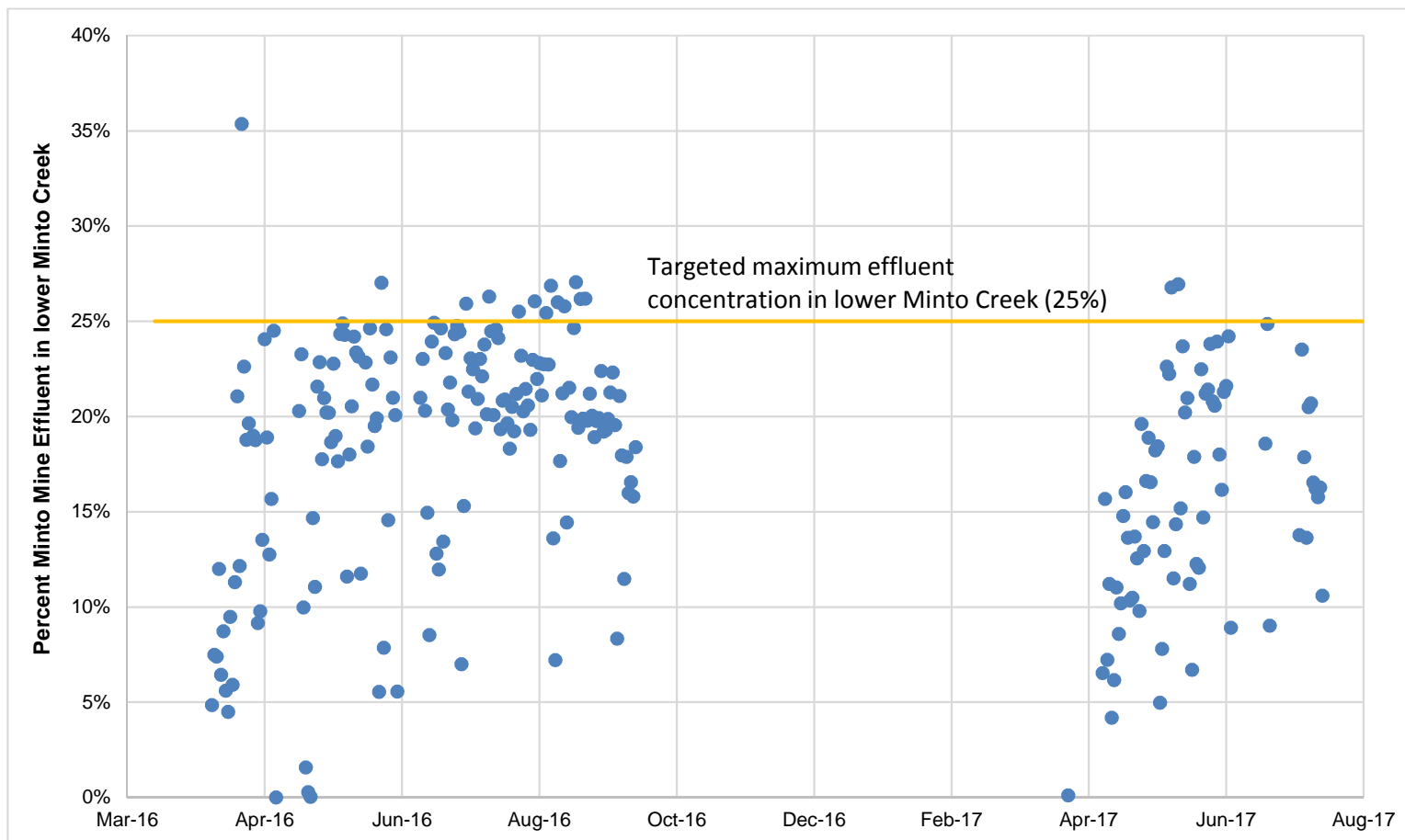


Figure A.1: Calculated Minto Mine Effluent Concentrations (% Effluent) in Lower Minto Creek 2015 to August 5th 2017 *

* calculated only for days when effluent flows and flows at lower Minto Creek (Station W1) were both available (the latter were not available in 2015).

APPENDIX B
DATA QUALITY REVIEW

APPENDIX B DATA QUALITY REVIEW

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B1 INTRODUCTION

B1.1 Background

Data Quality Review (DQR) was conducted on data collected as part of the Minto Mine Phase 4 Environmental Effects Monitoring (EEM) to define the overall quality of the data collected for the program, and by extension, the confidence with which the data can be used to derive conclusions. A variety of factors can influence the physical, chemical and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Depending on the magnitude of these influences, inaccuracy or imprecision have the potential to affect the reliability of any conclusions made from the data. Therefore, it is important to ensure that programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize the variability that does not reflect natural spatial and temporal variability in the environment) and thus assure the quality of the data.

Data quality as a concept is meaningful only when it relates to the intended use of the data. That is, the context in which the data will be interpreted must be known in order to establish a relevant basis for judging whether or not the data set is adequate. The Minto Mine Phase 4 EEM DQR involved comparison of field performance to generic data quality objectives (DQOs) established for the field components of environmental studies, including those for field blanks, field duplicates, data precision, and data accuracy. DQOs were established a-priori to reflect reasonable and achievable performance expectations. Overall, the intent of comparing data to DQOs was not to reject any measurement that did not meet the DQO, but rather to evaluate whether, based on the available data and using a weight-of-evidence approach, the field and/or analytical sample data adequately reflected actual conditions and can therefore be used with confidence to derive conclusions. Thus, questionable data, if any, receive more scrutiny to determine what effect, if any, they had on interpretation of results within the context of this project.

B1.2 Types of Quality Control Samples

Field Quality Control (QC) samples assessed for the Minto Mine Phase 4 EEM included one water field duplicate and one water trip blank. Laboratory QC samples included laboratory duplicates, method blanks, certified reference material (CRM) samples, laboratory control samples (LCS), and matrix spike (MS) samples for water, and the verification of the accuracy of sub-sampling and organism recovery for the benthic invertebrate component. These QC samples are defined as follows:



- **Field Duplicates** are sub-sample pairs collected from a randomly selected field station using identical collection and handling methods that are then analyzed separately in the laboratory. The duplicate samples are handled and analyzed in an identical manner in the laboratory. The data from field duplicate samples reflect natural variability, as well as the variability associated with sample collection methods, and therefore provide a measure of field precision.
- **Laboratory Duplicates** are sub-sample pairs which are split from a sample in the laboratory and then analyzed separately in an identical manner. The data from laboratory duplicate samples provide a measure of laboratory precision.
- **Blanks** are samples of de-ionized water, rinsate of sampling devices, and/or appropriate reagent(s) that are handled and analyzed the same way as regular samples. These samples will reflect any contamination that occurred in the field (in the case of field or trip blanks) or the laboratory (in the case of laboratory or method blanks). Analyte concentrations should be non-detectable, although a data quality objective of twice the method detection limit allows for slight “noise” around the detection limit.
- **CRM, LCS, and MS** are standardized samples of a particular matrix with a known concentration of analyte. They are used by the laboratory for calibrating instruments as well as for checking the quality of analytical results.
- **Sub-Sampling Checks** are performed on benthic invertebrate community samples when high sample volume and/or organism density results in only a fraction of the original sample being analyzed. By comparing the numbers of benthic invertebrates recovered between at least two sub-samples, this measure provides an evaluation of how effective the sub-sampling method was in evenly dividing the original sample, providing a measure of sub-sampling precision. Sub-sampling accuracy can be evaluated by processing an entire sample in representative fractions, and comparing the organism count in each of these fractions (multiplied by the number of fractions) to the total organism count of the entire sample.
- **Organism Recovery Checks** for benthic invertebrate community samples involve the re-processing of previously sorted material from a randomly selected sample to determine the number of invertebrates that were not recovered during the original sample processing. The reprocessing is conducted by an analyst not involved during the original processing to reduce any bias. This check allows the determination of accuracy through assessment of recovery efficiency.



B2 WATER SAMPLES

B2.1 Detection Limits

Method detection limits (MDLs) achieved by ALS Environmental for the thirty six supporting water samples from eight separate lab reports, one of which pertains to field Benthic Invertebrate Community sampling (L1834209), and seven which pertain to the Laboratory Fish Exposure study L1811593, L1813894, L1818233, L1822573, L1825883, L1829581, and L1831166; see Appendix C) were examined and assessed in all cases where sample results were reported as less than the MDL. For analytes for which a water quality guideline for the protection of aquatic life and/or a site-specific water quality objective (SSWQO) is available, the MDL should be lower than the available guideline and SSWQO values (Table B.1). Reported MDLs for all analytes with the exception of total beryllium and total chromium were lower than the applicable guideline values (Table B.1). For total beryllium, the MDL of 15 of the 36 samples (42%) exceeded the guideline, whereas for total chromium the MDL was equal to the guideline for all results. Beryllium is not of particular concern for the present monitoring program and chromium is a regionally-elevated analyte. Therefore, although the MDLs for these two analytes should be considered in data analysis, the impact on data interpretation will be very limited.

B2.2 Blank Sample Analysis

B2.2.1 Laboratory Blanks

The majority of laboratory blank results reported for the eight ALS Environmental laboratory reports (101 samples, 630 results) were non-detectable for the parameters reported (Appendix C; total and dissolved metals, total alkalinity, total ammonia, total and dissolved organic carbon, chloride, conductivity, nitrate, nitrite, total Kjeldahl nitrogen, total phosphorus, pH, total suspended and dissolved solids, and sulphate). Two blank results (one result for each of total alkalinity and total thallium) did not meet the laboratory criteria (representing 0.3% of results). For one of these results (total alkalinity), all associated sample results were > 5 times higher than the blank result, therefore data quality was not affected. For the second result (total thallium), limits of reporting were adjusted for all results within 5 times of the reported blank concentration of this sample. Overall, this indicates negligible contamination of samples within the laboratory during analysis.

B2.2.2 Trip Blanks

One unopened trip blank accompanied a shipment of water samples from the field sampling site to the laboratory, and was submitted for analysis (Appendix C). All results for this sample



Table B.1: Maximum Laboratory Method Detection Limits (MDL) for Analytes <MDL Relative to Water Quality Guidelines and Site-Specific Water Quality Objectives (SSWQO) for Minto Mine Phase 4 EEM, 2016

| Parameter | Units | Guidelines ^a | SSWQO ^b | Maximum Method Detection Limit Achieved |
|--|-------|------------------------------|---------------------------|---|
| Physical Tests, Anions and Nutrients | | | | |
| Carbonate Alkalinity (as CaCO ₃) | mg/L | - | - | 1.0 |
| Hydroxide Alkalinity (as CaCO ₃) | mg/L | - | - | 1.0 |
| Total Alkalinity (as CaCO ₃) | mg/L | - | - | 2.0 |
| Total Ammonia (as N) | mg/L | 0.41 ^c | 0.25 | 0.0050 |
| Chloride (Cl) | mg/L | 120 | - | 0.50 |
| Hardness (as CaCO ₃) | mg/L | - | - | 0.50 |
| Total Suspended Solids | mg/L | narrative ^d | - | 3.0 |
| Total Dissolved Solids | mg/L | - | - | 10.0 |
| Nitrate (as N) | mg/L | 3.0 | 9.1 | 0.0050 |
| Nitrate and Nitrite (as N) | mg/L | - | - | 0.0051 |
| Nitrite (as N) | mg/L | 0.06 | 0.06 | 0.0010 |
| Total Kjeldahl Nitrogen | mg/L | - | - | 0.050 |
| Total Phosphorus (P) | mg/L | - | - | 0.050 |
| Dissolved Phosphorus (P) | mg/L | - | - | 0.050 |
| Total Organic Carbon | mg/L | - | - | 0.50 |
| Total Metals | | | | |
| Aluminum (Al) | mg/L | 0.10 ^e | - | 0.0050 |
| Antimony (Sb) | mg/L | 0.0090 | - | 0.00050 |
| Arsenic (As) | mg/L | 0.0050 | - | 0.00050 |
| Barium (Ba) | mg/L | 1.0 | - | 0.020 |
| Beryllium (Be) | mg/L | 0.00013 | - | 0.0010 |
| Bismuth (Bi) | mg/L | - | - | 0.000050 |
| Boron (B) | mg/L | 1.5 | - | 0.10 |
| Cadmium (Cd) | mg/L | 0.00016 ^f | - | 0.0000050 |
| Calcium (Ca) | mg/L | - | - | 0.10 |
| Chromium (Cr) | mg/L | 0.0010 / 0.0090 ^g | - | 0.0010 |
| Cobalt (Co) | mg/L | 0.0040 | - | 0.00030 |
| Copper (Cu) | mg/L | 0.0024 ^f | - | 0.0010 |
| Iron (Fe) | mg/L | 0.30 | - | 0.030 |
| Lead (Pb) | mg/L | 0.0032 ^f | - | 0.00050 |
| Lithium (Li) | mg/L | - | - | 0.0010 |
| Magnesium (Mg) | mg/L | - | - | 0.10 |
| Manganese (Mn) | mg/L | 1.0 | - | 0.00030 |
| Mercury (Hg) | mg/L | 0.000026 | - | 0.0000050 |
| Molybdenum (Mo) | mg/L | 0.073 | - | 0.0010 |
| Nickel (Ni) | mg/L | 0.096 ^f | - | 0.0010 |
| Potassium (K) | mg/L | - | - | 2.0 |
| Selenium (Se) | mg/L | 0.0010 | - | 0.000050 |
| Silver (Ag) | mg/L | 0.00025 | - | 0.000020 |
| Sodium (Na) | mg/L | - | - | 2.0 |
| Thallium (Tl) | mg/L | 0.0008 | - | 0.00020 |
| Tin (Sn) | mg/L | - | - | 0.00050 |
| Titanium (Ti) | mg/L | - | - | 0.010 |
| Uranium (U) | mg/L | 0.015 | - | 0.00020 |
| Vanadium (V) | mg/L | - | - | 0.00050 |
| Zinc (Zn) | mg/L | 0.03 | - | 0.0050 |
| Zirconium (Zr) | mg/L | - | - | 0.00030 |
| Dissolved Metals | | | | |
| Aluminum (Al) | mg/L | - | 0.10 | 0.0050 |
| Antimony (Sb) | mg/L | - | - | 0.00050 |
| Arsenic (As) | mg/L | - | 0.0050 | 0.00050 |
| Barium (Ba) | mg/L | - | - | 0.020 |
| Beryllium (Be) | mg/L | - | - | 0.0010 |
| Bismuth (Bi) | mg/L | - | - | 0.000050 |
| Boron (B) | mg/L | - | - | 0.10 |
| Cadmium (Cd) | mg/L | - | 0.00021 | 0.0000050 |
| Chromium (Cr) | mg/L | - | 0.0010 | 0.0010 |
| Cobalt (Co) | mg/L | - | - | 0.00030 |
| Copper (Cu) | mg/L | - | 0.013 / 0.02 ^h | 0.0010 |
| Iron (Fe) | mg/L | - | 1.1 | 0.030 |
| Lead (Pb) | mg/L | - | 0.0040 | 0.00050 |
| Lithium (Li) | mg/L | - | - | 0.0010 |
| Mercury (Hg) | mg/L | - | - | 0.0000050 |
| Molybdenum (Mo) | mg/L | - | 0.073 | 0.0010 |
| Nickel (Ni) | mg/L | - | 0.11 | 0.0010 |
| Potassium (K) | mg/L | - | - | 2.0 |
| Silver (Ag) | mg/L | - | 0.00010 | 0.000020 |
| Sodium (Na) | mg/L | - | - | 2.0 |
| Thallium (Tl) | mg/L | - | - | 0.00020 |
| Tin (Sn) | mg/L | - | - | 0.00050 |
| Titanium (Ti) | mg/L | - | - | 0.010 |
| Uranium (U) | mg/L | - | - | 0.00020 |
| Vanadium (V) | mg/L | - | - | 0.00050 |
| Zinc (Zn) | mg/L | - | 0.030 | 0.0050 |
| Zirconium (Zr) | mg/L | - | - | 0.00030 |

Maximum MDLs that are greater or equal to Guideline or SSWQO values are highlighted.

Note: Only parameters with one or more results < MDL were included in the comparison to Guidelines and SSWQO.

^a Water quality guidelines for the protection of aquatic life. Black text are Canadian Environmental Quality Guidelines (CCME 2017); blue text are BC Water Quality Guidelines (BCMOE 2017a,b).

^b Site-specific water quality objectives for Station W2 per the Minto Mine Water Use Licence. For metals, the SSWQO are applicable on a dissolved basis.

^c At temperature 5°C and pH 8.5 (slightly conservative conditions).

^d Maximum increase of 25 mg/L from background for short-term exposures (e.g., 24-h period) and maximum increase of 5 mg/L from background for longer term exposures.

^e At pH 8.5 (slightly conservative conditions).

^f At hardness of 100 mg/L (conservative conditions for Minto Creek).

^g 0.001 for hexavalent chromium (CrVI); 0.009 for trivalent chromium (CrIII).

^h 0.013 mg/L copper at a dissolved organic carbon (DOC) concentration ≤10 mg/L and 0.02 mg/L copper at a DOC concentration >10 mg/L.

were below the laboratory MDLs, therefore indicating no contamination of samples during transport to and from the field sampling site or laboratory.

B2.3 Data Precision

B2.3.1 Field Duplicate Samples

One duplicate water sample was collected in the field. The duplicates showed excellent agreement in concentrations of all analytes except for total phosphorus, which had a relative percent difference (RPD) between the duplicates of 76% (Table B.2). Although the data quality objective of a RPD of $\leq 25\%$ was not met for this analyte, it had low reported concentrations. Consequently, although the absolute difference was small (0.0042 mg/L) the relative percent difference exceeded the DQO (Table B.2). Overall, the field duplicate sampling did not indicate any inconsistencies in sampling technique nor issues that could impair data interpretability.

B2.3.2 Laboratory Duplicate Samples

All laboratory duplicate results evaluated (14 samples, 139 results) in the eight laboratory reports met ALS Environmental's data quality objectives (generally $< 20\%$ RPD) for the parameters reported (Appendix C; total and dissolved metals, total alkalinity, total ammonia, chloride, conductivity, nitrate, nitrite, total Kjeldahl nitrogen, total phosphorus, pH, and sulphate). Therefore, the laboratory precision achieved in this study is considered good.

B2.4 Data Accuracy

The accuracy of laboratory data from the eight laboratory reports was assessed based on the results of certified reference materials (CRM), laboratory control samples (LCS) and matrix spike samples (MS; Appendix C). Specifically, twenty five CRM samples were used among the laboratory reports to assess the accuracy of total alkalinity, conductivity, total phosphorus, and pH analyses (Appendix C), and all results of these CRM samples (25 results) met laboratory quality control criteria. Eighty four LCS samples were used to evaluate the accuracy of total and dissolved metals, as well as physical, anion, and nutrient parameters (total alkalinity, total ammonia, chloride, conductivity, nitrate, nitrite, total Kjeldahl nitrogen, total and dissolved organic carbon, pH, total dissolved and suspended solids, and sulphate). All LCS results (626 results) met the laboratory quality control criteria for these samples. Finally, thirteen MS samples were also used to assess the accuracy of multiple parameters (total and dissolved metals, total ammonia, chloride, nitrate, nitrite, total Kjeldahl nitrogen, dissolved organic carbon, total phosphorus, and sulphate). The majority of MS results met the laboratory quality control criteria for these samples, however 10 of the 76 reported results (13%) could not be accurately calculated due to high analyte background concentration in the sample



Table B.2: Field Duplicate Results for Analysis of Water Quality Samples, Minto Mine Phase 4 EEM, 2016

| Sample ID | Units | REF-9 | REF-9X | RPD (%) ^a |
|---|-------|-------------|-------------|----------------------|
| Date Sampled | | 23-Sep-2016 | 23-Sep-2016 | |
| Physical Tests, Anions and Nutrients | | | | |
| Hardness (as CaCO ₃) | mg/L | 154 | 157 | 2% |
| Total Suspended Solids | mg/L | <3.0 | <3.0 | - |
| Total Dissolved Solids | mg/L | 181 | 214 | 17% |
| Total Alkalinity (as CaCO ₃) | mg/L | 129 | 127 | 2% |
| Total Ammonia (as N) | mg/L | <0.0050 | <0.0050 | - |
| Nitrate (as N) | mg/L | 0.166 | 0.165 | 1% |
| Total Kjeldahl Nitrogen | mg/L | 0.159 | 0.146 | 9% |
| Total Phosphorus (P) | mg/L | 0.0076 | 0.0034 | 76% |
| Dissolved Organic Carbon | mg/L | 4.25 | 4.34 | 2% |
| Total Metals | | | | |
| Aluminum (Al) | mg/L | 0.0212 | 0.0246 | 15% |
| Antimony (Sb) | mg/L | <0.00050 | <0.00050 | - |
| Arsenic (As) | mg/L | 0.00099 | 0.00102 | 3% |
| Barium (Ba) | mg/L | 0.058 | 0.059 | 2% |
| Beryllium (Be) | mg/L | <0.0010 | <0.0010 | - |
| Boron (B) | mg/L | <0.10 | <0.10 | - |
| Cadmium (Cd) | mg/L | <0.0000050 | <0.0000050 | - |
| Calcium (Ca) | mg/L | 33.3 | 33.8 | 1% |
| Chromium (Cr) | mg/L | <0.0010 | <0.0010 | - |
| Cobalt (Co) | mg/L | <0.00030 | <0.00030 | - |
| Copper (Cu) | mg/L | <0.0010 | <0.0010 | - |
| Iron (Fe) | mg/L | 0.092 | 0.092 | 0% |
| Lead (Pb) | mg/L | <0.00050 | <0.00050 | - |
| Lithium (Li) | mg/L | 0.0012 | 0.0011 | 9% |
| Magnesium (Mg) | mg/L | 16.7 | 16.9 | 1% |
| Manganese (Mn) | mg/L | 0.0360 | 0.0370 | 3% |
| Mercury (Hg) | mg/L | <0.0000050 | <0.0000050 | - |
| Molybdenum (Mo) | mg/L | <0.0010 | <0.0010 | - |
| Nickel (Ni) | mg/L | <0.0010 | <0.0010 | - |
| Potassium (K) | mg/L | <2.0 | <2.0 | - |
| Selenium (Se) | mg/L | 0.000249 | 0.000268 | 7% |
| Silver (Ag) | mg/L | <0.000020 | <0.000020 | - |
| Sodium (Na) | mg/L | <2.0 | <2.0 | - |
| Thallium (Tl) | mg/L | <0.00020 | <0.00020 | - |
| Tin (Sn) | mg/L | <0.00050 | <0.00050 | - |
| Titanium (Ti) | mg/L | <0.010 | <0.010 | - |
| Uranium (U) | mg/L | 0.00090 | 0.00091 | 1% |
| Vanadium (V) | mg/L | <0.00050 | <0.00050 | - |
| Zinc (Zn) | mg/L | <0.0050 | <0.0050 | - |
| Dissolved Metals | | | | |
| Aluminum (Al) | mg/L | 0.0094 | 0.0091 | 3% |
| Antimony (Sb) | mg/L | <0.00050 | <0.00050 | - |
| Arsenic (As) | mg/L | 0.00098 | 0.00093 | 5% |
| Barium (Ba) | mg/L | 0.055 | 0.057 | 4% |
| Beryllium (Be) | mg/L | <0.0010 | <0.0010 | - |
| Boron (B) | mg/L | <0.10 | <0.10 | - |
| Cadmium (Cd) | mg/L | <0.0000050 | <0.0000050 | - |
| Calcium (Ca) | mg/L | 36.5 | 36.9 | 1% |
| Chromium (Cr) | mg/L | <0.0010 | <0.0010 | - |
| Cobalt (Co) | mg/L | <0.00030 | <0.00030 | - |
| Copper (Cu) | mg/L | <0.0010 | <0.0010 | - |
| Iron (Fe) | mg/L | 0.056 | 0.057 | 2% |
| Lead (Pb) | mg/L | <0.00050 | <0.00050 | - |
| Lithium (Li) | mg/L | 0.0014 | 0.0013 | 7% |
| Magnesium (Mg) | mg/L | 15.3 | 15.7 | 3% |
| Manganese (Mn) | mg/L | 0.0323 | 0.0319 | 1% |
| Mercury (Hg) | mg/L | <0.0000050 | <0.0000050 | - |
| Molybdenum (Mo) | mg/L | <0.0010 | <0.0010 | - |
| Nickel (Ni) | mg/L | <0.0010 | <0.0010 | - |
| Potassium (K) | mg/L | <2.0 | <2.0 | - |
| Selenium (Se) | mg/L | 0.000260 | 0.000293 | 12% |
| Silver (Ag) | mg/L | <0.000020 | <0.000020 | - |
| Sodium (Na) | mg/L | <2.0 | <2.0 | - |
| Thallium (Tl) | mg/L | <0.00020 | <0.00020 | - |
| Tin (Sn) | mg/L | <0.00050 | <0.00050 | - |
| Titanium (Ti) | mg/L | <0.010 | <0.010 | - |
| Uranium (U) | mg/L | 0.00088 | 0.00089 | 1% |
| Vanadium (V) | mg/L | <0.00050 | <0.00050 | - |
| Zinc (Zn) | mg/L | <0.0050 | <0.0050 | - |

Calculated Relative Percent Difference (RPD) did not meet the Data Quality Objective (DQO) of ≤ 25% RPD.

^a RPD was calculated using < Method Detection Limit (MDL) results at 1x MDL if one result in a duplicate pair was below the MDL and one was above the MDL. RPD was not calculated if both results were < MDL.

(parameters included dissolved organic carbon, total aluminum, barium, manganese, silicon, sodium, and strontium, and dissolved barium, silicon, sodium, and strontium). All CRM, LCS, and MS results met ALS Environmental's data quality objectives for accuracy (Appendix C), with the exception of MS results that could not be calculated due to analyte concentrations in the spiked sample. Thus, laboratory accuracy associated with water samples in this study is considered excellent.

B2.5 Holding Time and General Laboratory Flags

A number of hold time exceedances were reported in the eight laboratory reports (Appendix C) due to the combination of short optimal hold times and remote sampling (sample shipment from Minto Mine, YT site to Burnaby, BC), factors which cannot readily be changed. Specifically, pH exceeded recommended hold times (15-minute hold times) in all 21 samples submitted in support of the Laboratory Fish Exposure study (L1811593, L1813894, L1818233, L1822573, L1825883, L1829581, and L1831166). However, the similarity of these laboratory pH data to corresponding *in situ* measures indicate these results are likely not highly impacted by this hold time exceedance. Additionally, the recommended hold times for nitrate and total alkalinity were each exceeded by one day in three samples, the former for samples UMC-1 to UMC-3 collected in support of the field Benthic Invertebrate Community sampling (laboratory report L1834209; Appendix C), and the latter for samples collected on August 29th, 2016 in support of the Laboratory Fish Exposure study (laboratory report L1822573; Appendix C). The hold time for total alkalinity in these samples was exceeded despite receipt of samples at the laboratory within the recommended hold time (laboratory report L1822573; Appendix C). Finally, recommended hold times for both nitrate and nitrite (3 days) were each exceeded by 4 days in three samples collected in support of the Laboratory Fish Exposure study on September 12th, 2016 (laboratory report L1829581; Appendix C). The exceedance of the nitrite hold time in particular may result in inaccurate results due to sample oxidation. These hold time exceedances should be considered during data interpretation, in particular for nitrite.



B3 BENTHIC INVERTEBRATE COMMUNITY SAMPLES

B3.1 Organism Recovery

Sorting efficiency (i.e., percent recovery) of the benthic invertebrate samples was high, achieving 98% for each of the two samples evaluated (Table B.3). Sorting efficiency for these samples achieved the DQO of $\geq 90\%$ recovery, and therefore the benthic invertebrate community sample recovery was acceptable.

B3.2 Subsampling Accuracy

The entire sample was sorted for eight of the fifteen benthic invertebrate community samples analysed, and between 6% and 75% of the remaining 7 samples was sorted (Table B.4). The precision and accuracy of the one benthic invertebrate sample evaluated for sub-sampling precision (4.4%) met the DQO of $\leq 20\%$ (Table B.5). Overall, this indicated that precision and accuracy for sub-sampling of the benthic invertebrate community samples was acceptable. It should be noted that measures of sub-sampling precision and accuracy did not meet the DQO for the first two samples that were examined by the laboratory, due to an issue with the sub-sampling device (Appendix D). As a result, analysis all of the sub-sampled samples was repeated after resolving the issue. The sub-sampling results presented (Table B.5) reflect the quality control results following the resolution of the issue.



Table B.3: Benthic Invertebrate Community Organism Recovery, Minto Mine Phase 4 EEM, 2016

| Sample ID | Number of Organisms Recovered (Initial Sort) | Number of Organisms in Re-sort | Percent Recovery |
|-----------|--|--------------------------------|------------------|
| UMC-2 | 180 | 4 | 98% |
| UMC-3 | 264 | 6 | 98% |

Highlighted values did not meet the Data Quality Objective (DQO) for sorting efficiencies of $\geq 90\%$.

Table B.4: Percent of Benthic Invertebrate Community Sample Sorted and Total Number of Invertebrate Recovered from Sampled Fraction (500 μm), Minto Mine Phase 4 EEM, 2016

| Sample ID | Date | % Sampled | # Invertebrates |
|-----------|-----------|-----------|-----------------|
| UMC-1 | 25-Sep-16 | 100% | 301 |
| UMC-2 | 22-Sep-16 | 100% | 180 |
| UMC-3 | 22-Sep-16 | 100% | 264 |
| UMC-4 | 25-Sep-16 | 100% | 435 |
| UMC-5 | 22-Sep-16 | 100% | 267 |
| REF-1 | 25-Sep-16 | 75% | 370 |
| REF-2 | 24-Sep-16 | 25% | 332 |
| REF-3 | 24-Sep-16 | 50% | 351 |
| REF-4 | 24-Sep-16 | 100% | 145 |
| REF-5 | 23-Sep-16 | 50% | 381 |
| REF-6 | 24-Sep-16 | 100% | 354 |
| REF-7 | 24-Sep-16 | 100% | 357 |
| REF-8 | 25-Sep-16 | 50% | 328 |
| REF-9 | 23-Sep-16 | 6% | 324 |
| REF-10 | 23-Sep-16 | 25% | 597 |

Table B.5: Benthic Invertebrate Community Sub-Sampling Precision, Minto Mine Phase 4 EEM, 2016

| Sample ID | Organisms in Subsample Fraction | | Actual Density | Precision | | Accuracy | |
|-----------|---------------------------------|-----|----------------|-----------|---------|----------|---------|
| | 1 | 2 | | Min (%) | Max (%) | Min (%) | Max (%) |
| REF-8 | 326 | 341 | 667 | 4.4 | 4.4 | 2.3 | 2.3 |

Highlighted values did not meet the Data Quality Objective (DQO) for sub-sampling error of $\leq 20\%$.

B4 DATA QUALITY STATEMENT

Data collected for the Minto Mine Phase 4 EEM was of good quality as characterized by good detectability, negligible analyte concentrations in method blanks, good field and laboratory precision, and good laboratory accuracy. The recommended hold times were exceeded for nitrate in a subset of supporting samples collected for the field Benthic Invertebrate Community sampling, and for pH, total alkalinity, nitrate, and nitrite in a subset of supporting samples collected for the Laboratory Fish Exposure study. These hold time exceedances were due to the combination of short optimal hold times and remote sampling (factors which cannot readily be changed), however the hold time exceedances for these analytes should be considered during data interpretation. Overall, the supporting water quality and benthic invertebrate community data reviewed can be used with a good level of confidence in the derivation of conclusions.



APPENDIX C
WATER QUALITY DATA

CONTENTS OF APPENDIX C: WATER QUALITY DATA

PART 1: ALS Water Quality Laboratory Reports

Part 1A: ALS Lab Report L1811593 (Finalized August 23, 2016)

Part 1B: ALS Lab Report L1813894 (Finalized August 26, 2016)

Part 1C: ALS Lab Report L1818233 (Finalized September 7, 2016)

Part 1D: ALS Lab Report L1822573 (Finalized September 19, 2016)

Part 1E: ALS Lab Report L1825883 (Finalized September 19, 2016)

Part 1F: ALS Lab Report L1829581 (Finalized September 27, 2016)

Part 1G: ALS Lab Report L1831166 (Finalized October 3, 2016)

Part 1H: ALS Lab Report L1834209 (Finalized October 6, 2016)

PART 2: Water Quality Figure and Tables

Figure C.1: Concentrations of Key Analytes of Routine Water Quality Monitoring under MMER at Lower Minto Creek (Station W2) and the Reference Tributary (Station W7), 2015 – 2017

Figure C.2: Regression of Total Metal Concentrations (mg/L) relative to Total Suspended Solids (mg/L) in Routine Water Quality Monitoring Samples under MMER at Lower Minto Creek (Station W2) and the Reference Tributary (Station W7), 2015-2017

Figure C.3: Concentrations of Dissolved Metals of Routine Water Quality Monitoring under MMER at Lower Minto Creek (Station W2) and the Reference Tributary (Station W7), 2015 - 2017

Table C.1: Minto Mine Routine EEM Water Quality Monitoring Data, 2014-2017

Table C.2: In-situ Water Quality and Physical Measures at Benthic Community Sites, Minto Mine Phase 4 EEM, September 2016

Table C.3: Intermediate Axis Length and Embeddedness of 100 Cobble Washed during Surber Sampling at Benthic Invertebrate Stations, Minto Mine Phase 4 EEM, 2016



Table C.4: Raw *In situ* Water Quality Measures for the Fish Exposure Study, August to September, 2016

Table C.5: Raw Supporting Water Quality Results for Laboratory Fish Exposure Study, Minto Mine Phase 4 EEM, 2016





Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 10-AUG-16
Report Date: 23-AUG-16 18:31 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1811593
Project P.O. #: 221837 (WUL)
Job Reference:
C of C Numbers: 2016-08-10 B
Legal Site Desc:

Ariel McDonnell, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1811593-1 | L1811593-2 | L1811593-3 |
|------------------------------|---|----------------------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 08-AUG-16 | 08-AUG-16 | 08-AUG-16 |
| | | Sampled Time | 10:25 | 10:30 | 10:35 |
| | | Client ID | E6 | E3 | C1 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 322 | 324 | 273 |
| | Hardness (as CaCO3) (mg/L) | | 136 | 139 | 119 |
| | pH (pH) | | 8.10 | 8.05 | 8.07 |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | <3.0 |
| | Total Dissolved Solids (mg/L) | | 176 | 180 | 148 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 107 | 110 | 95.0 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 107 | 110 | 95.0 |
| | Ammonia, Total (as N) (mg/L) | | 0.0712 | 0.0889 | 0.0485 |
| | Chloride (Cl) (mg/L) | | 26.9 | 22.0 | 23.8 |
| | Nitrate and Nitrite (as N) (mg/L) | | 1.06 | 1.55 | 0.402 |
| | Nitrate (as N) (mg/L) | | 1.05 | 1.53 | 0.402 |
| | Nitrite (as N) (mg/L) | | 0.0043 | 0.0135 | <0.0010 |
| | Sulfate (SO4) (mg/L) | | 16.6 | 21.6 | 11.1 |
| | Anion Sum (meq/L) | | 3.32 | 3.37 | 2.83 |
| | Cation Sum (meq/L) | | 3.28 | 3.33 | 2.85 |
| | Cation - Anion Balance (%) | | -0.6 | -0.6 | 0.3 |
| | Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0690 | 0.0719 |
| Antimony (Sb)-Total (mg/L) | | | <0.00010 | <0.00010 | <0.00010 |
| Arsenic (As)-Total (mg/L) | | | 0.00048 | 0.00053 | 0.00052 |
| Barium (Ba)-Total (mg/L) | | | 0.0495 | 0.0494 | 0.0446 |
| Beryllium (Be)-Total (mg/L) | | | <0.000020 | <0.000020 | <0.000020 |
| Bismuth (Bi)-Total (mg/L) | | | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Total (mg/L) | | | 0.011 | 0.016 | <0.010 |
| Cadmium (Cd)-Total (mg/L) | | | 0.0000091 | 0.0000110 | 0.0000086 |
| Calcium (Ca)-Total (mg/L) | | | 42.2 | 42.2 | 36.2 |
| Chromium (Cr)-Total (mg/L) | | | 0.00020 | 0.00020 | 0.00022 |
| Cobalt (Co)-Total (mg/L) | | | 0.00018 | 0.00017 | 0.00016 |
| Copper (Cu)-Total (mg/L) | | | 0.00552 | 0.00864 | 0.00278 |
| Iron (Fe)-Total (mg/L) | | | 0.150 | 0.172 | 0.152 |
| Lead (Pb)-Total (mg/L) | | | 0.000342 | 0.000196 | 0.000198 |
| Lithium (Li)-Total (mg/L) | | | <0.0010 | <0.0010 | <0.0010 |
| Magnesium (Mg)-Total (mg/L) | | | 8.31 | 9.07 | 6.99 |
| Manganese (Mn)-Total (mg/L) | | | 0.0204 | 0.0330 | 0.00733 |
| Mercury (Hg)-Total (mg/L) | | | <0.0000050 | <0.0000050 | <0.0000050 |
| Molybdenum (Mo)-Total (mg/L) | | | 0.00237 | 0.00259 | 0.00185 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1811593-1 Water 08-AUG-16 10:25 E6 | L1811593-2 Water 08-AUG-16 10:30 E3 | L1811593-3 Water 08-AUG-16 10:35 C1 | |
|-------------------------|---|---|---|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Nickel (Ni)-Total (mg/L) | 0.00074 | 0.00080 | 0.00074 | |
| | Phosphorus (P)-Total (mg/L) | <0.050 | 0.052 | <0.050 | |
| | Potassium (K)-Total (mg/L) | 2.43 | 2.54 | 1.92 | |
| | Selenium (Se)-Total (mg/L) | 0.000328 | 0.000492 | 0.000153 | |
| | Silicon (Si)-Total (mg/L) | 4.39 | 4.03 | 4.41 | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Sodium (Na)-Total (mg/L) | 12.0 | 12.2 | 9.56 | |
| | Strontium (Sr)-Total (mg/L) | 0.298 | 0.327 | 0.227 | |
| | Sulfur (S)-Total (mg/L) | 6.15 | 7.92 | 4.01 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Total (mg/L) | 0.00200 | 0.00227 | 0.00244 | |
| | Uranium (U)-Total (mg/L) | 0.00142 | 0.00136 | 0.00137 | |
| | Vanadium (V)-Total (mg/L) | 0.00072 | 0.00071 | 0.00070 | |
| | Zinc (Zn)-Total (mg/L) | 0.0195 | 0.0206 | 0.0092 | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0204 | 0.0195 | 0.0173 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00043 | 0.00043 | 0.00045 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0488 | 0.0518 | 0.0438 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.015 | <0.010 | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000057 | 0.0000084 | <0.0000050 | |
| | Calcium (Ca)-Dissolved (mg/L) | 41.3 | 41.4 | 36.4 | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00013 | 0.00013 | 0.00013 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00365 | 0.00636 | 0.00140 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.028 | 0.034 | 0.027 | |
| | Lead (Pb)-Dissolved (mg/L) | 0.000069 | 0.000050 | 0.000062 | |
| | Lithium (Li)-Dissolved (mg/L) | 0.0012 | <0.0010 | <0.0010 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 7.99 | 8.65 | 6.84 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0129 | 0.0240 | 0.00311 | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00220 | 0.00238 | 0.00183 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1811593-1 | L1811593-2 | L1811593-3 | | |
|-------------------------|---------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 08-AUG-16 | 08-AUG-16 | 08-AUG-16 | | |
| | | Sampled Time | 10:25 | 10:30 | 10:35 | | |
| | | Client ID | E6 | E3 | C1 | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Nickel (Ni)-Dissolved (mg/L) | | 0.00058 | 0.00064 | 0.00059 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | <0.050 | | |
| | Potassium (K)-Dissolved (mg/L) | | 2.30 | 2.41 | 1.85 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000304 | 0.000456 | 0.000156 | | |
| | Silicon (Si)-Dissolved (mg/L) | | 4.24 | 3.91 | 4.37 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 11.3 | 11.1 | 9.49 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.290 | 0.335 | 0.224 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 5.83 | 7.55 | 3.95 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.00130 | 0.00121 | 0.00134 | | |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0186 | 0.0208 | 0.0094 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Molybdenum (Mo)-Total | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Titanium (Ti)-Total | MS-B | L1811593-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1811593-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--------------------------------------|------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-DIS-LOW-ICP-VA | Water | Dissolved Metals in Water by ICPOES | EPA 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-TOT-LOW-ICP-VA | Water | Total Metals in Water by ICPOES | EPA 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |

Reference Information

S-DIS-ICP-VA Water Dissolved Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA Water Total Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2016-08-10 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1811593

Report Date: 20-DEC-17

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Client: Minto Explorations Ltd.
 Suite 2100- 510 West Georgia St
 Vancouver BC V6B 0M3

Contact: Minto Environment - Coordinator

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|--------------|----------------------------|------------|-----------|-------|-----|----------|-----------|
| ALK-TITR-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3530741 | | | | | | | |
| WG2371545-13 CRM | | VA-ALK-TITR-CONTROL | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 98.9 | | % | | 85-115 | 20-AUG-16 |
| WG2371545-11 MB | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 20-AUG-16 |
| BE-D-L-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3523960 | | | | | | | |
| WG2365363-2 LCS | | | | | | | | |
| Beryllium (Be)-Dissolved | | | 101.2 | | % | | 80-120 | 11-AUG-16 |
| BE-T-L-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3529596 | | | | | | | |
| WG2370965-2 LCS | | | | | | | | |
| Beryllium (Be)-Total | | | 102.8 | | % | | 80-120 | 19-AUG-16 |
| WG2370965-1 MB | | | | | | | | |
| Beryllium (Be)-Total | | | <0.000020 | | mg/L | | 0.00002 | 19-AUG-16 |
| CL-IC-N-WR | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3531122 | | | | | | | |
| WG2366021-10 LCS | | | | | | | | |
| Chloride (Cl) | | | 102.2 | | % | | 90-110 | 11-AUG-16 |
| WG2366021-9 MB | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 11-AUG-16 |
| EC-PCT-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3530741 | | | | | | | |
| WG2371545-14 CRM | | VA-EC-PCT-CONTROL | | | | | | |
| Conductivity | | | 101.5 | | % | | 90-110 | 20-AUG-16 |
| WG2371545-11 MB | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 20-AUG-16 |
| HG-D-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3523987 | | | | | | | |
| WG2365361-2 LCS | | | | | | | | |
| Mercury (Hg)-Dissolved | | | 95.5 | | % | | 80-120 | 11-AUG-16 |
| WG2365361-1 MB | | NP | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000005C | | mg/L | | 0.000005 | 11-AUG-16 |
| HG-T-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |



Quality Control Report

Workorder: L1811593

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|----------|--------------|------------|-----------|-------|-----|----------|-----------|
| HG-T-CVAA-VA | | Water | | | | | | |
| Batch | R3524172 | | | | | | | |
| WG2366202-2 LCS | | | | | | | | |
| Mercury (Hg)-Total | | | 96.1 | | % | | 80-120 | 11-AUG-16 |
| WG2366202-1 MB | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000005C | | mg/L | | 0.000005 | 11-AUG-16 |
| MET-D-CCMS-VA | | Water | | | | | | |
| Batch | R3523960 | | | | | | | |
| WG2365363-2 LCS | | | | | | | | |
| Aluminum (Al)-Dissolved | | | 103.0 | | % | | 80-120 | 11-AUG-16 |
| Antimony (Sb)-Dissolved | | | 96.8 | | % | | 80-120 | 11-AUG-16 |
| Arsenic (As)-Dissolved | | | 100.6 | | % | | 80-120 | 11-AUG-16 |
| Barium (Ba)-Dissolved | | | 97.0 | | % | | 80-120 | 11-AUG-16 |
| Bismuth (Bi)-Dissolved | | | 97.0 | | % | | 80-120 | 11-AUG-16 |
| Boron (B)-Dissolved | | | 95.6 | | % | | 80-120 | 11-AUG-16 |
| Cadmium (Cd)-Dissolved | | | 94.0 | | % | | 80-120 | 11-AUG-16 |
| Chromium (Cr)-Dissolved | | | 99.3 | | % | | 80-120 | 11-AUG-16 |
| Cobalt (Co)-Dissolved | | | 98.3 | | % | | 80-120 | 11-AUG-16 |
| Copper (Cu)-Dissolved | | | 98.4 | | % | | 80-120 | 11-AUG-16 |
| Lead (Pb)-Dissolved | | | 100.1 | | % | | 80-120 | 11-AUG-16 |
| Lithium (Li)-Dissolved | | | 105.2 | | % | | 80-120 | 11-AUG-16 |
| Manganese (Mn)-Dissolved | | | 99.0 | | % | | 80-120 | 11-AUG-16 |
| Molybdenum (Mo)-Dissolved | | | 104.1 | | % | | 80-120 | 11-AUG-16 |
| Nickel (Ni)-Dissolved | | | 98.6 | | % | | 80-120 | 11-AUG-16 |
| Selenium (Se)-Dissolved | | | 92.5 | | % | | 80-120 | 11-AUG-16 |
| Silver (Ag)-Dissolved | | | 103.1 | | % | | 80-120 | 11-AUG-16 |
| Sodium (Na)-Dissolved | | | 101.1 | | % | | 80-120 | 11-AUG-16 |
| Strontium (Sr)-Dissolved | | | 97.5 | | % | | 80-120 | 11-AUG-16 |
| Thallium (Tl)-Dissolved | | | 98.5 | | % | | 80-120 | 11-AUG-16 |
| Tin (Sn)-Dissolved | | | 97.7 | | % | | 80-120 | 11-AUG-16 |
| Titanium (Ti)-Dissolved | | | 94.6 | | % | | 80-120 | 11-AUG-16 |
| Uranium (U)-Dissolved | | | 102.8 | | % | | 80-120 | 11-AUG-16 |
| Vanadium (V)-Dissolved | | | 100.7 | | % | | 80-120 | 11-AUG-16 |
| Zinc (Zn)-Dissolved | | | 95.9 | | % | | 80-120 | 11-AUG-16 |
| Zirconium (Zr)-Dissolved | | | 99.3 | | % | | 80-120 | 11-AUG-16 |
| MET-DIS-LOW-ICP-VA | | Water | | | | | | |



Quality Control Report

Workorder: L1811593

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|--------|-----------|-------|-----|--------|-----------|
| MET-DIS-LOW-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3523991 | | | | | | | |
| WG2365363-2 | LCS | | | | | | | |
| Calcium (Ca)-Dissolved | | | 100.5 | | % | | 80-120 | 11-AUG-16 |
| Iron (Fe)-Dissolved | | | 89.5 | | % | | 80-120 | 11-AUG-16 |
| Magnesium (Mg)-Dissolved | | | 96.4 | | % | | 80-120 | 11-AUG-16 |
| Phosphorus (P)-Dissolved | | | 97.1 | | % | | 80-120 | 11-AUG-16 |
| Potassium (K)-Dissolved | | | 95.7 | | % | | 80-120 | 11-AUG-16 |
| Silicon (Si)-Dissolved | | | 97.5 | | % | | 80-120 | 11-AUG-16 |
| WG2365363-1 | MB | NP | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 11-AUG-16 |
| Iron (Fe)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 11-AUG-16 |
| Magnesium (Mg)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 11-AUG-16 |
| Phosphorus (P)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 11-AUG-16 |
| Potassium (K)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 11-AUG-16 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 11-AUG-16 |
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3529596 | | | | | | | |
| WG2370965-2 | LCS | | | | | | | |
| Aluminum (Al)-Total | | | 104.8 | | % | | 80-120 | 19-AUG-16 |
| Antimony (Sb)-Total | | | 104.7 | | % | | 80-120 | 19-AUG-16 |
| Arsenic (As)-Total | | | 108.6 | | % | | 80-120 | 19-AUG-16 |
| Barium (Ba)-Total | | | 106.1 | | % | | 80-120 | 19-AUG-16 |
| Bismuth (Bi)-Total | | | 103.2 | | % | | 80-120 | 19-AUG-16 |
| Boron (B)-Total | | | 102.5 | | % | | 80-120 | 19-AUG-16 |
| Cadmium (Cd)-Total | | | 104.4 | | % | | 80-120 | 19-AUG-16 |
| Chromium (Cr)-Total | | | 103.7 | | % | | 80-120 | 19-AUG-16 |
| Cobalt (Co)-Total | | | 103.4 | | % | | 80-120 | 19-AUG-16 |
| Copper (Cu)-Total | | | 101.2 | | % | | 80-120 | 19-AUG-16 |
| Lead (Pb)-Total | | | 104.2 | | % | | 80-120 | 19-AUG-16 |
| Lithium (Li)-Total | | | 103.7 | | % | | 80-120 | 19-AUG-16 |
| Manganese (Mn)-Total | | | 105.6 | | % | | 80-120 | 19-AUG-16 |
| Molybdenum (Mo)-Total | | | 108.7 | | % | | 80-120 | 19-AUG-16 |
| Nickel (Ni)-Total | | | 104.9 | | % | | 80-120 | 19-AUG-16 |
| Selenium (Se)-Total | | | 103.3 | | % | | 80-120 | 19-AUG-16 |
| Silver (Ag)-Total | | | 106.0 | | % | | 80-120 | 19-AUG-16 |
| Sodium (Na)-Total | | | 107.5 | | % | | 80-120 | 19-AUG-16 |



Quality Control Report

Workorder: L1811593

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-----------------------|-----------------|--------------|------------|-----------|-------|-----|----------|-----------|
| MET-T-CCMS-VA | | Water | | | | | | |
| Batch | R3529596 | | | | | | | |
| WG2370965-2 | LCS | | | | | | | |
| Strontium (Sr)-Total | | | 103.0 | | % | | 80-120 | 19-AUG-16 |
| Thallium (Tl)-Total | | | 102.8 | | % | | 80-120 | 19-AUG-16 |
| Tin (Sn)-Total | | | 102.5 | | % | | 80-120 | 19-AUG-16 |
| Titanium (Ti)-Total | | | 104.9 | | % | | 80-120 | 19-AUG-16 |
| Uranium (U)-Total | | | 106.2 | | % | | 80-120 | 19-AUG-16 |
| Vanadium (V)-Total | | | 105.5 | | % | | 80-120 | 19-AUG-16 |
| Zinc (Zn)-Total | | | 97.8 | | % | | 80-120 | 19-AUG-16 |
| Zirconium (Zr)-Total | | | 97.9 | | % | | 80-120 | 19-AUG-16 |
| WG2370965-1 | MB | | | | | | | |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 19-AUG-16 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 19-AUG-16 |
| Barium (Ba)-Total | | | <0.000050 | | mg/L | | 0.00005 | 19-AUG-16 |
| Bismuth (Bi)-Total | | | <0.000050 | | mg/L | | 0.00005 | 19-AUG-16 |
| Boron (B)-Total | | | <0.010 | | mg/L | | 0.01 | 19-AUG-16 |
| Cadmium (Cd)-Total | | | <0.0000050 | | mg/L | | 0.000005 | 19-AUG-16 |
| Chromium (Cr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 19-AUG-16 |
| Cobalt (Co)-Total | | | <0.00010 | | mg/L | | 0.0001 | 19-AUG-16 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 19-AUG-16 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 19-AUG-16 |
| Lithium (Li)-Total | | | <0.0010 | | mg/L | | 0.001 | 19-AUG-16 |
| Manganese (Mn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 19-AUG-16 |
| Molybdenum (Mo)-Total | | | <0.000050 | | mg/L | | 0.00005 | 19-AUG-16 |
| Nickel (Ni)-Total | | | <0.00050 | | mg/L | | 0.0005 | 19-AUG-16 |
| Selenium (Se)-Total | | | <0.000050 | | mg/L | | 0.00005 | 19-AUG-16 |
| Silver (Ag)-Total | | | <0.000010 | | mg/L | | 0.00001 | 19-AUG-16 |
| Sodium (Na)-Total | | | <0.050 | | mg/L | | 0.05 | 19-AUG-16 |
| Strontium (Sr)-Total | | | <0.00020 | | mg/L | | 0.0002 | 19-AUG-16 |
| Thallium (Tl)-Total | | | <0.000010 | | mg/L | | 0.00001 | 19-AUG-16 |
| Tin (Sn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 19-AUG-16 |
| Titanium (Ti)-Total | | | <0.00030 | | mg/L | | 0.0003 | 19-AUG-16 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 19-AUG-16 |
| Vanadium (V)-Total | | | <0.00050 | | mg/L | | 0.0005 | 19-AUG-16 |
| Zinc (Zn)-Total | | | <0.0030 | | mg/L | | 0.003 | 19-AUG-16 |
| Zirconium (Zr)-Total | | | <0.00030 | | mg/L | | 0.0003 | 19-AUG-16 |



Quality Control Report

Workorder: L1811593

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-------------------------|--------------|-------------------|---------|-----------|-------|-----|---------|-----------|
| NO3-L-IC-N-WR | Water | | | | | | | |
| Batch | R3531122 | | | | | | | |
| WG2366021-9 MB | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 11-AUG-16 |
| PH-PCT-VA | Water | | | | | | | |
| Batch | R3530741 | | | | | | | |
| WG2371545-12 CRM | | VA-PH7-BUF | | | | | | |
| pH | | | 7.01 | | pH | | 6.9-7.1 | 20-AUG-16 |
| S-DIS-ICP-VA | Water | | | | | | | |
| Batch | R3523991 | | | | | | | |
| WG2365363-2 LCS | | | | | | | | |
| Sulfur (S)-Dissolved | | | 94.1 | | % | | 80-120 | 11-AUG-16 |
| WG2365363-1 MB | | NP | | | | | | |
| Sulfur (S)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 11-AUG-16 |
| S-TOT-ICP-VA | Water | | | | | | | |
| Batch | R3529516 | | | | | | | |
| WG2370965-2 LCS | | | | | | | | |
| Sulfur (S)-Total | | | 103.4 | | % | | 80-120 | 19-AUG-16 |
| WG2370965-1 MB | | | | | | | | |
| Sulfur (S)-Total | | | <0.50 | | mg/L | | 0.5 | 19-AUG-16 |
| SO4-IC-N-WR | Water | | | | | | | |
| Batch | R3531122 | | | | | | | |
| WG2366021-10 LCS | | | | | | | | |
| Sulfate (SO4) | | | 102.8 | | % | | 90-110 | 11-AUG-16 |
| WG2366021-9 MB | | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 11-AUG-16 |
| TSS-MAN-WR | Water | | | | | | | |
| Batch | R3526741 | | | | | | | |
| WG2366093-2 LCS | | | | | | | | |
| Total Suspended Solids | | | 89.8 | | % | | 85-115 | 11-AUG-16 |
| WG2366093-1 MB | | | | | | | | |
| Total Suspended Solids | | | <3.0 | | mg/L | | 3 | 11-AUG-16 |

Quality Control Report

Workorder: L1811593

Report Date: 20-DEC-17

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Quality Control Report

Workorder: L1811593

Report Date: 20-DEC-17

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Hold Time Exceedances:

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|-------------------------|-----------|-----------------|-----------------|---------|-----------|-------|-----------|
| Physical Tests | | | | | | | |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 08-AUG-16 10:25 | 20-AUG-16 09:55 | 0.25 | 288 | hours | EHTR-FM |
| | 2 | 08-AUG-16 10:30 | 20-AUG-16 09:55 | 0.25 | 288 | hours | EHTR-FM |
| | 3 | 08-AUG-16 10:35 | 20-AUG-16 09:55 | 0.25 | 287 | hours | EHTR-FM |

Legend & Qualifier Definitions:

| | |
|----------|---|
| EHTR-FM: | Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended. |
| EHTR: | Exceeded ALS recommended hold time prior to sample receipt. |
| EHTL: | Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry. |
| EHT: | Exceeded ALS recommended hold time prior to analysis. |
| Rec. HT: | ALS recommended hold time (see units). |

Notes*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1811593 were received on 10-AUG-16 15:45.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1811593-COFC

COC Number: 2016-08-10 B

Page of

www.alsglobal.com

| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
|--|---|--|--------------|---|---|---------------------------------|------------------------------|---|---|-------------------------|--|---------------------------|--|----------------------|---|-------------|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (business days) 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> | | | | EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | Date and Time Required for all E&P TATs: | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| Project Information | | AFE/Cost Center: PO# | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: Routing Code: | | | | | | | | | | | | | | | |
| PO / AFE: 221837 (WUL) | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Ariel Tang Sampler: SR/SB | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (1) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | | |
| E6 | | 8-Aug-16 | 10:25 | Water | R | R | R | R | R | R | R | R | | | 7 | | |
| E3 | | 8-Aug-16 | 10:30 | Water | R | R | R | R | R | R | R | R | | | 7 | | |
| C1 | | 8-Aug-16 | 10:35 | Water | R | R | R | R | R | R | R | R | | | 7 | | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | |
| | | | | | 99.6, 8, 5.1 | | | | | | 5.7, 7.2, 4.3, 9 | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2016-08-10 | | Time: 11:00 | | Received by: <i>[Signature]</i> | | Date: 10-AUG-16 | | Time: 3:45 | | Received by: JC | | Date: 11 Aug | | Time: 15:00 | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-AUG-16
Report Date: 26-AUG-16 14:14 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1813894
Project P.O. #: 221837 (WUL)
Job Reference:
C of C Numbers: 2016-08-15 B
Legal Site Desc:

Ariel McDonnell, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1813894-1 | L1813894-2 | L1813894-3 | |
|------------------------------|---|----------------------------|------------|-------------------------|------------|---------|
| | | Description | Water | Water | Water | |
| | | Sampled Date | 15-AUG-16 | 15-AUG-16 | 15-AUG-16 | |
| | | Sampled Time | 08:10 | 08:38 | 07:30 | |
| | | Client ID | E6 | E3 | C1 | |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 209 | 236 | 169 | |
| | Hardness (as CaCO3) (mg/L) | | 95.3 | 110 | 78.6 | |
| | pH (pH) | | 7.82 | 7.82 | 7.76 | |
| | Total Suspended Solids (mg/L) | | 4.0 | 5.3 | 3.3 | |
| | Total Dissolved Solids (mg/L) | | 117 | 136 | 91.0 | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 87.4 | 95.4 | 76.2 | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 87.4 | 95.4 | 76.2 | |
| | Ammonia, Total (as N) (mg/L) | | 0.464 | 0.475 | 0.403 | |
| | Chloride (Cl) (mg/L) | | 3.09 | 3.04 | 1.92 | |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.768 | 1.33 | 0.0283 | |
| | Nitrate (as N) (mg/L) | | 0.761 | 1.32 | 0.0283 | |
| | Nitrite (as N) (mg/L) | | 0.0070 | 0.0129 | <0.0010 | |
| | Sulfate (SO4) (mg/L) | | 17.0 | 22.1 | 10.4 | |
| | Anion Sum (meq/L) | | 2.24 | 2.55 | 1.80 | |
| | Cation Sum (meq/L) | | 2.19 | 2.56 | 1.78 | |
| | Cation - Anion Balance (%) | | -1.2 | 0.2 | -0.5 | |
| | Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0614 | 0.0838 | 0.0537 |
| | | Antimony (Sb)-Total (mg/L) | | 0.00010 | 0.00010 | 0.00010 |
| Arsenic (As)-Total (mg/L) | | | 0.00086 | 0.00097 | 0.00087 | |
| Barium (Ba)-Total (mg/L) | | | 0.0433 | 0.0486 | 0.0406 | |
| Beryllium (Be)-Total (mg/L) | | | <0.000020 | <0.000020 | <0.000020 | |
| Bismuth (Bi)-Total (mg/L) | | | <0.000050 | <0.000050 | <0.000050 | |
| Boron (B)-Total (mg/L) | | | 0.011 | 0.016 | <0.010 | |
| Cadmium (Cd)-Total (mg/L) | | | 0.0000091 | 0.0000127 | 0.0000114 | |
| Calcium (Ca)-Total (mg/L) | | | 28.8 | 31.9 | 22.8 | |
| Chromium (Cr)-Total (mg/L) | | | 0.00026 | 0.00030 | 0.00027 | |
| Cobalt (Co)-Total (mg/L) | | | <0.00010 | <0.00010 | <0.00010 | |
| Copper (Cu)-Total (mg/L) | | | 0.00538 | 0.00785 | 0.00196 | |
| Iron (Fe)-Total (mg/L) | | | 0.156 | 0.177 | 0.121 | |
| Lead (Pb)-Total (mg/L) | | | 0.000166 | <0.00030 ^{DLB} | 0.000125 | |
| Lithium (Li)-Total (mg/L) | | | 0.0011 | <0.0010 | <0.0010 | |
| Magnesium (Mg)-Total (mg/L) | | | 7.19 | 8.12 | 5.92 | |
| Manganese (Mn)-Total (mg/L) | | | 0.0147 | 0.0277 | 0.00594 | |
| Mercury (Hg)-Total (mg/L) | | | <0.0000050 | <0.0000050 | <0.0000050 | |
| Molybdenum (Mo)-Total (mg/L) | | | 0.00178 | 0.00216 | 0.00132 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1813894-1 Water 15-AUG-16 08:10 E6 | L1813894-2 Water 15-AUG-16 08:38 E3 | L1813894-3 Water 15-AUG-16 07:30 C1 | | |
|-------------------------|---|---|---|---|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Nickel (Ni)-Total (mg/L) | 0.00074 | 0.00083 | 0.00074 | | |
| | Phosphorus (P)-Total (mg/L) | 0.124 | 0.124 | 0.109 | | |
| | Potassium (K)-Total (mg/L) | 1.42 | 1.73 | 0.98 | | |
| | Selenium (Se)-Total (mg/L) | 0.000327 | 0.000481 | 0.000137 | | |
| | Silicon (Si)-Total (mg/L) | 3.73 | 3.61 | 3.88 | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Total (mg/L) | 5.32 | 6.77 | 3.59 | | |
| | Strontium (Sr)-Total (mg/L) | 0.208 | 0.260 | 0.141 | | |
| | Sulfur (S)-Total (mg/L) | 6.28 | 8.01 | 3.90 | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Total (mg/L) | 0.00200 | 0.00259 | 0.00171 | | |
| | Uranium (U)-Total (mg/L) | 0.00112 | 0.00110 | 0.00108 | | |
| | Vanadium (V)-Total (mg/L) | 0.00070 | 0.00077 | 0.00075 | | |
| | Zinc (Zn)-Total (mg/L) | 0.0142 | 0.0179 | 0.0096 | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0137 | 0.0140 | 0.0129 | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00060 | 0.00060 | 0.00066 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0396 | 0.0442 | 0.0378 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.015 | <0.010 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000054 | 0.0000064 | 0.0000073 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 26.7 | 31.3 | 22.1 | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00013 | 0.00015 | 0.00015 | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00390 | 0.00611 | 0.00137 | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.034 | 0.033 | 0.031 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 6.96 | 7.84 | 5.70 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00221 | 0.00248 | 0.00134 | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00159 | 0.00187 | 0.00117 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1813894-1 | L1813894-2 | L1813894-3 | | |
|-------------------------|---------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 15-AUG-16 | 15-AUG-16 | 15-AUG-16 | | |
| | | Sampled Time | 08:10 | 08:38 | 07:30 | | |
| | | Client ID | E6 | E3 | C1 | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Nickel (Ni)-Dissolved (mg/L) | | 0.00057 | 0.00066 | 0.00060 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | 0.062 | 0.081 | 0.068 | | |
| | Potassium (K)-Dissolved (mg/L) | | 1.33 | 1.62 | 0.93 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000308 | 0.000490 | 0.000142 | | |
| | Silicon (Si)-Dissolved (mg/L) | | 3.55 | 3.37 | 3.73 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 4.98 | 6.28 | 3.49 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.206 | 0.248 | 0.135 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 5.91 | 7.66 | 3.61 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | 0.00033 | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.00104 | 0.00106 | 0.00102 | | |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | 0.00056 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0109 | 0.0137 | 0.0076 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|---------------------------|-----------|-----------------------------|
| Matrix Spike | Aluminum (Al)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Antimony (Sb)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Arsenic (As)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1813894-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1813894-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLB | Detection Limit Raised. Analyte detected at comparable level in Method Blank. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--------------------------------------|-------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |

Reference Information

| | | | |
|--|-------|--|---|
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-DIS-LOW-ICP-VA | Water | Dissolved Metals in Water by ICPOES | EPA 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-TOT-LOW-ICP-VA | Water | Total Metals in Water by ICPOES | EPA 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| S-DIS-ICP-VA | Water | Dissolved Sulfur in Water by ICPOES | EPA SW-846 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample. | | | |
| S-TOT-ICP-VA | Water | Total Sulfur in Water by ICPOES | EPA SW-846 3005A/6010B |

Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2016-08-15 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1813894

Report Date: 20-DEC-17

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Client: Minto Explorations Ltd.
 Suite 2100- 510 West Georgia St
 Vancouver BC V6B 0M3

Contact: Minto Environment - Coordinator

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|--------------|----------------------------|-----------|-----------|-------|-----|---------|-----------|
| ALK-TITR-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3530970 | | | | | | | |
| WG2372376-13 CRM | | VA-ALK-TITR-CONTROL | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 96.3 | | % | | 85-115 | 22-AUG-16 |
| WG2372376-11 MB | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 22-AUG-16 |
| BE-D-L-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3527994 | | | | | | | |
| WG2369236-2 LCS | | | | | | | | |
| Beryllium (Be)-Dissolved | | | 104.3 | | % | | 80-120 | 17-AUG-16 |
| WG2369236-1 MB | | NP | | | | | | |
| Beryllium (Be)-Dissolved | | | <0.000020 | | mg/L | | 0.00002 | 17-AUG-16 |
| Batch | R3533654 | | | | | | | |
| WG2369236-17 DUP | | L1813894-3 | | | | | | |
| Beryllium (Be)-Dissolved | | <0.000020 | <0.000020 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| BE-T-L-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3532912 | | | | | | | |
| WG2373588-2 LCS | | | | | | | | |
| Beryllium (Be)-Total | | | 99.8 | | % | | 80-120 | 24-AUG-16 |
| WG2373588-1 MB | | | | | | | | |
| Beryllium (Be)-Total | | | <0.000020 | | mg/L | | 0.00002 | 24-AUG-16 |
| CL-IC-N-WR | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3532062 | | | | | | | |
| WG2369969-2 LCS | | | | | | | | |
| Chloride (Cl) | | | 100.7 | | % | | 90-110 | 17-AUG-16 |
| WG2369969-1 MB | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 17-AUG-16 |
| EC-PCT-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3530970 | | | | | | | |
| WG2372376-14 CRM | | VA-EC-PCT-CONTROL | | | | | | |
| Conductivity | | | 102.4 | | % | | 90-110 | 22-AUG-16 |
| WG2372376-11 MB | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 22-AUG-16 |
| HG-D-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3528752 | | | | | | | |
| WG2370111-2 LCS | | | | | | | | |
| Mercury (Hg)-Dissolved | | | 108.2 | | % | | 80-120 | 18-AUG-16 |
| WG2370111-1 MB | | NP | | | | | | |



Quality Control Report

Workorder: L1813894

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|--------|-----------|------------|-----------|-------|-----|----------|-----------|
| HG-D-CVAA-VA | | | | | | | | |
| Batch R3528752 | | | | | | | | |
| WG2370111-1 | MB | NP | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000005C | | mg/L | | 0.000005 | 18-AUG-16 |
| HG-T-CVAA-VA | | | | | | | | |
| Batch R3528752 | | | | | | | | |
| WG2370800-2 | LCS | | | | | | | |
| Mercury (Hg)-Total | | | 105.8 | | % | | 80-120 | 18-AUG-16 |
| WG2370800-1 | MB | | | | | | | |
| Mercury (Hg)-Total | | | <0.000005C | | mg/L | | 0.000005 | 18-AUG-16 |
| MET-D-CCMS-VA | | | | | | | | |
| Batch R3527994 | | | | | | | | |
| WG2369236-2 | LCS | | | | | | | |
| Aluminum (Al)-Dissolved | | | 110.9 | | % | | 80-120 | 17-AUG-16 |
| Antimony (Sb)-Dissolved | | | 101.5 | | % | | 80-120 | 17-AUG-16 |
| Arsenic (As)-Dissolved | | | 105.8 | | % | | 80-120 | 17-AUG-16 |
| Barium (Ba)-Dissolved | | | 102.4 | | % | | 80-120 | 17-AUG-16 |
| Bismuth (Bi)-Dissolved | | | 103.0 | | % | | 80-120 | 17-AUG-16 |
| Boron (B)-Dissolved | | | 100.5 | | % | | 80-120 | 17-AUG-16 |
| Cadmium (Cd)-Dissolved | | | 104.4 | | % | | 80-120 | 17-AUG-16 |
| Chromium (Cr)-Dissolved | | | 108.6 | | % | | 80-120 | 17-AUG-16 |
| Cobalt (Co)-Dissolved | | | 105.7 | | % | | 80-120 | 17-AUG-16 |
| Copper (Cu)-Dissolved | | | 105.0 | | % | | 80-120 | 17-AUG-16 |
| Lead (Pb)-Dissolved | | | 104.5 | | % | | 80-120 | 17-AUG-16 |
| Lithium (Li)-Dissolved | | | 107.2 | | % | | 80-120 | 17-AUG-16 |
| Manganese (Mn)-Dissolved | | | 107.3 | | % | | 80-120 | 17-AUG-16 |
| Molybdenum (Mo)-Dissolved | | | 108.9 | | % | | 80-120 | 17-AUG-16 |
| Nickel (Ni)-Dissolved | | | 104.8 | | % | | 80-120 | 17-AUG-16 |
| Selenium (Se)-Dissolved | | | 105.4 | | % | | 80-120 | 17-AUG-16 |
| Silver (Ag)-Dissolved | | | 103.2 | | % | | 80-120 | 17-AUG-16 |
| Sodium (Na)-Dissolved | | | 105.8 | | % | | 80-120 | 17-AUG-16 |
| Strontium (Sr)-Dissolved | | | 103.3 | | % | | 80-120 | 17-AUG-16 |
| Thallium (Tl)-Dissolved | | | 103.8 | | % | | 80-120 | 17-AUG-16 |
| Tin (Sn)-Dissolved | | | 101.9 | | % | | 80-120 | 17-AUG-16 |
| Titanium (Ti)-Dissolved | | | 101.1 | | % | | 80-120 | 17-AUG-16 |
| Uranium (U)-Dissolved | | | 101.9 | | % | | 80-120 | 17-AUG-16 |
| Vanadium (V)-Dissolved | | | 106.1 | | % | | 80-120 | 17-AUG-16 |



Quality Control Report

Workorder: L1813894

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-------------------|------------|-----------|-------|-----|----------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3527994 | | | | | | | |
| WG2369236-2 | LCS | | | | | | | |
| Zinc (Zn)-Dissolved | | | 102.3 | | % | | 80-120 | 17-AUG-16 |
| Zirconium (Zr)-Dissolved | | | 99.8 | | % | | 80-120 | 17-AUG-16 |
| WG2369236-1 | MB | NP | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 17-AUG-16 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 17-AUG-16 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 17-AUG-16 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 17-AUG-16 |
| Bismuth (Bi)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 17-AUG-16 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 17-AUG-16 |
| Cadmium (Cd)-Dissolved | | | <0.0000050 | | mg/L | | 0.000005 | 17-AUG-16 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 17-AUG-16 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 17-AUG-16 |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 17-AUG-16 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 17-AUG-16 |
| Lithium (Li)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 17-AUG-16 |
| Manganese (Mn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 17-AUG-16 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 17-AUG-16 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 17-AUG-16 |
| Selenium (Se)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 17-AUG-16 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 17-AUG-16 |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 17-AUG-16 |
| Strontium (Sr)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 17-AUG-16 |
| Thallium (Tl)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 17-AUG-16 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 17-AUG-16 |
| Titanium (Ti)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 17-AUG-16 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 17-AUG-16 |
| Vanadium (V)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 17-AUG-16 |
| Zinc (Zn)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 17-AUG-16 |
| Zirconium (Zr)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 17-AUG-16 |
| Batch | R3533654 | | | | | | | |
| WG2369236-17 | DUP | L1813894-3 | | | | | | |
| Aluminum (Al)-Dissolved | | 0.0129 | 0.0127 | | mg/L | 1.7 | 20 | 24-AUG-16 |
| Antimony (Sb)-Dissolved | | <0.00010 | <0.00010 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| Arsenic (As)-Dissolved | | 0.00066 | 0.00062 | | mg/L | 5.6 | 20 | 24-AUG-16 |
| Barium (Ba)-Dissolved | | 0.0378 | 0.0381 | | mg/L | 0.9 | 20 | 24-AUG-16 |



Quality Control Report

Workorder: L1813894

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-------------------|-----------|-----------|-------|-----|--------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3533654 | | | | | | | |
| WG2369236-17 DUP | | L1813894-3 | | | | | | |
| Bismuth (Bi)-Dissolved | | <0.000050 | <0.000050 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| Boron (B)-Dissolved | | <0.010 | <0.010 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| Cadmium (Cd)-Dissolved | | 0.0000073 | 0.0000072 | | mg/L | 1.1 | 20 | 24-AUG-16 |
| Chromium (Cr)-Dissolved | | 0.00015 | 0.00018 | | mg/L | 16 | 20 | 24-AUG-16 |
| Cobalt (Co)-Dissolved | | <0.00010 | <0.00010 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| Copper (Cu)-Dissolved | | 0.00137 | 0.00134 | | mg/L | 2.4 | 20 | 24-AUG-16 |
| Lead (Pb)-Dissolved | | <0.000050 | <0.000050 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| Lithium (Li)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| Manganese (Mn)-Dissolved | | 0.00134 | 0.00125 | | mg/L | 6.7 | 20 | 24-AUG-16 |
| Molybdenum (Mo)-Dissolved | | 0.00117 | 0.00119 | | mg/L | 1.5 | 20 | 24-AUG-16 |
| Nickel (Ni)-Dissolved | | 0.00060 | 0.00063 | | mg/L | 4.3 | 20 | 24-AUG-16 |
| Selenium (Se)-Dissolved | | 0.000142 | 0.000131 | | mg/L | 8.0 | 20 | 24-AUG-16 |
| Silver (Ag)-Dissolved | | <0.000010 | <0.000010 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| Sodium (Na)-Dissolved | | 3.49 | 3.45 | | mg/L | 1.2 | 20 | 24-AUG-16 |
| Strontium (Sr)-Dissolved | | 0.135 | 0.135 | | mg/L | 0.2 | 20 | 24-AUG-16 |
| Thallium (Tl)-Dissolved | | <0.000010 | <0.000010 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| Tin (Sn)-Dissolved | | <0.00010 | <0.00010 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| Titanium (Ti)-Dissolved | | <0.00030 | <0.00030 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| Uranium (U)-Dissolved | | 0.00102 | 0.00101 | | mg/L | 1.4 | 20 | 24-AUG-16 |
| Vanadium (V)-Dissolved | | 0.00056 | 0.00053 | | mg/L | 4.1 | 20 | 24-AUG-16 |
| Zinc (Zn)-Dissolved | | 0.0076 | 0.0075 | | mg/L | 1.8 | 20 | 24-AUG-16 |
| Zirconium (Zr)-Dissolved | | <0.00030 | <0.00030 | RPD-NA | mg/L | N/A | 20 | 24-AUG-16 |
| MET-DIS-LOW-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3527812 | | | | | | | |
| WG2369236-1 MB | | NP | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 17-AUG-16 |
| Iron (Fe)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 17-AUG-16 |
| Magnesium (Mg)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 17-AUG-16 |
| Phosphorus (P)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 17-AUG-16 |
| Potassium (K)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 17-AUG-16 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 17-AUG-16 |
| Batch | R3527985 | | | | | | | |
| WG2369236-2 LCS | | | | | | | | |
| Calcium (Ca)-Dissolved | | | 99.6 | | % | | 80-120 | 17-AUG-16 |



Quality Control Report

Workorder: L1813894

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-------------------|--------|-----------|-------|-----|--------|-----------|
| MET-DIS-LOW-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3527985 | | | | | | | |
| WG2369236-2 | LCS | | | | | | | |
| Iron (Fe)-Dissolved | | | 95.5 | | % | | 80-120 | 17-AUG-16 |
| Magnesium (Mg)-Dissolved | | | 100.1 | | % | | 80-120 | 17-AUG-16 |
| Phosphorus (P)-Dissolved | | | 99.3 | | % | | 80-120 | 17-AUG-16 |
| Potassium (K)-Dissolved | | | 97.3 | | % | | 80-120 | 17-AUG-16 |
| Silicon (Si)-Dissolved | | | 103.7 | | % | | 80-120 | 17-AUG-16 |
| Batch | R3532688 | | | | | | | |
| WG2369236-17 | DUP | L1813894-3 | | | | | | |
| Calcium (Ca)-Dissolved | | 22.1 | 22.1 | | mg/L | 0.2 | 20 | 23-AUG-16 |
| Iron (Fe)-Dissolved | | 0.031 | 0.030 | | mg/L | 3.0 | 20 | 23-AUG-16 |
| Magnesium (Mg)-Dissolved | | 5.70 | 5.71 | | mg/L | 0.2 | 20 | 23-AUG-16 |
| Phosphorus (P)-Dissolved | | 0.068 | 0.078 | | mg/L | 13 | 20 | 23-AUG-16 |
| Potassium (K)-Dissolved | | 0.93 | 0.92 | | mg/L | 0.9 | 20 | 23-AUG-16 |
| Silicon (Si)-Dissolved | | 3.73 | 3.76 | | mg/L | 0.7 | 20 | 23-AUG-16 |
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3532912 | | | | | | | |
| WG2373588-2 | LCS | | | | | | | |
| Aluminum (Al)-Total | | | 104.1 | | % | | 80-120 | 24-AUG-16 |
| Antimony (Sb)-Total | | | 104.4 | | % | | 80-120 | 24-AUG-16 |
| Arsenic (As)-Total | | | 106.2 | | % | | 80-120 | 24-AUG-16 |
| Barium (Ba)-Total | | | 105.4 | | % | | 80-120 | 24-AUG-16 |
| Bismuth (Bi)-Total | | | 102.8 | | % | | 80-120 | 24-AUG-16 |
| Boron (B)-Total | | | 99.2 | | % | | 80-120 | 24-AUG-16 |
| Cadmium (Cd)-Total | | | 99.2 | | % | | 80-120 | 24-AUG-16 |
| Chromium (Cr)-Total | | | 95.9 | | % | | 80-120 | 24-AUG-16 |
| Cobalt (Co)-Total | | | 102.1 | | % | | 80-120 | 24-AUG-16 |
| Copper (Cu)-Total | | | 99.5 | | % | | 80-120 | 24-AUG-16 |
| Lead (Pb)-Total | | | 101.3 | | % | | 80-120 | 24-AUG-16 |
| Lithium (Li)-Total | | | 106.4 | | % | | 80-120 | 24-AUG-16 |
| Manganese (Mn)-Total | | | 100.4 | | % | | 80-120 | 24-AUG-16 |
| Molybdenum (Mo)-Total | | | 104.0 | | % | | 80-120 | 24-AUG-16 |
| Nickel (Ni)-Total | | | 103.5 | | % | | 80-120 | 24-AUG-16 |
| Selenium (Se)-Total | | | 102.7 | | % | | 80-120 | 24-AUG-16 |
| Silver (Ag)-Total | | | 97.9 | | % | | 80-120 | 24-AUG-16 |
| Sodium (Na)-Total | | | 102.0 | | % | | 80-120 | 24-AUG-16 |



Quality Control Report

Workorder: L1813894

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|--------------|------------|-----------|-------|-----|----------|-----------|
| MET-T-CCMS-VA | | Water | | | | | | |
| Batch | R3532912 | | | | | | | |
| WG2373588-2 | LCS | | | | | | | |
| Strontium (Sr)-Total | | | 100.6 | | % | | 80-120 | 24-AUG-16 |
| Thallium (Tl)-Total | | | 105.5 | | % | | 80-120 | 24-AUG-16 |
| Tin (Sn)-Total | | | 98.3 | | % | | 80-120 | 24-AUG-16 |
| Titanium (Ti)-Total | | | 98.8 | | % | | 80-120 | 24-AUG-16 |
| Uranium (U)-Total | | | 98.9 | | % | | 80-120 | 24-AUG-16 |
| Vanadium (V)-Total | | | 102.7 | | % | | 80-120 | 24-AUG-16 |
| Zinc (Zn)-Total | | | 97.0 | | % | | 80-120 | 24-AUG-16 |
| Zirconium (Zr)-Total | | | 95.8 | | % | | 80-120 | 24-AUG-16 |
| WG2373588-1 | MB | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 24-AUG-16 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 24-AUG-16 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 24-AUG-16 |
| Bismuth (Bi)-Total | | | <0.000050 | | mg/L | | 0.00005 | 24-AUG-16 |
| Boron (B)-Total | | | <0.010 | | mg/L | | 0.01 | 24-AUG-16 |
| Cadmium (Cd)-Total | | | <0.0000050 | | mg/L | | 0.000005 | 24-AUG-16 |
| Chromium (Cr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 24-AUG-16 |
| Cobalt (Co)-Total | | | <0.00010 | | mg/L | | 0.0001 | 24-AUG-16 |
| Lithium (Li)-Total | | | <0.0010 | | mg/L | | 0.001 | 24-AUG-16 |
| Manganese (Mn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 24-AUG-16 |
| Molybdenum (Mo)-Total | | | <0.000050 | | mg/L | | 0.00005 | 24-AUG-16 |
| Nickel (Ni)-Total | | | <0.00050 | | mg/L | | 0.0005 | 24-AUG-16 |
| Selenium (Se)-Total | | | <0.000050 | | mg/L | | 0.00005 | 24-AUG-16 |
| Silver (Ag)-Total | | | <0.000010 | | mg/L | | 0.00001 | 24-AUG-16 |
| Sodium (Na)-Total | | | <0.050 | | mg/L | | 0.05 | 24-AUG-16 |
| Strontium (Sr)-Total | | | <0.00020 | | mg/L | | 0.0002 | 24-AUG-16 |
| Thallium (Tl)-Total | | | <0.000010 | | mg/L | | 0.00001 | 24-AUG-16 |
| Tin (Sn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 24-AUG-16 |
| Titanium (Ti)-Total | | | <0.00030 | | mg/L | | 0.0003 | 24-AUG-16 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 24-AUG-16 |
| Vanadium (V)-Total | | | <0.00050 | | mg/L | | 0.0005 | 24-AUG-16 |
| Zinc (Zn)-Total | | | <0.0030 | | mg/L | | 0.003 | 24-AUG-16 |
| Zirconium (Zr)-Total | | | <0.00030 | | mg/L | | 0.0003 | 24-AUG-16 |
| MET-TOT-LOW-ICP-VA | Water | | | | | | | |



Quality Control Report

Workorder: L1813894

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|--------------|---------|-----------|-------|-----|--------|-----------|
| MET-TOT-LOW-ICP-VA | | Water | | | | | | |
| Batch | R3532688 | | | | | | | |
| WG2373588-2 | LCS | | | | | | | |
| Calcium (Ca)-Total | | | 100.1 | | % | | 80-120 | 23-AUG-16 |
| Iron (Fe)-Total | | | 93.8 | | % | | 80-120 | 23-AUG-16 |
| Magnesium (Mg)-Total | | | 98.3 | | % | | 80-120 | 23-AUG-16 |
| Phosphorus (P)-Total | | | 96.9 | | % | | 80-120 | 23-AUG-16 |
| Potassium (K)-Total | | | 101.4 | | % | | 80-120 | 23-AUG-16 |
| Silicon (Si)-Total | | | 102.7 | | % | | 80-120 | 23-AUG-16 |
| WG2373588-1 | MB | | | | | | | |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 23-AUG-16 |
| Iron (Fe)-Total | | | <0.010 | | mg/L | | 0.01 | 23-AUG-16 |
| Magnesium (Mg)-Total | | | <0.050 | | mg/L | | 0.05 | 23-AUG-16 |
| Phosphorus (P)-Total | | | <0.050 | | mg/L | | 0.05 | 23-AUG-16 |
| Potassium (K)-Total | | | <0.10 | | mg/L | | 0.1 | 23-AUG-16 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 23-AUG-16 |
| NH3-F-VA | | Water | | | | | | |
| Batch | R3532986 | | | | | | | |
| WG2374307-6 | LCS | | | | | | | |
| Ammonia, Total (as N) | | | 101.6 | | % | | 85-115 | 24-AUG-16 |
| WG2374307-5 | MB | | | | | | | |
| Ammonia, Total (as N) | | | <0.0050 | | mg/L | | 0.005 | 24-AUG-16 |
| Batch | R3533269 | | | | | | | |
| WG2374311-2 | LCS | | | | | | | |
| Ammonia, Total (as N) | | | 100.2 | | % | | 85-115 | 25-AUG-16 |
| WG2374311-1 | MB | | | | | | | |
| Ammonia, Total (as N) | | | <0.0050 | | mg/L | | 0.005 | 25-AUG-16 |
| NO2-L-IC-N-WR | | Water | | | | | | |
| Batch | R3532062 | | | | | | | |
| WG2369969-2 | LCS | | | | | | | |
| Nitrite (as N) | | | 99.4 | | % | | 90-110 | 17-AUG-16 |
| WG2369969-1 | MB | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 17-AUG-16 |
| NO3-L-IC-N-WR | | Water | | | | | | |
| Batch | R3532062 | | | | | | | |
| WG2369969-2 | LCS | | | | | | | |
| Nitrate (as N) | | | 100.7 | | % | | 90-110 | 17-AUG-16 |
| WG2369969-1 | MB | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 17-AUG-16 |



Quality Control Report

Workorder: L1813894

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|--------------|--------------------|--------|-----------|-------|-----|---------|-----------|
| PH-PCT-VA | Water | | | | | | | |
| Batch R3530970 WG2372376-12 CRM pH | | VA-PH7-BUF | 7.00 | | pH | | 6.9-7.1 | 22-AUG-16 |
| S-DIS-ICP-VA | Water | | | | | | | |
| Batch R3527812 WG2369236-1 MB Sulfur (S)-Dissolved | | NP | <0.50 | | mg/L | | 0.5 | 17-AUG-16 |
| Batch R3527985 WG2369236-2 LCS Sulfur (S)-Dissolved | | | 105.2 | | % | | 80-120 | 17-AUG-16 |
| Batch R3532688 WG2369236-17 DUP Sulfur (S)-Dissolved | | L1813894-3 3.61 | 3.65 | | mg/L | 1.1 | 20 | 23-AUG-16 |
| S-TOT-ICP-VA | Water | | | | | | | |
| Batch R3532688 WG2373588-2 LCS Sulfur (S)-Total | | | 102.7 | | % | | 80-120 | 23-AUG-16 |
| WG2373588-1 MB Sulfur (S)-Total | | | <0.50 | | mg/L | | 0.5 | 23-AUG-16 |
| SO4-IC-N-WR | Water | | | | | | | |
| Batch R3532062 WG2369969-2 LCS Sulfate (SO4) | | | 101.4 | | % | | 90-110 | 17-AUG-16 |
| WG2369969-1 MB Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 17-AUG-16 |
| TSS-MAN-WR | Water | | | | | | | |
| Batch R3531911 WG2373087-2 LCS Total Suspended Solids | | | 95.1 | | % | | 85-115 | 22-AUG-16 |
| WG2373087-1 MB Total Suspended Solids | | | <3.0 | | mg/L | | 3 | 22-AUG-16 |

Quality Control Report

Workorder: L1813894

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Sample Parameter Qualifier Definitions:

| Qualifier | Description |
|-----------|---|
| RPD-NA | Relative Percent Difference Not Available due to result(s) being less than detection limit. |

Quality Control Report

Workorder: L1813894

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Hold Time Exceedances:

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|-------------------------|-----------|-----------------|-----------------|---------|-----------|-------|-----------|
| Physical Tests | | | | | | | |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 15-AUG-16 08:10 | 22-AUG-16 08:42 | 0.25 | 168 | hours | EHTR-FM |
| | 2 | 15-AUG-16 08:38 | 22-AUG-16 08:42 | 0.25 | 168 | hours | EHTR-FM |
| | 3 | 15-AUG-16 07:30 | 22-AUG-16 08:42 | 0.25 | 169 | hours | EHTR-FM |

Legend & Qualifier Definitions:

| | |
|----------|---|
| EHTR-FM: | Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended. |
| EHTR: | Exceeded ALS recommended hold time prior to sample receipt. |
| EHTL: | Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry. |
| EHT: | Exceeded ALS recommended hold time prior to analysis. |
| Rec. HT: | ALS recommended hold time (see units). |

Notes*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1813894 were received on 16-AUG-16 10:05.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Chain of Custody (COC) / Analytical Request Form

COC Number: 2016-08-15 B

Affix ALS barcode label here

(lab use only)

Page of

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | |
|--|---|--|--|--|---|-------------------------------------|---|---|------------------------------|--|--|-------------------------|--|---------------------------|--------------------------------|----------------------|--|--|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | EMERGENCY | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | | | |
| Project Information | | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | | AFE/Cost Center: | | PO#: | | | | | | | | | | | | | |
| Job #: | | | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 221837 (WUL) | | | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | ALS Contact: Ariel Tang | | Sampler: CH | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury (1) (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | | | |
| E6 | | | | 15-Aug-16 | 8:10 | Water | R | R | R | R | R | R | R | R | R | 6 | | | |
| E3 | | | | 15-Aug-16 | 8:38 | Water | R | R | R | R | R | R | R | R | R | 6 | | | |
| C1 | | | | 15-Aug-16 | 7:30 | Water | R | R | R | R | R | R | R | R | R | 6 | | | |
| Short Holding Time Rush Processing | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | | | Special | | p-down list below | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> | | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> | | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | |
| | | | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | |
| | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | FINAL COOLER TEMPERATURES °C | | | | | | | | |
| | | | | | | | | | | | -2.1 5 | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | |
| Released by: Chris Blurton | | Date: 2016-08-15 | | Time: 12:30 | | Received by: Shayan | | Date: Aug. 16 | | Time: 1005 | | Received by: JC | | Date: AUG 17 2016 | | Time: 12:40 | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 24-AUG-16
Report Date: 07-SEP-16 18:00 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1818233
Project P.O. #: 221837 (WUL)
Job Reference:
C of C Numbers: 2016-08-23 B
Legal Site Desc:

Ariel McDonnell, B.Sc.
Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1818233-1 | L1818233-2 | L1818233-3 |
|------------------------------|---|----------------------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 22-AUG-16 | 22-AUG-16 | 22-AUG-16 |
| | | Sampled Time | 07:50 | 08:25 | 08:50 |
| | | Client ID | C1 | E6 | E3 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 161 | 205 | 231 |
| | Hardness (as CaCO3) (mg/L) | | 77.0 | 94.1 | 111 |
| | pH (pH) | | 7.75 | 7.88 | 7.86 |
| | Total Suspended Solids (mg/L) | | 4.0 | 4.0 | 6.0 |
| | Total Dissolved Solids (mg/L) | | 88.3 | 116 | 136 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 75.7 | 89.2 | 95.5 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 75.7 | 89.2 | 95.5 |
| | Ammonia, Total (as N) (mg/L) | | 0.384 | 0.441 | 0.470 |
| | Chloride (Cl) (mg/L) | | 0.69 | 1.57 | 2.01 |
| | Nitrate and Nitrite (as N) (mg/L) | | <0.0051 | 0.769 | 1.31 |
| | Nitrate (as N) (mg/L) | | <0.0050 | 0.761 | 1.29 |
| | Nitrite (as N) (mg/L) | | <0.0010 | 0.0075 | 0.0136 |
| | Sulfate (SO4) (mg/L) | | 10.6 | 17.6 | 22.4 |
| | Anion Sum (meq/L) | | 1.75 | 2.25 | 2.52 |
| | Cation Sum (meq/L) | | 1.72 | 2.15 | 2.61 |
| | Cation - Anion Balance (%) | | -0.8 | -2.2 | 1.6 |
| | Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0466 | 0.0499 |
| Antimony (Sb)-Total (mg/L) | | | 0.00012 | <0.00010 | <0.00010 |
| Arsenic (As)-Total (mg/L) | | | 0.00085 | 0.00078 | 0.00082 |
| Barium (Ba)-Total (mg/L) | | | 0.0407 | 0.0473 | 0.0482 |
| Beryllium (Be)-Total (mg/L) | | | <0.000020 | <0.000020 | <0.000020 |
| Bismuth (Bi)-Total (mg/L) | | | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Total (mg/L) | | | <0.010 | <0.010 | 0.014 |
| Cadmium (Cd)-Total (mg/L) | | | 0.0000127 | 0.0000105 | 0.0000115 |
| Calcium (Ca)-Total (mg/L) | | | 21.6 | 26.5 | 31.9 |
| Chromium (Cr)-Total (mg/L) | | | 0.00032 | 0.00023 | 0.00025 |
| Cobalt (Co)-Total (mg/L) | | | <0.00010 | <0.00010 | <0.00010 |
| Copper (Cu)-Total (mg/L) | | | 0.00219 | 0.00541 | 0.00762 |
| Iron (Fe)-Total (mg/L) | | | 0.119 | 0.131 | 0.119 |
| Lead (Pb)-Total (mg/L) | | | 0.000111 | 0.000128 | 0.000126 |
| Lithium (Li)-Total (mg/L) | | | <0.0010 | <0.0010 | <0.0010 |
| Magnesium (Mg)-Total (mg/L) | | | 5.75 | 7.15 | 8.23 |
| Manganese (Mn)-Total (mg/L) | | | 0.00609 | 0.0121 | 0.0157 |
| Mercury (Hg)-Total (mg/L) | | | <0.0000050 | <0.0000050 | <0.0000050 |
| Molybdenum (Mo)-Total (mg/L) | | | 0.00133 | 0.00183 | 0.00214 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1818233-1 | L1818233-2 | L1818233-3 |
|-------------------------|---------------------------------------|--------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 22-AUG-16 | 22-AUG-16 | 22-AUG-16 |
| | | Sampled Time | 07:50 | 08:25 | 08:50 |
| | | Client ID | C1 | E6 | E3 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Nickel (Ni)-Total (mg/L) | | 0.00065 | 0.00072 | 0.00061 |
| | Phosphorus (P)-Total (mg/L) | | 0.099 | 0.129 | 0.113 |
| | Potassium (K)-Total (mg/L) | | 0.89 | 1.27 | 1.60 |
| | Selenium (Se)-Total (mg/L) | | 0.000111 | 0.000357 | 0.000455 |
| | Silicon (Si)-Total (mg/L) | | 3.50 | 3.37 | 3.29 |
| | Silver (Ag)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | | 2.97 | 4.88 | 6.07 |
| | Strontium (Sr)-Total (mg/L) | | 0.135 | 0.209 | 0.257 |
| | Sulfur (S)-Total (mg/L) | | 3.65 | 6.06 | 7.63 |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | | 0.00148 | 0.00149 | 0.00135 |
| | Uranium (U)-Total (mg/L) | | 0.00103 | 0.00108 | 0.00107 |
| | Vanadium (V)-Total (mg/L) | | 0.00071 | 0.00071 | 0.00068 |
| | Zinc (Zn)-Total (mg/L) | | 0.0077 | 0.0119 | 0.0159 |
| | Zirconium (Zr)-Total (mg/L) | | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0111 | 0.0112 | 0.0096 |
| | Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00064 | 0.00063 | 0.00058 |
| | Barium (Ba)-Dissolved (mg/L) | | 0.0400 | 0.0441 | 0.0458 |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | <0.010 | <0.010 | 0.015 |
| | Cadmium (Cd)-Dissolved (mg/L) | | 0.0000083 | 0.0000066 | 0.0000074 |
| | Calcium (Ca)-Dissolved (mg/L) | | 21.5 | 26.1 | 31.5 |
| | Chromium (Cr)-Dissolved (mg/L) | | 0.00015 | 0.00011 | 0.00011 |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00127 | 0.00389 | 0.00554 |
| | Iron (Fe)-Dissolved (mg/L) | | 0.026 | 0.026 | 0.023 |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | | <0.0010 | <0.0010 | 0.0028 |
| | Magnesium (Mg)-Dissolved (mg/L) | | 5.69 | 7.03 | 7.93 |
| | Manganese (Mn)-Dissolved (mg/L) | | 0.00083 | 0.00147 | 0.00223 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00124 | 0.00167 | 0.00192 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1818233-1 | L1818233-2 | L1818233-3 | | |
|-------------------------|---------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 22-AUG-16 | 22-AUG-16 | 22-AUG-16 | | |
| | | Sampled Time | 07:50 | 08:25 | 08:50 | | |
| | | Client ID | C1 | E6 | E3 | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Nickel (Ni)-Dissolved (mg/L) | | 0.00051 | <0.00050 | 0.00054 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | 0.055 | 0.068 | 0.074 | | |
| | Potassium (K)-Dissolved (mg/L) | | 0.84 | 1.26 | 1.51 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000132 | 0.000347 | 0.000492 | | |
| | Silicon (Si)-Dissolved (mg/L) | | 3.45 | 3.29 | 3.16 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 3.08 | 4.70 | 7.15 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.132 | 0.202 | 0.263 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 3.61 | 6.00 | 7.60 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.000984 | 0.00101 | 0.00102 | | |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0053 | 0.0085 | 0.0130 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Aluminum (Al)-Dissolved | MS-B | L1818233-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1818233-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1818233-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1818233-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1818233-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1818233-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1818233-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1818233-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1818233-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1818233-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1818233-1, -2, -3 |
| Matrix Spike | Nitrate (as N) | MS-B | L1818233-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |

Reference Information

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-LOW-ICP-VA Water Dissolved Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-LOW-ICP-VA Water Total Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

S-DIS-ICP-VA Water Dissolved Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA Water Total Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2016-08-23 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1818233

Report Date: 20-DEC-17

Page 1 of 10

Client: Minto Explorations Ltd.
 Suite 2100- 510 West Georgia St
 Vancouver BC V6B 0M3

Contact: Minto Environment - Coordinator

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|----------------------------|-----------|-----------|-------|-----|---------|-----------|
| ALK-TITR-VA | | Water | | | | | | |
| Batch | R3537833 | | | | | | | |
| WG2378617-18 | CRM | VA-ALK-TITR-CONTROL | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 100.5 | | % | | 85-115 | 31-AUG-16 |
| WG2378617-23 | CRM | VA-ALK-TITR-CONTROL | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 100.1 | | % | | 85-115 | 31-AUG-16 |
| WG2378617-25 | DUP | L1818233-1 | | | | | | |
| Alkalinity, Total (as CaCO3) | | 75.7 | 75.7 | | mg/L | 0.0 | 20 | 31-AUG-16 |
| WG2378617-16 | MB | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 31-AUG-16 |
| WG2378617-21 | MB | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 31-AUG-16 |
| BE-D-L-CCMS-VA | | Water | | | | | | |
| Batch | R3534863 | | | | | | | |
| WG2375965-2 | LCS | | | | | | | |
| Beryllium (Be)-Dissolved | | | 104.4 | | % | | 80-120 | 26-AUG-16 |
| WG2375965-1 | MB | NP | | | | | | |
| Beryllium (Be)-Dissolved | | | <0.000020 | | mg/L | | 0.00002 | 26-AUG-16 |
| BE-T-L-CCMS-VA | | Water | | | | | | |
| Batch | R3538728 | | | | | | | |
| WG2379637-2 | LCS | | | | | | | |
| Beryllium (Be)-Total | | | 96.0 | | % | | 80-120 | 31-AUG-16 |
| WG2379637-1 | MB | | | | | | | |
| Beryllium (Be)-Total | | | <0.000020 | | mg/L | | 0.00002 | 31-AUG-16 |
| CL-IC-N-WR | | Water | | | | | | |
| Batch | R3536516 | | | | | | | |
| WG2375618-2 | LCS | | | | | | | |
| Chloride (Cl) | | | 104.5 | | % | | 90-110 | 25-AUG-16 |
| WG2375618-1 | MB | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 25-AUG-16 |
| EC-PCT-VA | | Water | | | | | | |
| Batch | R3537833 | | | | | | | |
| WG2378617-19 | CRM | VA-EC-PCT-CONTROL | | | | | | |
| Conductivity | | | 101.9 | | % | | 90-110 | 31-AUG-16 |
| WG2378617-24 | CRM | VA-EC-PCT-CONTROL | | | | | | |
| Conductivity | | | 102.6 | | % | | 90-110 | 31-AUG-16 |
| WG2378617-25 | DUP | L1818233-1 | | | | | | |
| Conductivity | | 161 | 159 | | uS/cm | 1.3 | 10 | 31-AUG-16 |
| WG2378617-16 | MB | | | | | | | |



Quality Control Report

Workorder: L1818233

Report Date: 20-DEC-17

Page 2 of 10

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-------------------------|-----------------|-------------------|------------|-----------|-------|-----|----------|-----------|
| EC-PCT-VA | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3537833 | | | | | | | |
| WG2378617-16 | MB | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 31-AUG-16 |
| WG2378617-21 | MB | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 31-AUG-16 |
| HG-D-CVAA-VA | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3534718 | | | | | | | |
| WG2375948-4 | DUP | L1818233-2 | | | | | | |
| Mercury (Hg)-Dissolved | | <0.0000050 | <0.0000050 | RPD-NA | mg/L | N/A | 20 | 26-AUG-16 |
| Batch | R3534765 | | | | | | | |
| WG2375948-2 | LCS | | | | | | | |
| Mercury (Hg)-Dissolved | | | 101.5 | | % | | 80-120 | 26-AUG-16 |
| Batch | R3534939 | | | | | | | |
| WG2375948-1 | MB | NP | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.0000050 | | mg/L | | 0.000005 | 26-AUG-16 |
| HG-T-CVAA-VA | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3534596 | | | | | | | |
| WG2376295-2 | LCS | | | | | | | |
| Mercury (Hg)-Total | | | 115.8 | | % | | 80-120 | 26-AUG-16 |
| WG2376295-1 | MB | | | | | | | |
| Mercury (Hg)-Total | | | <0.0000050 | | mg/L | | 0.000005 | 26-AUG-16 |
| MET-D-CCMS-VA | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3534863 | | | | | | | |
| WG2375965-2 | LCS | | | | | | | |
| Aluminum (Al)-Dissolved | | | 105.2 | | % | | 80-120 | 26-AUG-16 |
| Antimony (Sb)-Dissolved | | | 98.1 | | % | | 80-120 | 26-AUG-16 |
| Arsenic (As)-Dissolved | | | 107.0 | | % | | 80-120 | 26-AUG-16 |
| Barium (Ba)-Dissolved | | | 107.1 | | % | | 80-120 | 26-AUG-16 |
| Bismuth (Bi)-Dissolved | | | 101.6 | | % | | 80-120 | 26-AUG-16 |
| Boron (B)-Dissolved | | | 97.1 | | % | | 80-120 | 26-AUG-16 |
| Cadmium (Cd)-Dissolved | | | 104.6 | | % | | 80-120 | 26-AUG-16 |
| Chromium (Cr)-Dissolved | | | 106.3 | | % | | 80-120 | 26-AUG-16 |
| Cobalt (Co)-Dissolved | | | 105.0 | | % | | 80-120 | 26-AUG-16 |
| Copper (Cu)-Dissolved | | | 103.8 | | % | | 80-120 | 26-AUG-16 |
| Lead (Pb)-Dissolved | | | 102.9 | | % | | 80-120 | 26-AUG-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|------------|-----------|-------|-----|----------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3534863 | | | | | | | |
| WG2375965-2 | LCS | | | | | | | |
| Lithium (Li)-Dissolved | | | 103.3 | | % | | 80-120 | 26-AUG-16 |
| Manganese (Mn)-Dissolved | | | 103.9 | | % | | 80-120 | 26-AUG-16 |
| Molybdenum (Mo)-Dissolved | | | 106.0 | | % | | 80-120 | 26-AUG-16 |
| Nickel (Ni)-Dissolved | | | 102.9 | | % | | 80-120 | 26-AUG-16 |
| Selenium (Se)-Dissolved | | | 98.7 | | % | | 80-120 | 26-AUG-16 |
| Silver (Ag)-Dissolved | | | 104.2 | | % | | 80-120 | 26-AUG-16 |
| Sodium (Na)-Dissolved | | | 104.7 | | % | | 80-120 | 26-AUG-16 |
| Strontium (Sr)-Dissolved | | | 100.7 | | % | | 80-120 | 26-AUG-16 |
| Thallium (Tl)-Dissolved | | | 103.9 | | % | | 80-120 | 26-AUG-16 |
| Tin (Sn)-Dissolved | | | 103.1 | | % | | 80-120 | 26-AUG-16 |
| Titanium (Ti)-Dissolved | | | 105.9 | | % | | 80-120 | 26-AUG-16 |
| Uranium (U)-Dissolved | | | 101.7 | | % | | 80-120 | 26-AUG-16 |
| Vanadium (V)-Dissolved | | | 106.9 | | % | | 80-120 | 26-AUG-16 |
| Zinc (Zn)-Dissolved | | | 95.8 | | % | | 80-120 | 26-AUG-16 |
| Zirconium (Zr)-Dissolved | | | 95.1 | | % | | 80-120 | 26-AUG-16 |
| WG2375965-1 | MB | NP | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 26-AUG-16 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 26-AUG-16 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 26-AUG-16 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 26-AUG-16 |
| Bismuth (Bi)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 26-AUG-16 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 26-AUG-16 |
| Cadmium (Cd)-Dissolved | | | <0.0000050 | | mg/L | | 0.000005 | 26-AUG-16 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 26-AUG-16 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 26-AUG-16 |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 26-AUG-16 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 26-AUG-16 |
| Lithium (Li)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 26-AUG-16 |
| Manganese (Mn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 26-AUG-16 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 26-AUG-16 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 26-AUG-16 |
| Selenium (Se)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 26-AUG-16 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 26-AUG-16 |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 26-AUG-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|-----------|-----------|-------|-----|---------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3534863 | | | | | | | |
| WG2375965-1 | MB | NP | | | | | | |
| Strontium (Sr)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 26-AUG-16 |
| Thallium (Tl)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 26-AUG-16 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 26-AUG-16 |
| Titanium (Ti)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 26-AUG-16 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 26-AUG-16 |
| Vanadium (V)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 26-AUG-16 |
| Zinc (Zn)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 26-AUG-16 |
| Zirconium (Zr)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 26-AUG-16 |
| MET-DIS-LOW-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3534745 | | | | | | | |
| WG2375965-2 | LCS | | | | | | | |
| Calcium (Ca)-Dissolved | | | 101.9 | | % | | 80-120 | 26-AUG-16 |
| Iron (Fe)-Dissolved | | | 93.9 | | % | | 80-120 | 26-AUG-16 |
| Magnesium (Mg)-Dissolved | | | 99.2 | | % | | 80-120 | 26-AUG-16 |
| Phosphorus (P)-Dissolved | | | 101.5 | | % | | 80-120 | 26-AUG-16 |
| Potassium (K)-Dissolved | | | 97.1 | | % | | 80-120 | 26-AUG-16 |
| Silicon (Si)-Dissolved | | | 102.9 | | % | | 80-120 | 26-AUG-16 |
| WG2375965-1 | MB | NP | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 26-AUG-16 |
| Iron (Fe)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 26-AUG-16 |
| Magnesium (Mg)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 26-AUG-16 |
| Phosphorus (P)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 26-AUG-16 |
| Potassium (K)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 26-AUG-16 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 26-AUG-16 |
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3538728 | | | | | | | |
| WG2379637-2 | LCS | | | | | | | |
| Aluminum (Al)-Total | | | 96.3 | | % | | 80-120 | 31-AUG-16 |
| Antimony (Sb)-Total | | | 90.7 | | % | | 80-120 | 31-AUG-16 |
| Arsenic (As)-Total | | | 101.3 | | % | | 80-120 | 31-AUG-16 |
| Barium (Ba)-Total | | | 94.3 | | % | | 80-120 | 31-AUG-16 |
| Bismuth (Bi)-Total | | | 88.3 | | % | | 80-120 | 31-AUG-16 |
| Boron (B)-Total | | | 90.6 | | % | | 80-120 | 31-AUG-16 |
| Cadmium (Cd)-Total | | | 96.6 | | % | | 80-120 | 31-AUG-16 |
| Chromium (Cr)-Total | | | 97.2 | | % | | 80-120 | 31-AUG-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-----------------------|-----------------|-----------|------------|-----------|-------|-----|----------|-----------|
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3538728 | | | | | | | |
| WG2379637-2 | LCS | | | | | | | |
| Cobalt (Co)-Total | | | 98.1 | | % | | 80-120 | 31-AUG-16 |
| Copper (Cu)-Total | | | 99.8 | | % | | 80-120 | 31-AUG-16 |
| Lead (Pb)-Total | | | 91.1 | | % | | 80-120 | 31-AUG-16 |
| Lithium (Li)-Total | | | 104.3 | | % | | 80-120 | 31-AUG-16 |
| Manganese (Mn)-Total | | | 94.2 | | % | | 80-120 | 31-AUG-16 |
| Molybdenum (Mo)-Total | | | 93.9 | | % | | 80-120 | 31-AUG-16 |
| Nickel (Ni)-Total | | | 101.0 | | % | | 80-120 | 31-AUG-16 |
| Selenium (Se)-Total | | | 93.0 | | % | | 80-120 | 31-AUG-16 |
| Silver (Ag)-Total | | | 84.7 | | % | | 80-120 | 31-AUG-16 |
| Sodium (Na)-Total | | | 95.2 | | % | | 80-120 | 31-AUG-16 |
| Strontium (Sr)-Total | | | 88.1 | | % | | 80-120 | 31-AUG-16 |
| Thallium (Tl)-Total | | | 91.2 | | % | | 80-120 | 31-AUG-16 |
| Tin (Sn)-Total | | | 85.2 | | % | | 80-120 | 31-AUG-16 |
| Titanium (Ti)-Total | | | 87.5 | | % | | 80-120 | 31-AUG-16 |
| Uranium (U)-Total | | | 88.4 | | % | | 80-120 | 31-AUG-16 |
| Vanadium (V)-Total | | | 97.8 | | % | | 80-120 | 31-AUG-16 |
| Zinc (Zn)-Total | | | 89.4 | | % | | 80-120 | 31-AUG-16 |
| Zirconium (Zr)-Total | | | 84.4 | | % | | 80-120 | 31-AUG-16 |
| WG2379637-1 | MB | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 31-AUG-16 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 31-AUG-16 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 31-AUG-16 |
| Barium (Ba)-Total | | | <0.000050 | | mg/L | | 0.00005 | 31-AUG-16 |
| Bismuth (Bi)-Total | | | <0.000050 | | mg/L | | 0.00005 | 31-AUG-16 |
| Boron (B)-Total | | | <0.010 | | mg/L | | 0.01 | 31-AUG-16 |
| Cadmium (Cd)-Total | | | <0.0000050 | | mg/L | | 0.000005 | 31-AUG-16 |
| Chromium (Cr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 31-AUG-16 |
| Cobalt (Co)-Total | | | <0.00010 | | mg/L | | 0.0001 | 31-AUG-16 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 31-AUG-16 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 31-AUG-16 |
| Lithium (Li)-Total | | | <0.0010 | | mg/L | | 0.001 | 31-AUG-16 |
| Manganese (Mn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 31-AUG-16 |
| Molybdenum (Mo)-Total | | | <0.000050 | | mg/L | | 0.00005 | 31-AUG-16 |
| Nickel (Ni)-Total | | | <0.00050 | | mg/L | | 0.0005 | 31-AUG-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|--------------|-----------|-----------|-------|-----|---------|-----------|
| MET-T-CCMS-VA | | Water | | | | | | |
| Batch | R3538728 | | | | | | | |
| WG2379637-1 MB | | | | | | | | |
| Selenium (Se)-Total | | | <0.000050 | | mg/L | | 0.00005 | 31-AUG-16 |
| Silver (Ag)-Total | | | <0.000010 | | mg/L | | 0.00001 | 31-AUG-16 |
| Sodium (Na)-Total | | | <0.050 | | mg/L | | 0.05 | 31-AUG-16 |
| Strontium (Sr)-Total | | | <0.00020 | | mg/L | | 0.0002 | 31-AUG-16 |
| Thallium (Tl)-Total | | | <0.000010 | | mg/L | | 0.00001 | 31-AUG-16 |
| Tin (Sn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 31-AUG-16 |
| Titanium (Ti)-Total | | | <0.00030 | | mg/L | | 0.0003 | 31-AUG-16 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 31-AUG-16 |
| Vanadium (V)-Total | | | <0.00050 | | mg/L | | 0.0005 | 31-AUG-16 |
| Zinc (Zn)-Total | | | <0.0030 | | mg/L | | 0.003 | 31-AUG-16 |
| Zirconium (Zr)-Total | | | <0.00030 | | mg/L | | 0.0003 | 31-AUG-16 |
| MET-TOT-LOW-ICP-VA | | Water | | | | | | |
| Batch | R3538880 | | | | | | | |
| WG2379637-2 LCS | | | | | | | | |
| Calcium (Ca)-Total | | | 103.2 | | % | | 80-120 | 31-AUG-16 |
| Iron (Fe)-Total | | | 98.8 | | % | | 80-120 | 31-AUG-16 |
| Magnesium (Mg)-Total | | | 102.6 | | % | | 80-120 | 31-AUG-16 |
| Phosphorus (P)-Total | | | 98.1 | | % | | 80-120 | 31-AUG-16 |
| Potassium (K)-Total | | | 106.4 | | % | | 80-120 | 31-AUG-16 |
| Silicon (Si)-Total | | | 107.4 | | % | | 80-120 | 31-AUG-16 |
| WG2379637-1 MB | | | | | | | | |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 31-AUG-16 |
| Iron (Fe)-Total | | | <0.010 | | mg/L | | 0.01 | 31-AUG-16 |
| Magnesium (Mg)-Total | | | <0.050 | | mg/L | | 0.05 | 31-AUG-16 |
| Phosphorus (P)-Total | | | <0.050 | | mg/L | | 0.05 | 31-AUG-16 |
| Potassium (K)-Total | | | <0.10 | | mg/L | | 0.1 | 31-AUG-16 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 31-AUG-16 |
| NH3-F-VA | | Water | | | | | | |
| Batch | R3539519 | | | | | | | |
| WG2380805-6 LCS | | | | | | | | |
| Ammonia, Total (as N) | | | 102.8 | | % | | 85-115 | 01-SEP-16 |
| WG2380805-5 MB | | | | | | | | |
| Ammonia, Total (as N) | | | <0.0050 | | mg/L | | 0.005 | 01-SEP-16 |
| NO2-L-IC-N-WR | | Water | | | | | | |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|----------------------|--------------|-------------------|---------|-----------|-------|------|---------|-----------|
| NO2-L-IC-N-WR | Water | | | | | | | |
| Batch | R3536516 | | | | | | | |
| WG2375618-2 | LCS | | | | | | | |
| Nitrite (as N) | | | 101.5 | | % | | 90-110 | 25-AUG-16 |
| WG2375618-1 | MB | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 25-AUG-16 |
| NO3-L-IC-N-WR | Water | | | | | | | |
| Batch | R3536516 | | | | | | | |
| WG2375618-2 | LCS | | | | | | | |
| Nitrate (as N) | | | 104.5 | | % | | 90-110 | 25-AUG-16 |
| WG2375618-1 | MB | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 25-AUG-16 |
| PH-PCT-VA | Water | | | | | | | |
| Batch | R3537833 | | | | | | | |
| WG2378617-17 | CRM | VA-PH7-BUF | | | | | | |
| pH | | | 7.01 | | pH | | 6.9-7.1 | 31-AUG-16 |
| WG2378617-22 | CRM | VA-PH7-BUF | | | | | | |
| pH | | | 7.00 | | pH | | 6.9-7.1 | 31-AUG-16 |
| WG2378617-25 | DUP | L1818233-1 | | | | | | |
| pH | | 7.75 | 7.78 | J | pH | 0.03 | 0.3 | 31-AUG-16 |
| S-DIS-ICP-VA | Water | | | | | | | |
| Batch | R3534745 | | | | | | | |
| WG2375965-2 | LCS | | | | | | | |
| Sulfur (S)-Dissolved | | | 100.0 | | % | | 80-120 | 26-AUG-16 |
| WG2375965-1 | MB | NP | | | | | | |
| Sulfur (S)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 26-AUG-16 |
| S-TOT-ICP-VA | Water | | | | | | | |
| Batch | R3538880 | | | | | | | |
| WG2379637-2 | LCS | | | | | | | |
| Sulfur (S)-Total | | | 106.4 | | % | | 80-120 | 31-AUG-16 |
| WG2379637-1 | MB | | | | | | | |
| Sulfur (S)-Total | | | <0.50 | | mg/L | | 0.5 | 31-AUG-16 |
| SO4-IC-N-WR | Water | | | | | | | |
| Batch | R3536516 | | | | | | | |
| WG2375618-2 | LCS | | | | | | | |
| Sulfate (SO4) | | | 104.9 | | % | | 90-110 | 25-AUG-16 |
| WG2375618-1 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 25-AUG-16 |
| TSS-MAN-WR | Water | | | | | | | |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------|-----------------|-----------|--------|-----------|-------|-----|--------|-----------|
| TSS-MAN-WR | Water | | | | | | | |
| Batch | R3536088 | | | | | | | |
| WG2374852-2 | LCS | | | | | | | |
| Total Suspended Solids | | | 99.6 | | % | | 85-115 | 24-AUG-16 |
| WG2374852-1 | MB | | | | | | | |
| Total Suspended Solids | | | <3.0 | | mg/L | | 3 | 24-AUG-16 |

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Sample Parameter Qualifier Definitions:

| Qualifier | Description |
|-----------|---|
| J | Duplicate results and limits are expressed in terms of absolute difference. |
| RPD-NA | Relative Percent Difference Not Available due to result(s) being less than detection limit. |

Quality Control Report

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Hold Time Exceedances:

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|-------------------------|-----------|-----------------|-----------------|---------|-----------|-------|-----------|
| Physical Tests | | | | | | | |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 22-AUG-16 07:50 | 31-AUG-16 08:49 | 0.25 | 217 | hours | EHTR-FM |
| | 2 | 22-AUG-16 08:25 | 31-AUG-16 08:49 | 0.25 | 216 | hours | EHTR-FM |
| | 3 | 22-AUG-16 08:50 | 31-AUG-16 08:49 | 0.25 | 216 | hours | EHTR-FM |

Legend & Qualifier Definitions:

| | |
|----------|---|
| EHTR-FM: | Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended. |
| EHTR: | Exceeded ALS recommended hold time prior to sample receipt. |
| EHTL: | Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry. |
| EHT: | Exceeded ALS recommended hold time prior to analysis. |
| Rec. HT: | ALS recommended hold time (see units). |

Notes*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1818233 were received on 24-AUG-16 10:25.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Chain of Custody (COC) / Analytical Request Form



COC Number: 2016-08-23 B

Canada Toll Free: 1 800 668 9878

L1818233-COFC

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www.alsglobal.com

| | | | | | | | | | | | | | | | | |
|---|---|--|-------------------------|--|--|------------------------------|-------------------------------------|--|--|------------------------------|--|---------------------------|--------------------------------|--|--|----------------------|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | | 1 Business day [E1] <input type="checkbox"/> | | | | | |
| Phone: | 1-804-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | Analysis Request | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO#: | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | |
| PO / AFE: | 221837 (WUL) | Requisitioner: | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Ariel Tang | Sampler: | CH | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | | | Number of Containers |
| | C1 | 22-Aug-16 | 7:50 | Water | R | R | R | R | R | R | R | R | R | | | 6 |
| | E6 | 22-Aug-16 | 8:25 | Water | R | R | R | R | R | R | R | R | R | | | 6 |
| | E3 | 22-Aug-16 | 8:50 | Water | R | R | R | R | R | R | R | R | R | | | 6 |
| <div style="border: 1px solid black; padding: 5px; display: inline-block;"> <p>Short Holding Time</p> <p><i>Rush Processing</i></p> </div> | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | |
| | | | | | 4.0, 3.0 | | | | | 9 3 | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | |
| Released by: Chris Harry | Date: 2016-08-23 11:00 | Time: | Received by: <i>EHP</i> | Date: <i>24 Aug 2016</i> | Time: <i>10:25</i> | Received by: <i>CS</i> | Date: <i>Aug 25/16</i> | Time: <i>1:15pm</i> | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 WHITE - LABORATORY COPY YELLOW - CLIENT COPY
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 31-AUG-16
Report Date: 19-SEP-16 16:58 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1822573
Project P.O. #: 220405 (MMER)
Job Reference:
C of C Numbers: 2016-08-31 E
Legal Site Desc:

Ariel McDonnell, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1822573-1 | L1822573-2 | L1822573-3 |
|------------------------------|---|----------------------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 29-AUG-16 | 29-AUG-16 | 29-AUG-16 |
| | | Sampled Time | 09:20 | 09:15 | 09:10 |
| | | Client ID | YRC | E6 | E3 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (umhos/cm) | | 160 | 205 | 245 |
| | Hardness (as CaCO3) (mg/L) | | 74.9 | 93.6 | 119 |
| | pH (pH units) | | 7.66 | 7.68 | 7.61 |
| | Total Suspended Solids (mg/L) | | <3.0 | 6.7 | 8.7 |
| | TDS (Calculated) (mg/L) | | 85.4 | 114 | 143 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 73.4 | 84.8 | 95.7 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 73.4 | 84.8 | 95.7 |
| | Ammonia, Total (as N) (mg/L) | | 0.231 | 0.291 | 0.655 |
| | Chloride (Cl) (mg/L) | | <0.50 | 1.25 | 2.19 |
| | Nitrate and Nitrite (as N) (mg/L) | | <0.0051 | 0.822 | 1.50 |
| | Nitrate (as N) (mg/L) | | <0.0050 | 0.814 | 1.49 |
| | Nitrite (as N) (mg/L) | | <0.0010 | 0.0077 | 0.0093 |
| | Sulfate (SO4) (mg/L) | | 10.6 | 18.3 | 25.0 |
| | Anion Sum (meq/L) | | 1.69 | 2.17 | 2.60 |
| | Cation Sum (meq/L) | | 1.68 | 2.15 | 2.77 |
| | Cation - Anion Balance (%) | | -0.4 | -0.4 | 3.2 |
| | Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0910 | 0.108 |
| Antimony (Sb)-Total (mg/L) | | | 0.00015 | 0.00011 | 0.00010 |
| Arsenic (As)-Total (mg/L) | | | 0.00083 | 0.00088 | 0.00076 |
| Barium (Ba)-Total (mg/L) | | | 0.0429 | 0.0482 | 0.0457 |
| Beryllium (Be)-Total (mg/L) | | | <0.000020 | <0.000020 | <0.000020 |
| Bismuth (Bi)-Total (mg/L) | | | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Total (mg/L) | | | <0.010 | 0.011 | 0.016 |
| Cadmium (Cd)-Total (mg/L) | | | 0.0000078 | 0.0000139 | 0.0000120 |
| Calcium (Ca)-Total (mg/L) | | | 20.6 | 26.2 | 31.5 |
| Chromium (Cr)-Total (mg/L) | | | 0.00038 | 0.00037 | 0.00033 |
| Cobalt (Co)-Total (mg/L) | | | <0.00010 | 0.00010 | 0.00011 |
| Copper (Cu)-Total (mg/L) | | | 0.00192 | 0.00547 | 0.00848 |
| Iron (Fe)-Total (mg/L) | | | 0.153 | 0.197 | 0.212 |
| Lead (Pb)-Total (mg/L) | | | 0.000188 | 0.000228 | 0.000264 |
| Lithium (Li)-Total (mg/L) | | | 0.0011 | <0.0010 | <0.0010 |
| Magnesium (Mg)-Total (mg/L) | | | 5.63 | 7.11 | 8.41 |
| Manganese (Mn)-Total (mg/L) | | | 0.00752 | 0.0168 | 0.0225 |
| Mercury (Hg)-Total (mg/L) | | | <0.0000050 | <0.0000050 | <0.0000050 |
| Molybdenum (Mo)-Total (mg/L) | | | 0.00128 | 0.00178 | 0.00213 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1822573-1 Water 29-AUG-16 09:20 YRC | L1822573-2 Water 29-AUG-16 09:15 E6 | L1822573-3 Water 29-AUG-16 09:10 E3 | | |
|-------------------------|---|--|---|---|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Nickel (Ni)-Total (mg/L) | 0.00100 | 0.00117 | 0.00101 | | |
| | Phosphorus (P)-Total (mg/L) | 0.054 | 0.074 | 0.187 | | |
| | Potassium (K)-Total (mg/L) | 0.86 | 1.29 | 1.72 | | |
| | Selenium (Se)-Total (mg/L) | 0.000121 | 0.000370 | 0.000532 | | |
| | Silicon (Si)-Total (mg/L) | 3.70 | 3.56 | 3.41 | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Total (mg/L) | 3.42 | 5.36 | 6.34 | | |
| | Strontium (Sr)-Total (mg/L) | 0.139 | 0.221 | 0.278 | | |
| | Sulfur (S)-Total (mg/L) | 3.45 | 6.15 | 8.15 | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Total (mg/L) | 0.00326 | 0.00339 | 0.00365 | | |
| | Uranium (U)-Total (mg/L) | 0.00115 | 0.00119 | 0.00120 | | |
| | Vanadium (V)-Total (mg/L) | 0.00093 | 0.00093 | 0.00082 | | |
| | Zinc (Zn)-Total (mg/L) | 0.0061 | 0.0093 | 0.0124 | | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0153 | 0.0157 | 0.0144 | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00010 | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00057 | 0.00062 | 0.00058 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0391 | 0.0477 | 0.0504 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.011 | 0.015 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000056 | 0.0000084 | 0.0000057 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 20.7 | 25.8 | 33.8 | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00013 | 0.00010 | 0.00016 | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00135 | 0.00397 | 0.00657 | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.030 | 0.025 | 0.028 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 5.61 | 7.10 | 8.35 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00116 | 0.00116 | 0.00251 | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00118 | 0.00158 | 0.00210 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1822573-1 | L1822573-2 | L1822573-3 | | |
|-------------------------|---------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 29-AUG-16 | 29-AUG-16 | 29-AUG-16 | | |
| | | Sampled Time | 09:20 | 09:15 | 09:10 | | |
| | | Client ID | YRC | E6 | E3 | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Nickel (Ni)-Dissolved (mg/L) | | 0.00070 | 0.00057 | 0.00069 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | <0.050 | 0.122 | | |
| | Potassium (K)-Dissolved (mg/L) | | 0.86 | 1.33 | 1.71 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000105 | 0.000336 | 0.000494 | | |
| | Silicon (Si)-Dissolved (mg/L) | | 3.49 | 3.28 | 3.13 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 3.17 | 5.17 | 7.02 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.135 | 0.211 | 0.288 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 3.48 | 5.93 | 8.07 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.00030 | 0.00031 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.00108 | 0.00103 | 0.00113 | | |
| | Vanadium (V)-Dissolved (mg/L) | | 0.00056 | 0.00052 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0040 | 0.0084 | 0.0097 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|---------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1822573-1, -2, -3 |
| Matrix Spike | Nitrate (as N) | MS-B | L1822573-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|------------------------------------|--------------------|
| ALK-CO3-CALC-WP | Water | Alkalinity, Carbonate (as CaCO3) | CALCULATION |
| <p>The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by carbonate is calculated and reported as mg/L CaCO3.</p> | | | |
| ALK-HCO3-CALC-WP | Water | Alkalinity, Bicarbonate (as CaCO3) | CALCULATION |
| <p>The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by bicarbonate is calculated and reported as mg/L CaCO3.</p> | | | |
| ALK-OH-CALC-WP | Water | Alkalinity, Hydroxide (as CaCO3) | CALCULATION |
| <p>The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by hydroxide is calculated and reported as mg/L CaCO3.</p> | | | |
| ALK-TITR-WP | Water | Alkalinity, Total (as CaCO3) | APHA 2320B |
| <p>The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. Total alkalinity is determined by titration with a strong standard mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.</p> | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| <p>Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.</p> | | | |

Reference Information

| | | | |
|---|-------|--|---|
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-WP | Water | Conductivity | APHA 2510B |
| Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-DIS-LOW-ICP-VA | Water | Dissolved Metals in Water by ICPOES | EPA 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-TOT-LOW-ICP-VA | Water | Total Metals in Water by ICPOES | EPA 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |

Reference Information

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-WP Water pH APHA 4500H

The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.

S-DIS-ICP-VA Water Dissolved Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA Water Total Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| WP | ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2016-08-31 E

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1822573

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Client: Minto Explorations Ltd.
 Suite 2100- 510 West Georgia St
 Vancouver BC V6B 0M3

Contact: Minto Environment - Coordinator

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|-----------|------------|-----------|----------|-----|----------|-----------|
| ALK-TITR-WP | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3547966 | | | | | | | |
| WG2387735-4 | LCS | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 103.9 | | % | | 85-115 | 13-SEP-16 |
| WG2387735-1 | MB | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 13-SEP-16 |
| BE-D-L-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3542125 | | | | | | | |
| WG2381670-2 | LCS | | | | | | | |
| Beryllium (Be)-Dissolved | | | 98.2 | | % | | 80-120 | 03-SEP-16 |
| WG2381670-1 | MB | NP | | | | | | |
| Beryllium (Be)-Dissolved | | | <0.000020 | | mg/L | | 0.00002 | 03-SEP-16 |
| BE-T-L-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3544850 | | | | | | | |
| WG2384758-2 | LCS | | | | | | | |
| Beryllium (Be)-Total | | | 100.8 | | % | | 80-120 | 09-SEP-16 |
| WG2384758-1 | MB | | | | | | | |
| Beryllium (Be)-Total | | | <0.000020 | | mg/L | | 0.00002 | 09-SEP-16 |
| CL-IC-N-WR | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3543987 | | | | | | | |
| WG2384610-10 | LCS | | | | | | | |
| Chloride (Cl) | | | 102.3 | | % | | 90-110 | 01-SEP-16 |
| WG2384610-9 | MB | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 01-SEP-16 |
| EC-WP | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3547966 | | | | | | | |
| WG2387735-3 | LCS | | | | | | | |
| Conductivity | | | 99.2 | | % | | 90-110 | 13-SEP-16 |
| WG2387735-1 | MB | | | | | | | |
| Conductivity | | | <1.0 | | umhos/cm | | 1 | 13-SEP-16 |
| HG-D-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3540602 | | | | | | | |
| WG2381669-2 | LCS | | | | | | | |
| Mercury (Hg)-Dissolved | | | 93.2 | | % | | 80-120 | 03-SEP-16 |
| Batch | R3541033 | | | | | | | |
| WG2381669-1 | MB | NP | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.0000050 | | mg/L | | 0.000005 | 03-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|------------|-----------|-------|-----|----------|-----------|
| HG-T-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3541477 | | | | | | | |
| WG2382198-2 | LCS | | | | | | | |
| Mercury (Hg)-Total | | | 97.3 | | % | | 80-120 | 05-SEP-16 |
| WG2382198-1 | MB | | | | | | | |
| Mercury (Hg)-Total | | | <0.000005C | | mg/L | | 0.000005 | 05-SEP-16 |
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3542125 | | | | | | | |
| WG2381670-2 | LCS | | | | | | | |
| Aluminum (Al)-Dissolved | | | 97.4 | | % | | 80-120 | 03-SEP-16 |
| Antimony (Sb)-Dissolved | | | 90.0 | | % | | 80-120 | 03-SEP-16 |
| Arsenic (As)-Dissolved | | | 97.1 | | % | | 80-120 | 03-SEP-16 |
| Barium (Ba)-Dissolved | | | 97.1 | | % | | 80-120 | 03-SEP-16 |
| Bismuth (Bi)-Dissolved | | | 97.8 | | % | | 80-120 | 03-SEP-16 |
| Boron (B)-Dissolved | | | 93.6 | | % | | 80-120 | 03-SEP-16 |
| Cadmium (Cd)-Dissolved | | | 96.3 | | % | | 80-120 | 03-SEP-16 |
| Chromium (Cr)-Dissolved | | | 96.4 | | % | | 80-120 | 03-SEP-16 |
| Cobalt (Co)-Dissolved | | | 95.8 | | % | | 80-120 | 03-SEP-16 |
| Copper (Cu)-Dissolved | | | 94.8 | | % | | 80-120 | 03-SEP-16 |
| Lead (Pb)-Dissolved | | | 96.9 | | % | | 80-120 | 03-SEP-16 |
| Lithium (Li)-Dissolved | | | 98.0 | | % | | 80-120 | 03-SEP-16 |
| Manganese (Mn)-Dissolved | | | 97.8 | | % | | 80-120 | 03-SEP-16 |
| Molybdenum (Mo)-Dissolved | | | 98.0 | | % | | 80-120 | 03-SEP-16 |
| Nickel (Ni)-Dissolved | | | 94.5 | | % | | 80-120 | 03-SEP-16 |
| Selenium (Se)-Dissolved | | | 91.8 | | % | | 80-120 | 03-SEP-16 |
| Silver (Ag)-Dissolved | | | 95.5 | | % | | 80-120 | 03-SEP-16 |
| Sodium (Na)-Dissolved | | | 96.8 | | % | | 80-120 | 03-SEP-16 |
| Strontium (Sr)-Dissolved | | | 92.8 | | % | | 80-120 | 03-SEP-16 |
| Thallium (Tl)-Dissolved | | | 97.2 | | % | | 80-120 | 03-SEP-16 |
| Tin (Sn)-Dissolved | | | 94.5 | | % | | 80-120 | 03-SEP-16 |
| Titanium (Ti)-Dissolved | | | 90.9 | | % | | 80-120 | 03-SEP-16 |
| Uranium (U)-Dissolved | | | 97.5 | | % | | 80-120 | 03-SEP-16 |
| Vanadium (V)-Dissolved | | | 94.9 | | % | | 80-120 | 03-SEP-16 |
| Zinc (Zn)-Dissolved | | | 87.9 | | % | | 80-120 | 03-SEP-16 |
| Zirconium (Zr)-Dissolved | | | 91.0 | | % | | 80-120 | 03-SEP-16 |
| WG2381670-1 | MB | NP | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 03-SEP-16 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 03-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|------------|-----------|-------|-----|----------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3542125 | | | | | | | |
| WG2381670-1 | MB | NP | | | | | | |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 03-SEP-16 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 03-SEP-16 |
| Bismuth (Bi)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 03-SEP-16 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 03-SEP-16 |
| Cadmium (Cd)-Dissolved | | | <0.0000050 | | mg/L | | 0.000005 | 03-SEP-16 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 03-SEP-16 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 03-SEP-16 |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 03-SEP-16 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 03-SEP-16 |
| Lithium (Li)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 03-SEP-16 |
| Manganese (Mn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 03-SEP-16 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 03-SEP-16 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 03-SEP-16 |
| Selenium (Se)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 03-SEP-16 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 03-SEP-16 |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 03-SEP-16 |
| Strontium (Sr)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 03-SEP-16 |
| Thallium (Tl)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 03-SEP-16 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 03-SEP-16 |
| Titanium (Ti)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 03-SEP-16 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 03-SEP-16 |
| Vanadium (V)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 03-SEP-16 |
| Zinc (Zn)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 03-SEP-16 |
| Zirconium (Zr)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 03-SEP-16 |
| MET-DIS-LOW-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3541275 | | | | | | | |
| WG2381670-2 | LCS | | | | | | | |
| Calcium (Ca)-Dissolved | | | 101.5 | | % | | 80-120 | 03-SEP-16 |
| Iron (Fe)-Dissolved | | | 96.8 | | % | | 80-120 | 03-SEP-16 |
| Magnesium (Mg)-Dissolved | | | 98.6 | | % | | 80-120 | 03-SEP-16 |
| Phosphorus (P)-Dissolved | | | 99.1 | | % | | 80-120 | 03-SEP-16 |
| Potassium (K)-Dissolved | | | 98.5 | | % | | 80-120 | 03-SEP-16 |
| Silicon (Si)-Dissolved | | | 103.9 | | % | | 80-120 | 03-SEP-16 |
| WG2381670-1 | MB | NP | | | | | | |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|--------|-----------|-------|-----|--------|-----------|
| MET-DIS-LOW-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3541275 | | | | | | | |
| WG2381670-1 | MB | NP | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 03-SEP-16 |
| Iron (Fe)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 03-SEP-16 |
| Magnesium (Mg)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 03-SEP-16 |
| Phosphorus (P)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 03-SEP-16 |
| Potassium (K)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 03-SEP-16 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 03-SEP-16 |
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3544850 | | | | | | | |
| WG2384758-2 | LCS | | | | | | | |
| Aluminum (Al)-Total | | | 100.8 | | % | | 80-120 | 09-SEP-16 |
| Antimony (Sb)-Total | | | 101.7 | | % | | 80-120 | 09-SEP-16 |
| Arsenic (As)-Total | | | 100.4 | | % | | 80-120 | 09-SEP-16 |
| Barium (Ba)-Total | | | 102.1 | | % | | 80-120 | 09-SEP-16 |
| Bismuth (Bi)-Total | | | 100.8 | | % | | 80-120 | 09-SEP-16 |
| Boron (B)-Total | | | 96.3 | | % | | 80-120 | 09-SEP-16 |
| Cadmium (Cd)-Total | | | 101.9 | | % | | 80-120 | 09-SEP-16 |
| Chromium (Cr)-Total | | | 101.7 | | % | | 80-120 | 09-SEP-16 |
| Cobalt (Co)-Total | | | 100.4 | | % | | 80-120 | 09-SEP-16 |
| Copper (Cu)-Total | | | 97.3 | | % | | 80-120 | 09-SEP-16 |
| Lead (Pb)-Total | | | 99.1 | | % | | 80-120 | 09-SEP-16 |
| Lithium (Li)-Total | | | 102.0 | | % | | 80-120 | 09-SEP-16 |
| Manganese (Mn)-Total | | | 102.3 | | % | | 80-120 | 09-SEP-16 |
| Molybdenum (Mo)-Total | | | 104.4 | | % | | 80-120 | 09-SEP-16 |
| Nickel (Ni)-Total | | | 98.1 | | % | | 80-120 | 09-SEP-16 |
| Selenium (Se)-Total | | | 100.4 | | % | | 80-120 | 09-SEP-16 |
| Silver (Ag)-Total | | | 102.4 | | % | | 80-120 | 09-SEP-16 |
| Sodium (Na)-Total | | | 104.6 | | % | | 80-120 | 09-SEP-16 |
| Strontium (Sr)-Total | | | 100.5 | | % | | 80-120 | 09-SEP-16 |
| Thallium (Tl)-Total | | | 99.6 | | % | | 80-120 | 09-SEP-16 |
| Tin (Sn)-Total | | | 99.2 | | % | | 80-120 | 09-SEP-16 |
| Titanium (Ti)-Total | | | 93.1 | | % | | 80-120 | 09-SEP-16 |
| Uranium (U)-Total | | | 101.7 | | % | | 80-120 | 09-SEP-16 |
| Vanadium (V)-Total | | | 100.9 | | % | | 80-120 | 09-SEP-16 |
| Zinc (Zn)-Total | | | 93.9 | | % | | 80-120 | 09-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|--------------|------------|-----------|-------|-----|----------|-----------|
| MET-T-CCMS-VA | | Water | | | | | | |
| Batch | R3544850 | | | | | | | |
| WG2384758-2 | LCS | | | | | | | |
| Zirconium (Zr)-Total | | | 91.0 | | % | | 80-120 | 09-SEP-16 |
| WG2384758-1 | MB | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 09-SEP-16 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Barium (Ba)-Total | | | <0.000050 | | mg/L | | 0.00005 | 09-SEP-16 |
| Bismuth (Bi)-Total | | | <0.000050 | | mg/L | | 0.00005 | 09-SEP-16 |
| Boron (B)-Total | | | <0.010 | | mg/L | | 0.01 | 09-SEP-16 |
| Cadmium (Cd)-Total | | | <0.0000050 | | mg/L | | 0.000005 | 09-SEP-16 |
| Chromium (Cr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Cobalt (Co)-Total | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 09-SEP-16 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 09-SEP-16 |
| Lithium (Li)-Total | | | <0.0010 | | mg/L | | 0.001 | 09-SEP-16 |
| Manganese (Mn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Molybdenum (Mo)-Total | | | <0.000050 | | mg/L | | 0.00005 | 09-SEP-16 |
| Nickel (Ni)-Total | | | <0.00050 | | mg/L | | 0.0005 | 09-SEP-16 |
| Selenium (Se)-Total | | | <0.000050 | | mg/L | | 0.00005 | 09-SEP-16 |
| Silver (Ag)-Total | | | <0.000010 | | mg/L | | 0.00001 | 09-SEP-16 |
| Sodium (Na)-Total | | | <0.050 | | mg/L | | 0.05 | 09-SEP-16 |
| Strontium (Sr)-Total | | | <0.00020 | | mg/L | | 0.0002 | 09-SEP-16 |
| Thallium (Tl)-Total | | | <0.000010 | | mg/L | | 0.00001 | 09-SEP-16 |
| Tin (Sn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Titanium (Ti)-Total | | | <0.00030 | | mg/L | | 0.0003 | 09-SEP-16 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 09-SEP-16 |
| Vanadium (V)-Total | | | <0.00050 | | mg/L | | 0.0005 | 09-SEP-16 |
| Zinc (Zn)-Total | | | <0.0030 | | mg/L | | 0.003 | 09-SEP-16 |
| Zirconium (Zr)-Total | | | <0.00030 | | mg/L | | 0.0003 | 09-SEP-16 |
| MET-TOT-LOW-ICP-VA | | Water | | | | | | |
| Batch | R3544841 | | | | | | | |
| WG2384758-2 | LCS | | | | | | | |
| Calcium (Ca)-Total | | | 102.6 | | % | | 80-120 | 09-SEP-16 |
| Iron (Fe)-Total | | | 101.4 | | % | | 80-120 | 09-SEP-16 |
| Magnesium (Mg)-Total | | | 101.6 | | % | | 80-120 | 09-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|----------|--------------|---------|-----------|-------|-----|--------|-----------|
| MET-TOT-LOW-ICP-VA | | Water | | | | | | |
| Batch | R3544841 | | | | | | | |
| WG2384758-2 LCS | | | | | | | | |
| Phosphorus (P)-Total | | | 97.6 | | % | | 80-120 | 09-SEP-16 |
| Potassium (K)-Total | | | 99.1 | | % | | 80-120 | 09-SEP-16 |
| Silicon (Si)-Total | | | 110.5 | | % | | 80-120 | 09-SEP-16 |
| WG2384758-1 MB | | | | | | | | |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 09-SEP-16 |
| Iron (Fe)-Total | | | <0.010 | | mg/L | | 0.01 | 09-SEP-16 |
| Magnesium (Mg)-Total | | | <0.050 | | mg/L | | 0.05 | 09-SEP-16 |
| Phosphorus (P)-Total | | | <0.050 | | mg/L | | 0.05 | 09-SEP-16 |
| Potassium (K)-Total | | | <0.10 | | mg/L | | 0.1 | 09-SEP-16 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 09-SEP-16 |
| NH3-F-VA | | Water | | | | | | |
| Batch | R3546678 | | | | | | | |
| WG2386655-2 LCS | | | | | | | | |
| Ammonia, Total (as N) | | | 101.3 | | % | | 85-115 | 12-SEP-16 |
| WG2386655-1 MB | | | | | | | | |
| Ammonia, Total (as N) | | | <0.0050 | | mg/L | | 0.005 | 12-SEP-16 |
| Batch | R3549646 | | | | | | | |
| WG2389835-10 LCS | | | | | | | | |
| Ammonia, Total (as N) | | | 95.1 | | % | | 85-115 | 16-SEP-16 |
| WG2389835-9 MB | | | | | | | | |
| Ammonia, Total (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-SEP-16 |
| NO2-L-IC-N-WR | | Water | | | | | | |
| Batch | R3543987 | | | | | | | |
| WG2384610-10 LCS | | | | | | | | |
| Nitrite (as N) | | | 101.2 | | % | | 90-110 | 01-SEP-16 |
| WG2384610-9 MB | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 01-SEP-16 |
| NO3-L-IC-N-WR | | Water | | | | | | |
| Batch | R3543987 | | | | | | | |
| WG2384610-10 LCS | | | | | | | | |
| Nitrate (as N) | | | 102.6 | | % | | 90-110 | 01-SEP-16 |
| WG2384610-9 MB | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 01-SEP-16 |
| PH-WP | | Water | | | | | | |



Quality Control Report

Workorder: L1822573

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------|--------------|-----------|--------|-----------|----------|-----|---------|-----------|
| PH-WP | Water | | | | | | | |
| Batch R3547966 | | | | | | | | |
| WG2387735-2 LCS | | | | | | | | |
| pH | | | 7.41 | | pH units | | 7.3-7.5 | 13-SEP-16 |
| S-DIS-ICP-VA | Water | | | | | | | |
| Batch R3541275 | | | | | | | | |
| WG2381670-2 LCS | | | | | | | | |
| Sulfur (S)-Dissolved | | | 101.7 | | % | | 80-120 | 03-SEP-16 |
| WG2381670-1 MB | | NP | | | | | | |
| Sulfur (S)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 03-SEP-16 |
| S-TOT-ICP-VA | Water | | | | | | | |
| Batch R3544841 | | | | | | | | |
| WG2384758-2 LCS | | | | | | | | |
| Sulfur (S)-Total | | | 105.4 | | % | | 80-120 | 09-SEP-16 |
| WG2384758-1 MB | | | | | | | | |
| Sulfur (S)-Total | | | <0.50 | | mg/L | | 0.5 | 09-SEP-16 |
| SO4-IC-N-WR | Water | | | | | | | |
| Batch R3543987 | | | | | | | | |
| WG2384610-10 LCS | | | | | | | | |
| Sulfate (SO4) | | | 102.7 | | % | | 90-110 | 01-SEP-16 |
| WG2384610-9 MB | | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 01-SEP-16 |
| TSS-MAN-WR | Water | | | | | | | |
| Batch R3546087 | | | | | | | | |
| WG2381455-2 LCS | | | | | | | | |
| Total Suspended Solids | | | 109.3 | | % | | 85-115 | 02-SEP-16 |
| WG2381455-1 MB | | | | | | | | |
| Total Suspended Solids | | | <3.0 | | mg/L | | 3 | 02-SEP-16 |

Quality Control Report

Workorder: L1822573

Report Date: 20-DEC-17

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Quality Control Report

Workorder: L1822573

Report Date: 20-DEC-17

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Hold Time Exceedances:

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|------------------------------|-----------|-----------------|-----------------|---------|-----------|-------|-----------|
| Physical Tests | | | | | | | |
| pH | 1 | 29-AUG-16 09:20 | 13-SEP-16 12:45 | 0.25 | 363 | hours | EHTR-FM |
| | 2 | 29-AUG-16 09:15 | 13-SEP-16 12:45 | 0.25 | 364 | hours | EHTR-FM |
| | 3 | 29-AUG-16 09:10 | 13-SEP-16 12:45 | 0.25 | 364 | hours | EHTR-FM |
| Anions and Nutrients | | | | | | | |
| Alkalinity, Total (as CaCO3) | 1 | 29-AUG-16 09:20 | 13-SEP-16 12:45 | 14 | 15 | days | EHT |
| | 2 | 29-AUG-16 09:15 | 13-SEP-16 12:45 | 14 | 15 | days | EHT |
| | 3 | 29-AUG-16 09:10 | 13-SEP-16 12:45 | 14 | 15 | days | EHT |

Legend & Qualifier Definitions:

- EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1822573 were received on 31-AUG-16 16:00.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



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| | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|---|--------------------|---|--|------------------------------|-----------------------------|--|-------------------------|--|---------------------------|--------------------------------|----------------------|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | | 1 Business day [E1] <input type="checkbox"/> | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: 220405 (MMER) | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Ariel Tang | | Sampler: SB | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | pH / Conductivity / Alkalinity / Anions | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | Dissolved Organic Carbon (DOC) | Number of Containers | |
| | YRC ✓ | | | 29-Aug-16 | 9:20 | Water | R | R | R | R | R | R | R | R | | 6 | |
| | E6 ✓ | | | 29-Aug-16 | 9:15 | Water | R | R | R | R | R | R | R | R | | 6 | |
| | E3 ✓ | | | 29-Aug-16 | 9:10 | Water | R | R | R | R | R | R | R | R | | 6 | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | |
| | | | | | 6.2, 7.4 | | | | | | 4.6, 6.4 | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 31-Aug-2016 | | Time: 11:00 | | Received by: | | Date: 31-Aug-16 | | Time: 4:00 | | Received by: | | Date: | | Time: | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 07-SEP-16
Report Date: 19-SEP-16 17:22 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1825883
Project P.O. #: 220405 (MMER)
Job Reference:
C of C Numbers: 2016-09-07 B
Legal Site Desc:

Ariel McDonnell, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1825883-1 | L1825883-2 | L1825883-3 |
|------------------------------|---|----------------------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 05-SEP-16 | 05-SEP-16 | 05-SEP-16 |
| | | Sampled Time | 07:40 | 07:55 | 08:10 |
| | | Client ID | YRC | E6 | E3 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 160 | 214 | 236 |
| | Hardness (as CaCO3) (mg/L) | | 78.2 | 103 | 115 |
| | pH (pH) | | 7.90 | 7.89 | 7.92 |
| | Total Suspended Solids (mg/L) | | <3.0 | 3.6 | <3.0 |
| | TDS (Calculated) (mg/L) | | 88.3 | 122 | 139 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 75.5 | 88.5 | 95.9 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 75.5 | 88.5 | 95.9 |
| | Ammonia, Total (as N) (mg/L) | | 0.394 | 0.323 | 0.599 |
| | Chloride (Cl) (mg/L) | | <0.50 | 1.36 | 1.79 |
| | Nitrate and Nitrite (as N) (mg/L) | | <0.0051 | 0.955 | 1.38 |
| | Nitrate (as N) (mg/L) | | <0.0050 | 0.951 | 1.37 |
| | Nitrite (as N) (mg/L) | | <0.0010 | 0.0039 | 0.0095 |
| | Sulfate (SO4) (mg/L) | | 10.9 | 20.2 | 24.3 |
| | Anion Sum (meq/L) | | 1.73 | 2.30 | 2.57 |
| | Cation Sum (meq/L) | | 1.76 | 2.36 | 2.67 |
| | Cation - Anion Balance (%) | | 0.7 | 1.3 | 1.8 |
| | Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0704 | 0.0611 |
| Antimony (Sb)-Total (mg/L) | | | 0.00011 | 0.00010 | 0.00010 |
| Arsenic (As)-Total (mg/L) | | | 0.00091 | 0.00080 | 0.00076 |
| Barium (Ba)-Total (mg/L) | | | 0.0429 | 0.0485 | 0.0497 |
| Beryllium (Be)-Total (mg/L) | | | <0.000020 | <0.000020 | <0.000020 |
| Bismuth (Bi)-Total (mg/L) | | | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Total (mg/L) | | | <0.010 | 0.010 | 0.014 |
| Cadmium (Cd)-Total (mg/L) | | | 0.0000056 | 0.0000083 | 0.0000108 |
| Calcium (Ca)-Total (mg/L) | | | 20.3 | 28.2 | 30.8 |
| Chromium (Cr)-Total (mg/L) | | | 0.00030 | 0.00027 | 0.000875 |
| Cobalt (Co)-Total (mg/L) | | | <0.00010 | <0.00010 | <0.00010 |
| Copper (Cu)-Total (mg/L) | | | 0.00194 | 0.00565 | 0.00732 |
| Iron (Fe)-Total (mg/L) | | | 0.135 | 0.126 | 0.148 |
| Lead (Pb)-Total (mg/L) | | | 0.000089 | 0.000082 | 0.000070 |
| Lithium (Li)-Total (mg/L) | | | <0.0010 | <0.0010 | <0.0010 |
| Magnesium (Mg)-Total (mg/L) | | | 5.75 | 7.78 | 8.63 |
| Manganese (Mn)-Total (mg/L) | | | 0.00704 | 0.0112 | 0.0113 |
| Mercury (Hg)-Total (mg/L) | | | <0.0000050 | <0.0000050 | <0.0000050 |
| Molybdenum (Mo)-Total (mg/L) | | | 0.00124 | 0.00180 | 0.00211 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1825883-1 Water 05-SEP-16 07:40 YRC | L1825883-2 Water 05-SEP-16 07:55 E6 | L1825883-3 Water 05-SEP-16 08:10 E3 | |
|-------------------------|---|--|---|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Nickel (Ni)-Total (mg/L) | 0.00069 | 0.00071 | 0.00155 | |
| | Phosphorus (P)-Total (mg/L) | 0.082 | 0.067 | 0.139 | |
| | Potassium (K)-Total (mg/L) | 0.82 | 1.39 | 1.63 | |
| | Selenium (Se)-Total (mg/L) | 0.000129 | 0.000376 | 0.000492 | |
| | Silicon (Si)-Total (mg/L) | 3.75 | 3.64 | 3.53 | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Sodium (Na)-Total (mg/L) | 3.28 | 5.37 | 6.38 | |
| | Strontium (Sr)-Total (mg/L) | 0.141 | 0.233 | 0.277 | |
| | Sulfur (S)-Total (mg/L) | 3.93 | 7.53 | 9.04 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Total (mg/L) | 0.00276 | 0.00218 | 0.00203 | |
| | Uranium (U)-Total (mg/L) | 0.00104 | 0.00109 | 0.00111 | |
| | Vanadium (V)-Total (mg/L) | 0.00084 | 0.00080 | 0.00080 | |
| | Zinc (Zn)-Total (mg/L) | 0.0044 | 0.0069 | 0.0089 | |
| | Zirconium (Zr)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0163 | 0.0233 | 0.0171 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00066 | 0.00061 | 0.00056 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0427 | 0.0471 | 0.0496 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | 0.014 | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.0000056 | 0.0000072 | 0.0000057 | |
| | Calcium (Ca)-Dissolved (mg/L) | 21.4 | 28.4 | 32.1 | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00015 | 0.00018 | 0.00014 | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00137 | 0.00641 | 0.00586 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.036 | 0.048 | 0.035 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 6.00 | 7.88 | 8.56 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00239 | 0.0126 | 0.00178 | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00144 | 0.00172 | 0.00288 ^{DTC} | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1825883-1 | L1825883-2 | L1825883-3 | | |
|-------------------------|---------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 05-SEP-16 | 05-SEP-16 | 05-SEP-16 | | |
| | | Sampled Time | 07:40 | 07:55 | 08:10 | | |
| | | Client ID | YRC | E6 | E3 | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Nickel (Ni)-Dissolved (mg/L) | | 0.00059 | 0.00058 | 0.00060 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | 0.066 | <0.050 | 0.107 | | |
| | Potassium (K)-Dissolved (mg/L) | | 0.80 | 1.31 | 1.56 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000107 | 0.000376 | 0.000467 | | |
| | Silicon (Si)-Dissolved (mg/L) | | 3.89 | 3.65 | 3.48 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 3.33 | 5.25 | 6.28 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.145 | 0.227 | 0.266 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 3.83 | 6.79 | 8.10 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | 0.00041 | 0.00083 | 0.00039 | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.00107 | 0.00103 | 0.00104 | | |
| | Vanadium (V)-Dissolved (mg/L) | | 0.00054 | 0.00052 | 0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0031 | 0.0046 | 0.0074 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Cobalt (Co)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Nickel (Ni)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1825883-1, -2, -3 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1825883-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|----------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-LOW-ICP-VA Water Dissolved Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-LOW-ICP-VA Water Total Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

S-DIS-ICP-VA Water Dissolved Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA Water Total Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2016-09-07 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1825883

Report Date: 20-DEC-17

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Client: Minto Explorations Ltd.
 Suite 2100- 510 West Georgia St
 Vancouver BC V6B 0M3

Contact: Minto Environment - Coordinator

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|----------------------------|-----------|-----------|-------|-----|---------|-----------|
| ALK-TITR-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3551617 | | | | | | | |
| WG2390178-13 | CRM | VA-ALK-TITR-CONTROL | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 101.6 | | % | | 85-115 | 18-SEP-16 |
| WG2390178-11 | MB | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-SEP-16 |
| BE-D-L-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3544850 | | | | | | | |
| WG2384851-2 | LCS | | | | | | | |
| Beryllium (Be)-Dissolved | | | 101.5 | | % | | 80-120 | 09-SEP-16 |
| WG2384851-1 | MB | NP | | | | | | |
| Beryllium (Be)-Dissolved | | | <0.000020 | | mg/L | | 0.00002 | 09-SEP-16 |
| Batch | R3548122 | | | | | | | |
| WG2384851-8 | MS | L1825883-3 | | | | | | |
| Beryllium (Be)-Dissolved | | | 98.9 | | % | | 70-130 | 13-SEP-16 |
| BE-T-L-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3547388 | | | | | | | |
| WG2386385-2 | LCS | | | | | | | |
| Beryllium (Be)-Total | | | 102.2 | | % | | 80-120 | 13-SEP-16 |
| WG2386385-1 | MB | | | | | | | |
| Beryllium (Be)-Total | | | <0.000020 | | mg/L | | 0.00002 | 13-SEP-16 |
| CL-IC-N-WR | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3547911 | | | | | | | |
| WG2385261-2 | LCS | | | | | | | |
| Chloride (Cl) | | | 101.9 | | % | | 90-110 | 07-SEP-16 |
| WG2385261-1 | MB | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 07-SEP-16 |
| EC-PCT-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3551617 | | | | | | | |
| WG2390178-14 | CRM | VA-EC-PCT-CONTROL | | | | | | |
| Conductivity | | | 101.4 | | % | | 90-110 | 18-SEP-16 |
| WG2390178-11 | MB | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 18-SEP-16 |
| HG-D-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3544761 | | | | | | | |
| WG2384866-2 | LCS | | | | | | | |
| Mercury (Hg)-Dissolved | | | 99.7 | | % | | 80-120 | 09-SEP-16 |
| WG2384866-1 | MB | NP | | | | | | |



Quality Control Report

Workorder: L1825883

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|------------|-----------|-------|-----|----------|-----------|
| HG-D-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3544761 | | | | | | | |
| WG2384866-1 | MB | NP | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000005C | | mg/L | | 0.000005 | 09-SEP-16 |
| HG-T-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3544214 | | | | | | | |
| WG2384928-2 | LCS | | | | | | | |
| Mercury (Hg)-Total | | | 107.3 | | % | | 80-120 | 08-SEP-16 |
| WG2384928-1 | MB | | | | | | | |
| Mercury (Hg)-Total | | | <0.000005C | | mg/L | | 0.000005 | 08-SEP-16 |
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3544850 | | | | | | | |
| WG2384851-2 | LCS | | | | | | | |
| Aluminum (Al)-Dissolved | | | 104.0 | | % | | 80-120 | 09-SEP-16 |
| Antimony (Sb)-Dissolved | | | 95.1 | | % | | 80-120 | 09-SEP-16 |
| Arsenic (As)-Dissolved | | | 100.1 | | % | | 80-120 | 09-SEP-16 |
| Barium (Ba)-Dissolved | | | 100.5 | | % | | 80-120 | 09-SEP-16 |
| Bismuth (Bi)-Dissolved | | | 99.0 | | % | | 80-120 | 09-SEP-16 |
| Boron (B)-Dissolved | | | 96.6 | | % | | 80-120 | 09-SEP-16 |
| Cadmium (Cd)-Dissolved | | | 92.0 | | % | | 80-120 | 09-SEP-16 |
| Chromium (Cr)-Dissolved | | | 100.1 | | % | | 80-120 | 09-SEP-16 |
| Cobalt (Co)-Dissolved | | | 99.6 | | % | | 80-120 | 09-SEP-16 |
| Copper (Cu)-Dissolved | | | 95.8 | | % | | 80-120 | 09-SEP-16 |
| Lead (Pb)-Dissolved | | | 98.1 | | % | | 80-120 | 09-SEP-16 |
| Lithium (Li)-Dissolved | | | 103.1 | | % | | 80-120 | 09-SEP-16 |
| Manganese (Mn)-Dissolved | | | 100.3 | | % | | 80-120 | 09-SEP-16 |
| Molybdenum (Mo)-Dissolved | | | 103.5 | | % | | 80-120 | 09-SEP-16 |
| Nickel (Ni)-Dissolved | | | 96.4 | | % | | 80-120 | 09-SEP-16 |
| Selenium (Se)-Dissolved | | | 96.7 | | % | | 80-120 | 09-SEP-16 |
| Silver (Ag)-Dissolved | | | 101.6 | | % | | 80-120 | 09-SEP-16 |
| Sodium (Na)-Dissolved | | | 103.8 | | % | | 80-120 | 09-SEP-16 |
| Strontium (Sr)-Dissolved | | | 97.3 | | % | | 80-120 | 09-SEP-16 |
| Thallium (Tl)-Dissolved | | | 98.2 | | % | | 80-120 | 09-SEP-16 |
| Tin (Sn)-Dissolved | | | 98.0 | | % | | 80-120 | 09-SEP-16 |
| Titanium (Ti)-Dissolved | | | 97.9 | | % | | 80-120 | 09-SEP-16 |
| Uranium (U)-Dissolved | | | 101.7 | | % | | 80-120 | 09-SEP-16 |
| Vanadium (V)-Dissolved | | | 100.4 | | % | | 80-120 | 09-SEP-16 |



Quality Control Report

Workorder: L1825883

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-------------------|------------|-----------|-------|-----|----------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3544850 | | | | | | | |
| WG2384851-2 | LCS | | | | | | | |
| Zinc (Zn)-Dissolved | | | 92.6 | | % | | 80-120 | 09-SEP-16 |
| Zirconium (Zr)-Dissolved | | | 90.9 | | % | | 80-120 | 09-SEP-16 |
| WG2384851-1 | MB | NP | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 09-SEP-16 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 09-SEP-16 |
| Bismuth (Bi)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 09-SEP-16 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 09-SEP-16 |
| Cadmium (Cd)-Dissolved | | | <0.0000050 | | mg/L | | 0.000005 | 09-SEP-16 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 09-SEP-16 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 09-SEP-16 |
| Lithium (Li)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 09-SEP-16 |
| Manganese (Mn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 09-SEP-16 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 09-SEP-16 |
| Selenium (Se)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 09-SEP-16 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 09-SEP-16 |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 09-SEP-16 |
| Strontium (Sr)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 09-SEP-16 |
| Thallium (Tl)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 09-SEP-16 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 09-SEP-16 |
| Titanium (Ti)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 09-SEP-16 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 09-SEP-16 |
| Vanadium (V)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 09-SEP-16 |
| Zinc (Zn)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 09-SEP-16 |
| Zirconium (Zr)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 09-SEP-16 |
| Batch | R3548122 | | | | | | | |
| WG2384851-8 | MS | L1825883-3 | | | | | | |
| Aluminum (Al)-Dissolved | | | 96.4 | | % | | 70-130 | 13-SEP-16 |
| Antimony (Sb)-Dissolved | | | 95.7 | | % | | 70-130 | 13-SEP-16 |
| Arsenic (As)-Dissolved | | | 99.4 | | % | | 70-130 | 13-SEP-16 |



Quality Control Report

Workorder: L1825883

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-------------------|--------|-----------|-------|-----|--------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3548122 | | | | | | | |
| WG2384851-8 | MS | L1825883-3 | | | | | | |
| Barium (Ba)-Dissolved | | | N/A | MS-B | % | - | | 13-SEP-16 |
| Bismuth (Bi)-Dissolved | | | 81.1 | | % | | 70-130 | 13-SEP-16 |
| Boron (B)-Dissolved | | | 92.9 | | % | | 70-130 | 13-SEP-16 |
| Cadmium (Cd)-Dissolved | | | 96.5 | | % | | 70-130 | 13-SEP-16 |
| Chromium (Cr)-Dissolved | | | 93.4 | | % | | 70-130 | 13-SEP-16 |
| Cobalt (Co)-Dissolved | | | 95.5 | | % | | 70-130 | 13-SEP-16 |
| Copper (Cu)-Dissolved | | | 92.1 | | % | | 70-130 | 13-SEP-16 |
| Lead (Pb)-Dissolved | | | 91.7 | | % | | 70-130 | 13-SEP-16 |
| Lithium (Li)-Dissolved | | | 90.6 | | % | | 70-130 | 13-SEP-16 |
| Manganese (Mn)-Dissolved | | | 93.9 | | % | | 70-130 | 13-SEP-16 |
| Molybdenum (Mo)-Dissolved | | | 96.6 | | % | | 70-130 | 13-SEP-16 |
| Nickel (Ni)-Dissolved | | | 93.5 | | % | | 70-130 | 13-SEP-16 |
| Selenium (Se)-Dissolved | | | 98.4 | | % | | 70-130 | 13-SEP-16 |
| Silver (Ag)-Dissolved | | | 94.4 | | % | | 70-130 | 13-SEP-16 |
| Sodium (Na)-Dissolved | | | N/A | MS-B | % | - | | 13-SEP-16 |
| Strontium (Sr)-Dissolved | | | N/A | MS-B | % | - | | 13-SEP-16 |
| Thallium (Tl)-Dissolved | | | 88.7 | | % | | 70-130 | 13-SEP-16 |
| Tin (Sn)-Dissolved | | | 97.7 | | % | | 70-130 | 13-SEP-16 |
| Titanium (Ti)-Dissolved | | | 97.7 | | % | | 70-130 | 13-SEP-16 |
| Uranium (U)-Dissolved | | | 89.3 | | % | | 70-130 | 13-SEP-16 |
| Vanadium (V)-Dissolved | | | 100.2 | | % | | 70-130 | 13-SEP-16 |
| Zinc (Zn)-Dissolved | | | 90.8 | | % | | 70-130 | 13-SEP-16 |
| Zirconium (Zr)-Dissolved | | | 95.9 | | % | | 70-130 | 13-SEP-16 |
| MET-DIS-LOW-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3544841 | | | | | | | |
| WG2384851-2 | LCS | | | | | | | |
| Calcium (Ca)-Dissolved | | | 101.9 | | % | | 80-120 | 09-SEP-16 |
| Iron (Fe)-Dissolved | | | 100.3 | | % | | 80-120 | 09-SEP-16 |
| Magnesium (Mg)-Dissolved | | | 101.0 | | % | | 80-120 | 09-SEP-16 |
| Phosphorus (P)-Dissolved | | | 98.6 | | % | | 80-120 | 09-SEP-16 |
| Potassium (K)-Dissolved | | | 98.6 | | % | | 80-120 | 09-SEP-16 |
| Silicon (Si)-Dissolved | | | 109.4 | | % | | 80-120 | 09-SEP-16 |
| WG2384851-1 | MB | NP | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 09-SEP-16 |



Quality Control Report

Workorder: L1825883

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-------------------|--------|-----------|-------|-----|--------|-----------|
| MET-DIS-LOW-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3544841 | | | | | | | |
| WG2384851-1 | MB | NP | | | | | | |
| Iron (Fe)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 09-SEP-16 |
| Magnesium (Mg)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 09-SEP-16 |
| Phosphorus (P)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 09-SEP-16 |
| Potassium (K)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 09-SEP-16 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 09-SEP-16 |
| Batch | R3545181 | | | | | | | |
| WG2384851-8 | MS | L1825883-3 | | | | | | |
| Calcium (Ca)-Dissolved | | | 99.4 | | % | | 70-130 | 09-SEP-16 |
| Iron (Fe)-Dissolved | | | 95.8 | | % | | 70-130 | 09-SEP-16 |
| Magnesium (Mg)-Dissolved | | | 99.5 | | % | | 70-130 | 09-SEP-16 |
| Phosphorus (P)-Dissolved | | | 102.4 | | % | | 70-130 | 09-SEP-16 |
| Potassium (K)-Dissolved | | | 102.1 | | % | | 70-130 | 09-SEP-16 |
| Silicon (Si)-Dissolved | | | N/A | MS-B | % | | - | 09-SEP-16 |
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3547388 | | | | | | | |
| WG2386385-2 | LCS | | | | | | | |
| Aluminum (Al)-Total | | | 103.8 | | % | | 80-120 | 13-SEP-16 |
| Antimony (Sb)-Total | | | 103.3 | | % | | 80-120 | 13-SEP-16 |
| Arsenic (As)-Total | | | 100.3 | | % | | 80-120 | 13-SEP-16 |
| Barium (Ba)-Total | | | 100.5 | | % | | 80-120 | 13-SEP-16 |
| Bismuth (Bi)-Total | | | 99.2 | | % | | 80-120 | 13-SEP-16 |
| Boron (B)-Total | | | 97.1 | | % | | 80-120 | 13-SEP-16 |
| Cadmium (Cd)-Total | | | 92.5 | | % | | 80-120 | 13-SEP-16 |
| Chromium (Cr)-Total | | | 99.1 | | % | | 80-120 | 13-SEP-16 |
| Cobalt (Co)-Total | | | 97.9 | | % | | 80-120 | 13-SEP-16 |
| Copper (Cu)-Total | | | 96.8 | | % | | 80-120 | 13-SEP-16 |
| Lead (Pb)-Total | | | 96.5 | | % | | 80-120 | 13-SEP-16 |
| Lithium (Li)-Total | | | 106.5 | | % | | 80-120 | 13-SEP-16 |
| Manganese (Mn)-Total | | | 101.0 | | % | | 80-120 | 13-SEP-16 |
| Molybdenum (Mo)-Total | | | 104.1 | | % | | 80-120 | 13-SEP-16 |
| Nickel (Ni)-Total | | | 100.5 | | % | | 80-120 | 13-SEP-16 |
| Selenium (Se)-Total | | | 95.8 | | % | | 80-120 | 13-SEP-16 |
| Silver (Ag)-Total | | | 97.7 | | % | | 80-120 | 13-SEP-16 |
| Sodium (Na)-Total | | | 104.4 | | % | | 80-120 | 13-SEP-16 |



Quality Control Report

Workorder: L1825883

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-----------------------|-----------------|--------------|------------|-----------|-------|-----|----------|-----------|
| MET-T-CCMS-VA | | Water | | | | | | |
| Batch | R3547388 | | | | | | | |
| WG2386385-2 | LCS | | | | | | | |
| Strontium (Sr)-Total | | | 98.6 | | % | | 80-120 | 13-SEP-16 |
| Thallium (Tl)-Total | | | 101.5 | | % | | 80-120 | 13-SEP-16 |
| Tin (Sn)-Total | | | 95.2 | | % | | 80-120 | 13-SEP-16 |
| Titanium (Ti)-Total | | | 98.1 | | % | | 80-120 | 13-SEP-16 |
| Uranium (U)-Total | | | 93.3 | | % | | 80-120 | 13-SEP-16 |
| Vanadium (V)-Total | | | 103.3 | | % | | 80-120 | 13-SEP-16 |
| Zinc (Zn)-Total | | | 95.6 | | % | | 80-120 | 13-SEP-16 |
| Zirconium (Zr)-Total | | | 93.9 | | % | | 80-120 | 13-SEP-16 |
| WG2386385-1 | MB | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 13-SEP-16 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-SEP-16 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-SEP-16 |
| Barium (Ba)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-SEP-16 |
| Bismuth (Bi)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-SEP-16 |
| Boron (B)-Total | | | <0.010 | | mg/L | | 0.01 | 13-SEP-16 |
| Cadmium (Cd)-Total | | | <0.0000050 | | mg/L | | 0.000005 | 13-SEP-16 |
| Chromium (Cr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-SEP-16 |
| Cobalt (Co)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-SEP-16 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 13-SEP-16 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-SEP-16 |
| Lithium (Li)-Total | | | <0.0010 | | mg/L | | 0.001 | 13-SEP-16 |
| Manganese (Mn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-SEP-16 |
| Molybdenum (Mo)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-SEP-16 |
| Nickel (Ni)-Total | | | <0.00050 | | mg/L | | 0.0005 | 13-SEP-16 |
| Selenium (Se)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-SEP-16 |
| Sodium (Na)-Total | | | <0.050 | | mg/L | | 0.05 | 13-SEP-16 |
| Strontium (Sr)-Total | | | <0.00020 | | mg/L | | 0.0002 | 13-SEP-16 |
| Thallium (Tl)-Total | | | <0.000010 | | mg/L | | 0.00001 | 13-SEP-16 |
| Tin (Sn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-SEP-16 |
| Titanium (Ti)-Total | | | <0.00030 | | mg/L | | 0.0003 | 13-SEP-16 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 13-SEP-16 |
| Vanadium (V)-Total | | | <0.00050 | | mg/L | | 0.0005 | 13-SEP-16 |
| Zinc (Zn)-Total | | | <0.0030 | | mg/L | | 0.003 | 13-SEP-16 |
| Zirconium (Zr)-Total | | | <0.00030 | | mg/L | | 0.0003 | 13-SEP-16 |



Quality Control Report

Workorder: L1825883

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--|--------|-----------|-----------|-----------|-------|-----|---------|-----------|
| MET-T-CCMS-VA Water | | | | | | | | |
| Batch R3548231 | | | | | | | | |
| WG2386385-1 MB | | | | | | | | |
| Silver (Ag)-Total | | | <0.000010 | | mg/L | | 0.00001 | 13-SEP-16 |
| MET-TOT-LOW-ICP-VA Water | | | | | | | | |
| Batch R3547156 | | | | | | | | |
| WG2386385-2 LCS | | | | | | | | |
| Calcium (Ca)-Total | | | 99.5 | | % | | 80-120 | 12-SEP-16 |
| Iron (Fe)-Total | | | 96.8 | | % | | 80-120 | 12-SEP-16 |
| Magnesium (Mg)-Total | | | 96.8 | | % | | 80-120 | 12-SEP-16 |
| Phosphorus (P)-Total | | | 97.9 | | % | | 80-120 | 12-SEP-16 |
| Potassium (K)-Total | | | 103.2 | | % | | 80-120 | 12-SEP-16 |
| Silicon (Si)-Total | | | 104.6 | | % | | 80-120 | 12-SEP-16 |
| WG2386385-1 MB | | | | | | | | |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 12-SEP-16 |
| Iron (Fe)-Total | | | <0.010 | | mg/L | | 0.01 | 12-SEP-16 |
| Magnesium (Mg)-Total | | | <0.050 | | mg/L | | 0.05 | 12-SEP-16 |
| Phosphorus (P)-Total | | | <0.050 | | mg/L | | 0.05 | 12-SEP-16 |
| Potassium (K)-Total | | | <0.10 | | mg/L | | 0.1 | 12-SEP-16 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 12-SEP-16 |
| NH3-F-VA Water | | | | | | | | |
| Batch R3549358 | | | | | | | | |
| WG2389354-2 LCS | | | | | | | | |
| Ammonia, Total (as N) | | | 98.8 | | % | | 85-115 | 16-SEP-16 |
| WG2389354-1 MB | | | | | | | | |
| Ammonia, Total (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-SEP-16 |
| Batch R3549646 | | | | | | | | |
| WG2389835-10 LCS | | | | | | | | |
| Ammonia, Total (as N) | | | 95.1 | | % | | 85-115 | 16-SEP-16 |
| WG2389835-9 MB | | | | | | | | |
| Ammonia, Total (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-SEP-16 |
| NO2-L-IC-N-WR Water | | | | | | | | |
| Batch R3547911 | | | | | | | | |
| WG2385261-2 LCS | | | | | | | | |
| Nitrite (as N) | | | 99.3 | | % | | 90-110 | 07-SEP-16 |
| WG2385261-1 MB | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 07-SEP-16 |
| NO3-L-IC-N-WR Water | | | | | | | | |



Quality Control Report

Workorder: L1825883

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------|--------------|-------------------|---------|-----------|-------|-----|---------|-----------|
| NO3-L-IC-N-WR | Water | | | | | | | |
| Batch | R3547911 | | | | | | | |
| WG2385261-2 | LCS | | | | | | | |
| Nitrate (as N) | | | 102.0 | | % | | 90-110 | 07-SEP-16 |
| WG2385261-1 | MB | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 07-SEP-16 |
| PH-PCT-VA | Water | | | | | | | |
| Batch | R3551617 | | | | | | | |
| WG2390178-12 | CRM | VA-PH7-BUF | | | | | | |
| pH | | | 7.01 | | pH | | 6.9-7.1 | 18-SEP-16 |
| S-DIS-ICP-VA | Water | | | | | | | |
| Batch | R3544841 | | | | | | | |
| WG2384851-2 | LCS | | | | | | | |
| Sulfur (S)-Dissolved | | | 105.7 | | % | | 80-120 | 09-SEP-16 |
| WG2384851-1 | MB | NP | | | | | | |
| Sulfur (S)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 09-SEP-16 |
| Batch | R3545181 | | | | | | | |
| WG2384851-8 | MS | L1825883-3 | | | | | | |
| Sulfur (S)-Dissolved | | | 99.6 | | % | | 70-130 | 09-SEP-16 |
| S-TOT-ICP-VA | Water | | | | | | | |
| Batch | R3547156 | | | | | | | |
| WG2386385-2 | LCS | | | | | | | |
| Sulfur (S)-Total | | | 100.9 | | % | | 80-120 | 12-SEP-16 |
| WG2386385-1 | MB | | | | | | | |
| Sulfur (S)-Total | | | <0.50 | | mg/L | | 0.5 | 12-SEP-16 |
| SO4-IC-N-WR | Water | | | | | | | |
| Batch | R3547911 | | | | | | | |
| WG2385261-2 | LCS | | | | | | | |
| Sulfate (SO4) | | | 102.2 | | % | | 90-110 | 07-SEP-16 |
| WG2385261-1 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 07-SEP-16 |
| TSS-VA | Water | | | | | | | |
| Batch | R3544569 | | | | | | | |
| WG2384823-5 | LCS | | | | | | | |
| Total Suspended Solids | | | 89.9 | | % | | 85-115 | 08-SEP-16 |
| WG2384823-4 | MB | | | | | | | |
| Total Suspended Solids | | | <3.0 | | mg/L | | 3 | 08-SEP-16 |

Quality Control Report

Workorder: L1825883

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Sample Parameter Qualifier Definitions:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Quality Control Report

Workorder: L1825883

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Hold Time Exceedances:

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|-------------------------|-----------|-----------------|-----------------|---------|-----------|-------|-----------|
| Physical Tests | | | | | | | |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 05-SEP-16 07:40 | 18-SEP-16 10:25 | 0.25 | 315 | hours | EHTR-FM |
| | 2 | 05-SEP-16 07:55 | 18-SEP-16 10:25 | 0.25 | 314 | hours | EHTR-FM |
| | 3 | 05-SEP-16 08:10 | 18-SEP-16 10:25 | 0.25 | 314 | hours | EHTR-FM |

Legend & Qualifier Definitions:

| | |
|----------|---|
| EHTR-FM: | Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended. |
| EHTR: | Exceeded ALS recommended hold time prior to sample receipt. |
| EHTL: | Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry. |
| EHT: | Exceeded ALS recommended hold time prior to analysis. |
| Rec. HT: | ALS recommended hold time (see units). |

Notes*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1825883 were received on 07-SEP-16 15:20.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Short Holding Time

Rush Processing

Study (COC) / Analytical Request Form

Toll Free: 1 800 668 9878



L1825883-COFC

COC Number: 2016-09-07 B

Page of

| | | | | | | | | | | | | | | | | | | | |
|--|---|--|--|-----------------|--|-------------------------------|----|--|------------|------------|--|--------------------------------|----|-------------------------|----|--------------------|-----------|-----|------------|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | | EMERGENCY | | | Business day [E1] <input type="checkbox"/> | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 4 day [P4] <input type="checkbox"/> | | | 3 day [P3] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | 2 day [P2] <input type="checkbox"/> | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintonline.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | Number of Containers | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | pH / Conductivity / Alkalinity / Anions | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintonline.com | | | Total Suspended Solids (TSS) | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | Total Dissolved Solids (TDS) | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | Total Metals (TM), Hardness | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | Dissolved Metals (DM) (filtered and preserved) | | | Total Mercury, Hardness | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | Total Mercury (T) (Filtered + preserved) | | | Total Nutrients (Ammonia) | | | | | | | | |
| PO / AFE: 220405 (MMER) | | Requisitioner: | | | Location: | | | Dissolved Organic Carbon (DOC) | | | | | | | | | | | |
| LSD: | | ALS Lab Work Order # (lab use only) L1825883 | | | ALS Contact: Ariel Tang | | | Sampler: SB | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | pH | Conductivity | Alkalinity | Anions | TSS | TDS | TM | Hardness | DM | Mercury | Nutrients | DOC | Containers |
| YRC ✓ | | | | 5-Sep-16 | 7:40 | Water | R | R | R | R | R | R | R | R | R | R | R | R | 6 |
| E6 ✓ | | | | 5-Sep-16 | 7:55 | Water | R | R | R | R | R | R | R | R | R | R | R | R | 6 |
| E3 ✓ | | | | 5-Sep-16 | 8:10 | Water | R | R | R | R | R | R | R | R | R | R | R | R | 6 |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | |
| | | | | | 0.200 | | | | | | 1,5,3,4,4,9,1 | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | |
| Released by: Shaun Roberts | | Date: 2016-09-07 | | Time: 10:30 | | Received by: <i>Scott-7-K</i> | | Date: <i>SEP 7-16</i> | | Time: 3:20 | | Received by: <i>Lorena May</i> | | Date: <i>SEP 8 2016</i> | | Time: <i>12:40</i> | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 FAILURE TO COMPLETE ALL PORTIONS OF THIS FORM MAY DELAY ANALYSIS. PLEASE FILL IN THIS FORM LEGIBLY. BY THE USE OF THIS FORM THE USER ACKNOWLEDGES AND AGREES WITH THE TERMS AND CONDITIONS AS SPECIFIED ON THE BACK PAGE OF THE WHITE REPORT COPY.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 15-SEP-16
Report Date: 27-SEP-16 16:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1829581
Project P.O. #: 220405 (MMER)
Job Reference:
C of C Numbers: 2016-09-13 C
Legal Site Desc:

Ariel McDonnell, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1829581-1 | L1829581-2 | L1829581-3 |
|------------------------------|---|----------------------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 12-SEP-16 | 12-SEP-16 | 12-SEP-16 |
| | | Sampled Time | 08:30 | 08:46 | 09:15 |
| | | Client ID | YRC | E6 | E3 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 162 | 209 | 241 |
| | Hardness (as CaCO3) (mg/L) | | 79.3 | 102 | 118 |
| | pH (pH) | | 7.95 | 7.96 | 7.96 |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | <3.0 |
| | TDS (Calculated) (mg/L) | | 89.9 | 119 | 141 |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 77.8 | 88.9 | 98.9 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 77.8 | 88.9 | 98.9 |
| | Ammonia, Total (as N) (mg/L) | | 0.414 | 0.406 | 0.612 |
| | Chloride (Cl) (mg/L) | | <0.50 | 1.22 | 1.77 |
| | Nitrate and Nitrite (as N) (mg/L) | | <0.0051 | 0.781 | 1.34 |
| | Nitrate (as N) (mg/L) | | <0.0050 | 0.776 | 1.33 |
| | Nitrite (as N) (mg/L) | | <0.0010 | 0.0048 | 0.0081 |
| | Sulfate (SO4) (mg/L) | | 10.9 | 18.6 | 24.0 |
| | Anion Sum (meq/L) | | 1.78 | 2.25 | 2.62 |
| | Cation Sum (meq/L) | | 1.77 | 2.30 | 2.68 |
| | Cation - Anion Balance (%) | | -0.3 | 1.0 | 1.2 |
| | Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0586 | 0.0559 |
| Antimony (Sb)-Total (mg/L) | | | <0.00010 | <0.00010 | <0.00010 |
| Arsenic (As)-Total (mg/L) | | | 0.00074 | 0.00065 | 0.00071 |
| Barium (Ba)-Total (mg/L) | | | 0.0421 | 0.0460 | 0.0506 |
| Beryllium (Be)-Total (mg/L) | | | <0.000020 | <0.000020 | <0.000020 |
| Bismuth (Bi)-Total (mg/L) | | | <0.000050 | <0.000050 | <0.000050 |
| Boron (B)-Total (mg/L) | | | <0.010 | <0.010 | 0.014 |
| Cadmium (Cd)-Total (mg/L) | | | 0.0000076 | <0.0000050 | 0.0000105 |
| Calcium (Ca)-Total (mg/L) | | | 21.8 | 26.8 | 32.2 |
| Chromium (Cr)-Total (mg/L) | | | 0.00024 | 0.00025 | 0.00026 |
| Cobalt (Co)-Total (mg/L) | | | <0.00010 | <0.00010 | <0.00010 |
| Copper (Cu)-Total (mg/L) | | | 0.00179 | 0.00414 | 0.00648 |
| Iron (Fe)-Total (mg/L) | | | 0.097 | 0.093 | 0.103 |
| Lead (Pb)-Total (mg/L) | | | 0.000110 | 0.000137 | 0.000124 |
| Lithium (Li)-Total (mg/L) | | | <0.0010 | <0.0010 | <0.0010 |
| Magnesium (Mg)-Total (mg/L) | | | 5.85 | 7.39 | 8.69 |
| Manganese (Mn)-Total (mg/L) | | | 0.00594 | 0.00841 | 0.0114 |
| Mercury (Hg)-Total (mg/L) | | | <0.0000050 | <0.0000050 | <0.0000050 |
| Molybdenum (Mo)-Total (mg/L) | | | 0.00135 | 0.00171 | 0.00201 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1829581-1 | L1829581-2 | L1829581-3 |
|-------------------------|---------------------------------------|--------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 12-SEP-16 | 12-SEP-16 | 12-SEP-16 |
| | | Sampled Time | 08:30 | 08:46 | 09:15 |
| | | Client ID | YRC | E6 | E3 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Nickel (Ni)-Total (mg/L) | | 0.00070 | 0.00067 | 0.00077 |
| | Phosphorus (P)-Total (mg/L) | | 0.067 | 0.090 | 0.119 |
| | Potassium (K)-Total (mg/L) | | 0.75 | 1.17 | 1.46 |
| | Selenium (Se)-Total (mg/L) | | 0.000177 | 0.000330 | 0.000306 |
| | Silicon (Si)-Total (mg/L) | | 3.79 | 3.54 | 3.52 |
| | Silver (Ag)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | | 3.21 | 4.83 | 6.17 |
| | Strontium (Sr)-Total (mg/L) | | 0.140 | 0.210 | 0.258 |
| | Sulfur (S)-Total (mg/L) | | 4.06 | 6.79 | 8.60 |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | | 0.00201 | 0.00175 | 0.00187 |
| | Uranium (U)-Total (mg/L) | | 0.00116 | 0.00113 | 0.00116 |
| | Vanadium (V)-Total (mg/L) | | 0.00069 | 0.00071 | 0.00069 |
| | Zinc (Zn)-Total (mg/L) | | <0.0030 | 0.0041 | 0.0070 |
| | Zirconium (Zr)-Total (mg/L) | | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0130 | 0.0119 | 0.0109 |
| | Antimony (Sb)-Dissolved (mg/L) | | 0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00061 | 0.00056 | 0.00053 |
| | Barium (Ba)-Dissolved (mg/L) | | 0.0425 | 0.0455 | 0.0489 |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | <0.010 | <0.010 | 0.012 |
| | Cadmium (Cd)-Dissolved (mg/L) | | <0.0000050 | 0.0000059 | 0.0000067 |
| | Calcium (Ca)-Dissolved (mg/L) | | 21.8 | 28.3 | 32.8 |
| | Chromium (Cr)-Dissolved (mg/L) | | 0.00014 | 0.00014 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00122 | 0.00349 | 0.00542 |
| | Iron (Fe)-Dissolved (mg/L) | | 0.027 | 0.028 | 0.028 |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | | <0.0010 | <0.0010 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | | 6.05 | 7.55 | 8.64 |
| | Manganese (Mn)-Dissolved (mg/L) | | 0.00218 | 0.00112 | 0.00129 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00124 | 0.00165 | 0.00192 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1829581-1 | L1829581-2 | L1829581-3 | | |
|-------------------------|---------------------------------|--------------|------------|------------|-------------------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 12-SEP-16 | 12-SEP-16 | 12-SEP-16 | | |
| | | Sampled Time | 08:30 | 08:46 | 09:15 | | |
| | | Client ID | YRC | E6 | E3 | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Dissolved Metals | Nickel (Ni)-Dissolved (mg/L) | | 0.00056 | 0.00057 | 0.00057 | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.050 | 0.064 | 0.091 | | |
| | Potassium (K)-Dissolved (mg/L) | | 0.83 | 1.22 | 1.51 | | |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000120 | 0.000301 | 0.000534 ^{DTC} | | |
| | Silicon (Si)-Dissolved (mg/L) | | 3.67 | 3.47 | 3.39 | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | | 3.05 | 4.64 | 5.74 | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.143 | 0.220 | 0.272 | | |
| | Sulfur (S)-Dissolved (mg/L) | | 3.97 | 6.59 | 8.58 | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | | 0.00035 | <0.00030 | <0.00030 | | |
| | Uranium (U)-Dissolved (mg/L) | | 0.00107 | 0.00107 | 0.00108 | | |
| | Vanadium (V)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | | |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0033 | 0.0034 | 0.0058 | | |
| | Zirconium (Zr)-Dissolved (mg/L) | | <0.00030 | <0.00030 | <0.00030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|------------------------------|-----------|-----------------------------|
| Method Blank | Alkalinity, Total (as CaCO3) | B | L1829581-1, -2, -3 |
| Matrix Spike | Aluminum (Al)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Total | MS-B | L1829581-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1829581-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| B | Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable. |
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-VA | Water | Nitrite & Nitrate in Water (Calculation) | EPA 300.0 |
| Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N). | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |

Reference Information

| | | | |
|--|-------|--|---|
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| $\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$ | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-DIS-LOW-ICP-VA | Water | Dissolved Metals in Water by ICPOES | EPA 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-TOT-LOW-ICP-VA | Water | Total Metals in Water by ICPOES | EPA 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-VA | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| S-DIS-ICP-VA | Water | Dissolved Sulfur in Water by ICPOES | EPA SW-846 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |

Reference Information

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA Water Total Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2016-09-13 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

- mg/kg - milligrams per kilogram based on dry weight of sample.*
- mg/kg wwt - milligrams per kilogram based on wet weight of sample.*
- mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.*
- mg/L - milligrams per litre.*

- < - Less than.*
- D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).*
- N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.
 UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
 Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*



Quality Control Report

Workorder: L1829581

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-------------------------|--------|--------------------------|------------|-----------|-------|-----|----------|-----------|
| CL-IC-N-VA | | | | | | | | |
| Batch R3553819 | | | | | | | | |
| WG2391409-7 MB | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 19-SEP-16 |
| WG2391409-14 MS | | L1829581-1 | | | | | | |
| Chloride (Cl) | | | 98.4 | | % | | 75-125 | 19-SEP-16 |
| EC-PCT-VA | | | | | | | | |
| Batch R3557052 | | | | | | | | |
| WG2395728-29 CRM | | VA-EC-PCT-CONTROL | | | | | | |
| Conductivity | | | 101.8 | | % | | 90-110 | 24-SEP-16 |
| WG2395728-26 MB | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 24-SEP-16 |
| HG-D-CVAA-VA | | | | | | | | |
| Batch R3549956 | | | | | | | | |
| WG2389897-6 DUP | | L1829581-1 | | | | | | |
| Mercury (Hg)-Dissolved | | <0.0000050 | <0.0000050 | RPD-NA | mg/L | N/A | 20 | 16-SEP-16 |
| WG2389897-2 LCS | | | | | | | | |
| Mercury (Hg)-Dissolved | | | 93.9 | | % | | 80-120 | 16-SEP-16 |
| WG2389897-1 MB | | NP | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.0000050 | | mg/L | | 0.000005 | 16-SEP-16 |
| WG2389897-11 MS | | L1829581-3 | | | | | | |
| Mercury (Hg)-Dissolved | | | 88.7 | | % | | 70-130 | 16-SEP-16 |
| HG-T-CVAA-VA | | | | | | | | |
| Batch R3549956 | | | | | | | | |
| WG2390517-2 LCS | | | | | | | | |
| Mercury (Hg)-Total | | | 94.7 | | % | | 80-120 | 16-SEP-16 |
| WG2390517-1 MB | | | | | | | | |
| Mercury (Hg)-Total | | | <0.0000050 | | mg/L | | 0.000005 | 16-SEP-16 |
| MET-D-CCMS-VA | | | | | | | | |
| Batch R3549964 | | | | | | | | |
| WG2389895-2 LCS | | | | | | | | |
| Aluminum (Al)-Dissolved | | | 106.5 | | % | | 80-120 | 16-SEP-16 |
| Antimony (Sb)-Dissolved | | | 98.9 | | % | | 80-120 | 16-SEP-16 |
| Arsenic (As)-Dissolved | | | 101.1 | | % | | 80-120 | 16-SEP-16 |
| Barium (Ba)-Dissolved | | | 101.6 | | % | | 80-120 | 16-SEP-16 |
| Bismuth (Bi)-Dissolved | | | 99.9 | | % | | 80-120 | 16-SEP-16 |
| Boron (B)-Dissolved | | | 98.8 | | % | | 80-120 | 16-SEP-16 |
| Cadmium (Cd)-Dissolved | | | 97.6 | | % | | 80-120 | 16-SEP-16 |
| Chromium (Cr)-Dissolved | | | 100.4 | | % | | 80-120 | 16-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|------------|-----------|-------|-----|----------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3549964 | | | | | | | |
| WG2389895-2 | LCS | | | | | | | |
| Cobalt (Co)-Dissolved | | | 99.1 | | % | | 80-120 | 16-SEP-16 |
| Copper (Cu)-Dissolved | | | 97.0 | | % | | 80-120 | 16-SEP-16 |
| Lead (Pb)-Dissolved | | | 101.6 | | % | | 80-120 | 16-SEP-16 |
| Lithium (Li)-Dissolved | | | 102.2 | | % | | 80-120 | 16-SEP-16 |
| Manganese (Mn)-Dissolved | | | 99.4 | | % | | 80-120 | 16-SEP-16 |
| Molybdenum (Mo)-Dissolved | | | 106.6 | | % | | 80-120 | 16-SEP-16 |
| Nickel (Ni)-Dissolved | | | 97.8 | | % | | 80-120 | 16-SEP-16 |
| Selenium (Se)-Dissolved | | | 93.2 | | % | | 80-120 | 16-SEP-16 |
| Silver (Ag)-Dissolved | | | 103.2 | | % | | 80-120 | 16-SEP-16 |
| Sodium (Na)-Dissolved | | | 102.6 | | % | | 80-120 | 16-SEP-16 |
| Strontium (Sr)-Dissolved | | | 99.8 | | % | | 80-120 | 16-SEP-16 |
| Thallium (Tl)-Dissolved | | | 101.9 | | % | | 80-120 | 16-SEP-16 |
| Tin (Sn)-Dissolved | | | 98.1 | | % | | 80-120 | 16-SEP-16 |
| Titanium (Ti)-Dissolved | | | 99.2 | | % | | 80-120 | 16-SEP-16 |
| Uranium (U)-Dissolved | | | 102.6 | | % | | 80-120 | 16-SEP-16 |
| Vanadium (V)-Dissolved | | | 102.0 | | % | | 80-120 | 16-SEP-16 |
| Zinc (Zn)-Dissolved | | | 95.0 | | % | | 80-120 | 16-SEP-16 |
| Zirconium (Zr)-Dissolved | | | 93.9 | | % | | 80-120 | 16-SEP-16 |
| WG2389895-1 | MB | NP | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-SEP-16 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 16-SEP-16 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 16-SEP-16 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 16-SEP-16 |
| Bismuth (Bi)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 16-SEP-16 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 16-SEP-16 |
| Cadmium (Cd)-Dissolved | | | <0.0000050 | | mg/L | | 0.000005 | 16-SEP-16 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 16-SEP-16 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 16-SEP-16 |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 16-SEP-16 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 16-SEP-16 |
| Lithium (Li)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-SEP-16 |
| Manganese (Mn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 16-SEP-16 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 16-SEP-16 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 16-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|-----------|-----------|-------|-----|---------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3549964 | | | | | | | |
| WG2389895-1 | MB | NP | | | | | | |
| Selenium (Se)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 16-SEP-16 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 16-SEP-16 |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 16-SEP-16 |
| Strontium (Sr)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 16-SEP-16 |
| Thallium (Tl)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 16-SEP-16 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 16-SEP-16 |
| Titanium (Ti)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 16-SEP-16 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 16-SEP-16 |
| Vanadium (V)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 16-SEP-16 |
| Zinc (Zn)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-SEP-16 |
| Zirconium (Zr)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 16-SEP-16 |
| MET-DIS-LOW-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3549928 | | | | | | | |
| WG2389895-2 | LCS | | | | | | | |
| Calcium (Ca)-Dissolved | | | 100.9 | | % | | 80-120 | 16-SEP-16 |
| Iron (Fe)-Dissolved | | | 98.3 | | % | | 80-120 | 16-SEP-16 |
| Magnesium (Mg)-Dissolved | | | 100.9 | | % | | 80-120 | 16-SEP-16 |
| Phosphorus (P)-Dissolved | | | 101.8 | | % | | 80-120 | 16-SEP-16 |
| Potassium (K)-Dissolved | | | 98.3 | | % | | 80-120 | 16-SEP-16 |
| Silicon (Si)-Dissolved | | | 106.9 | | % | | 80-120 | 16-SEP-16 |
| WG2389895-1 | MB | NP | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 16-SEP-16 |
| Iron (Fe)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 16-SEP-16 |
| Magnesium (Mg)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 16-SEP-16 |
| Phosphorus (P)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 16-SEP-16 |
| Potassium (K)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 16-SEP-16 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 16-SEP-16 |
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3552865 | | | | | | | |
| WG2392133-2 | LCS | | | | | | | |
| Aluminum (Al)-Total | | | 101.3 | | % | | 80-120 | 20-SEP-16 |
| Antimony (Sb)-Total | | | 103.9 | | % | | 80-120 | 20-SEP-16 |
| Arsenic (As)-Total | | | 102.3 | | % | | 80-120 | 20-SEP-16 |
| Barium (Ba)-Total | | | 101.8 | | % | | 80-120 | 20-SEP-16 |
| Bismuth (Bi)-Total | | | 101.9 | | % | | 80-120 | 20-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-----------------------|-----------------|-----------|------------|-----------|-------|-----|----------|-----------|
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3552865 | | | | | | | |
| WG2392133-2 | LCS | | | | | | | |
| Boron (B)-Total | | | 99.7 | | % | | 80-120 | 20-SEP-16 |
| Cadmium (Cd)-Total | | | 100.5 | | % | | 80-120 | 20-SEP-16 |
| Chromium (Cr)-Total | | | 98.4 | | % | | 80-120 | 20-SEP-16 |
| Cobalt (Co)-Total | | | 99.99 | | % | | 80-120 | 20-SEP-16 |
| Copper (Cu)-Total | | | 105.9 | | % | | 80-120 | 20-SEP-16 |
| Lead (Pb)-Total | | | 102.1 | | % | | 80-120 | 20-SEP-16 |
| Lithium (Li)-Total | | | 104.0 | | % | | 80-120 | 20-SEP-16 |
| Manganese (Mn)-Total | | | 101.9 | | % | | 80-120 | 20-SEP-16 |
| Molybdenum (Mo)-Total | | | 106.5 | | % | | 80-120 | 20-SEP-16 |
| Nickel (Ni)-Total | | | 98.2 | | % | | 80-120 | 20-SEP-16 |
| Selenium (Se)-Total | | | 98.4 | | % | | 80-120 | 20-SEP-16 |
| Silver (Ag)-Total | | | 104.2 | | % | | 80-120 | 20-SEP-16 |
| Sodium (Na)-Total | | | 101.7 | | % | | 80-120 | 20-SEP-16 |
| Strontium (Sr)-Total | | | 101.3 | | % | | 80-120 | 20-SEP-16 |
| Thallium (Tl)-Total | | | 102.2 | | % | | 80-120 | 20-SEP-16 |
| Tin (Sn)-Total | | | 100.3 | | % | | 80-120 | 20-SEP-16 |
| Titanium (Ti)-Total | | | 91.9 | | % | | 80-120 | 20-SEP-16 |
| Uranium (U)-Total | | | 105.6 | | % | | 80-120 | 20-SEP-16 |
| Vanadium (V)-Total | | | 101.9 | | % | | 80-120 | 20-SEP-16 |
| Zinc (Zn)-Total | | | 94.9 | | % | | 80-120 | 20-SEP-16 |
| Zirconium (Zr)-Total | | | 97.4 | | % | | 80-120 | 20-SEP-16 |
| WG2392133-1 | MB | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 20-SEP-16 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 20-SEP-16 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 20-SEP-16 |
| Barium (Ba)-Total | | | <0.000050 | | mg/L | | 0.00005 | 20-SEP-16 |
| Bismuth (Bi)-Total | | | <0.000050 | | mg/L | | 0.00005 | 20-SEP-16 |
| Boron (B)-Total | | | <0.010 | | mg/L | | 0.01 | 20-SEP-16 |
| Cadmium (Cd)-Total | | | <0.0000050 | | mg/L | | 0.000005 | 20-SEP-16 |
| Chromium (Cr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 20-SEP-16 |
| Cobalt (Co)-Total | | | <0.00010 | | mg/L | | 0.0001 | 20-SEP-16 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 20-SEP-16 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 20-SEP-16 |
| Lithium (Li)-Total | | | <0.0010 | | mg/L | | 0.001 | 20-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-----------------------|-----------------|-------------------|-----------|-----------|-------|----------|---------|-----------|
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3552865 | | | | | | | |
| WG2392133-1 | MB | | | | | | | |
| Manganese (Mn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 20-SEP-16 |
| Molybdenum (Mo)-Total | | | <0.000050 | | mg/L | | 0.00005 | 20-SEP-16 |
| Nickel (Ni)-Total | | | <0.00050 | | mg/L | | 0.0005 | 20-SEP-16 |
| Selenium (Se)-Total | | | <0.000050 | | mg/L | | 0.00005 | 20-SEP-16 |
| Silver (Ag)-Total | | | <0.000010 | | mg/L | | 0.00001 | 20-SEP-16 |
| Sodium (Na)-Total | | | <0.050 | | mg/L | | 0.05 | 20-SEP-16 |
| Strontium (Sr)-Total | | | <0.00020 | | mg/L | | 0.0002 | 20-SEP-16 |
| Thallium (Tl)-Total | | | <0.000010 | | mg/L | | 0.00001 | 20-SEP-16 |
| Tin (Sn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 20-SEP-16 |
| Titanium (Ti)-Total | | | <0.00030 | | mg/L | | 0.0003 | 20-SEP-16 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 20-SEP-16 |
| Vanadium (V)-Total | | | <0.00050 | | mg/L | | 0.0005 | 20-SEP-16 |
| Zinc (Zn)-Total | | | <0.0030 | | mg/L | | 0.003 | 20-SEP-16 |
| Zirconium (Zr)-Total | | | <0.00030 | | mg/L | | 0.0003 | 20-SEP-16 |
| Batch | R3553921 | | | | | | | |
| WG2392133-3 | DUP | L1829581-1 | | | | | | |
| Aluminum (Al)-Total | | 0.0586 | 0.0571 | | mg/L | 2.5 | 20 | 20-SEP-16 |
| Antimony (Sb)-Total | | <0.00010 | 0.00011 | RPD-NA | mg/L | N/A | 20 | 20-SEP-16 |
| Arsenic (As)-Total | | 0.00074 | 0.00073 | | mg/L | 1.9 | 20 | 20-SEP-16 |
| Barium (Ba)-Total | | 0.0421 | 0.0419 | | mg/L | 0.7 | 20 | 20-SEP-16 |
| Bismuth (Bi)-Total | | <0.000050 | <0.000050 | RPD-NA | mg/L | N/A | 20 | 20-SEP-16 |
| Boron (B)-Total | | <0.010 | <0.010 | RPD-NA | mg/L | N/A | 20 | 20-SEP-16 |
| Cadmium (Cd)-Total | | 0.0000076 | 0.0000075 | | mg/L | 0.9 | 20 | 20-SEP-16 |
| Chromium (Cr)-Total | | 0.00024 | 0.00024 | | mg/L | 0.0 | 20 | 20-SEP-16 |
| Cobalt (Co)-Total | | <0.00010 | <0.00010 | RPD-NA | mg/L | N/A | 20 | 20-SEP-16 |
| Copper (Cu)-Total | | 0.00179 | 0.00169 | | mg/L | 6.3 | 20 | 20-SEP-16 |
| Lead (Pb)-Total | | 0.000110 | 0.000105 | | mg/L | 4.0 | 20 | 20-SEP-16 |
| Lithium (Li)-Total | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 20-SEP-16 |
| Manganese (Mn)-Total | | 0.00594 | 0.00612 | | mg/L | 2.9 | 20 | 20-SEP-16 |
| Molybdenum (Mo)-Total | | 0.00135 | 0.00132 | | mg/L | 2.4 | 20 | 20-SEP-16 |
| Nickel (Ni)-Total | | 0.00070 | 0.00069 | | mg/L | 0.7 | 20 | 20-SEP-16 |
| Selenium (Se)-Total | | 0.000177 | 0.000142 | J | mg/L | 0.000035 | 0.0001 | 20-SEP-16 |
| Silver (Ag)-Total | | <0.000010 | <0.000010 | RPD-NA | mg/L | N/A | 20 | 20-SEP-16 |
| Sodium (Na)-Total | | 3.21 | 3.20 | | mg/L | 0.4 | 20 | 20-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-----------------------|-----------------|-------------------|-----------|-----------|-------|-----|--------|-----------|
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3553921 | | | | | | | |
| WG2392133-3 | DUP | L1829581-1 | | | | | | |
| Strontium (Sr)-Total | | 0.140 | 0.138 | | mg/L | 1.3 | 20 | 20-SEP-16 |
| Thallium (Tl)-Total | | <0.000010 | <0.000010 | RPD-NA | mg/L | N/A | 20 | 20-SEP-16 |
| Tin (Sn)-Total | | <0.00010 | <0.00010 | RPD-NA | mg/L | N/A | 20 | 20-SEP-16 |
| Titanium (Ti)-Total | | 0.00201 | 0.00173 | | mg/L | 15 | 20 | 20-SEP-16 |
| Uranium (U)-Total | | 0.00116 | 0.00114 | | mg/L | 2.0 | 20 | 20-SEP-16 |
| Vanadium (V)-Total | | 0.00069 | 0.00070 | | mg/L | 1.6 | 20 | 20-SEP-16 |
| Zinc (Zn)-Total | | <0.0030 | 0.0032 | RPD-NA | mg/L | N/A | 20 | 20-SEP-16 |
| Zirconium (Zr)-Total | | <0.00030 | <0.00030 | RPD-NA | mg/L | N/A | 20 | 20-SEP-16 |
| WG2392133-4 | MS | L1829581-3 | | | | | | |
| Aluminum (Al)-Total | | | 102.4 | | % | | 70-130 | 20-SEP-16 |
| Antimony (Sb)-Total | | | 101.1 | | % | | 70-130 | 20-SEP-16 |
| Arsenic (As)-Total | | | 103.8 | | % | | 70-130 | 20-SEP-16 |
| Barium (Ba)-Total | | | N/A | MS-B | % | | - | 20-SEP-16 |
| Bismuth (Bi)-Total | | | 98.5 | | % | | 70-130 | 20-SEP-16 |
| Boron (B)-Total | | | 102.6 | | % | | 70-130 | 20-SEP-16 |
| Cadmium (Cd)-Total | | | 98.9 | | % | | 70-130 | 20-SEP-16 |
| Chromium (Cr)-Total | | | 101.4 | | % | | 70-130 | 20-SEP-16 |
| Cobalt (Co)-Total | | | 102.1 | | % | | 70-130 | 20-SEP-16 |
| Copper (Cu)-Total | | | 98.0 | | % | | 70-130 | 20-SEP-16 |
| Lead (Pb)-Total | | | 97.3 | | % | | 70-130 | 20-SEP-16 |
| Lithium (Li)-Total | | | 104.9 | | % | | 70-130 | 20-SEP-16 |
| Manganese (Mn)-Total | | | 104.8 | | % | | 70-130 | 20-SEP-16 |
| Molybdenum (Mo)-Total | | | 101.7 | | % | | 70-130 | 20-SEP-16 |
| Nickel (Ni)-Total | | | 101.4 | | % | | 70-130 | 20-SEP-16 |
| Selenium (Se)-Total | | | 103.9 | | % | | 70-130 | 20-SEP-16 |
| Silver (Ag)-Total | | | 101.0 | | % | | 70-130 | 20-SEP-16 |
| Sodium (Na)-Total | | | N/A | MS-B | % | | - | 20-SEP-16 |
| Strontium (Sr)-Total | | | N/A | MS-B | % | | - | 20-SEP-16 |
| Thallium (Tl)-Total | | | 95.7 | | % | | 70-130 | 20-SEP-16 |
| Tin (Sn)-Total | | | 99.8 | | % | | 70-130 | 20-SEP-16 |
| Titanium (Ti)-Total | | | 107.7 | | % | | 70-130 | 20-SEP-16 |
| Uranium (U)-Total | | | 98.9 | | % | | 70-130 | 20-SEP-16 |
| Vanadium (V)-Total | | | 104.2 | | % | | 70-130 | 20-SEP-16 |
| Zinc (Zn)-Total | | | 94.1 | | % | | 70-130 | 20-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-------------------|--------|-----------|-------|-----|--------|-----------|
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3553921 | | | | | | | |
| WG2392133-4 MS | | L1829581-3 | | | | | | |
| Zirconium (Zr)-Total | | | 100.6 | | % | | 70-130 | 20-SEP-16 |
| MET-TOT-LOW-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3552886 | | | | | | | |
| WG2392133-2 LCS | | | | | | | | |
| Calcium (Ca)-Total | | | 101.4 | | % | | 80-120 | 20-SEP-16 |
| Iron (Fe)-Total | | | 96.1 | | % | | 80-120 | 20-SEP-16 |
| Magnesium (Mg)-Total | | | 99.5 | | % | | 80-120 | 20-SEP-16 |
| Phosphorus (P)-Total | | | 99.6 | | % | | 80-120 | 20-SEP-16 |
| Potassium (K)-Total | | | 104.2 | | % | | 80-120 | 20-SEP-16 |
| Silicon (Si)-Total | | | 116.5 | | % | | 80-120 | 20-SEP-16 |
| WG2392133-1 MB | | | | | | | | |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 20-SEP-16 |
| Iron (Fe)-Total | | | <0.010 | | mg/L | | 0.01 | 20-SEP-16 |
| Magnesium (Mg)-Total | | | <0.050 | | mg/L | | 0.05 | 20-SEP-16 |
| Phosphorus (P)-Total | | | <0.050 | | mg/L | | 0.05 | 20-SEP-16 |
| Potassium (K)-Total | | | <0.10 | | mg/L | | 0.1 | 20-SEP-16 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 20-SEP-16 |
| Batch | R3553912 | | | | | | | |
| WG2392133-3 DUP | | L1829581-1 | | | | | | |
| Calcium (Ca)-Total | | 21.8 | 21.8 | | mg/L | 0.1 | 20 | 21-SEP-16 |
| Iron (Fe)-Total | | 0.097 | 0.097 | | mg/L | 0.7 | 20 | 21-SEP-16 |
| Magnesium (Mg)-Total | | 5.85 | 5.94 | | mg/L | 1.5 | 20 | 21-SEP-16 |
| Phosphorus (P)-Total | | 0.067 | 0.058 | | mg/L | 14 | 20 | 21-SEP-16 |
| Potassium (K)-Total | | 0.75 | 0.78 | | mg/L | 4.1 | 20 | 21-SEP-16 |
| Silicon (Si)-Total | | 3.79 | 3.78 | | mg/L | 0.2 | 20 | 21-SEP-16 |
| WG2392133-4 MS | | L1829581-3 | | | | | | |
| Calcium (Ca)-Total | | | 95.4 | | % | | 70-130 | 21-SEP-16 |
| Iron (Fe)-Total | | | 97.1 | | % | | 70-130 | 21-SEP-16 |
| Magnesium (Mg)-Total | | | 97.4 | | % | | 70-130 | 21-SEP-16 |
| Phosphorus (P)-Total | | | 98.2 | | % | | 70-130 | 21-SEP-16 |
| Potassium (K)-Total | | | 95.0 | | % | | 70-130 | 21-SEP-16 |
| Silicon (Si)-Total | | | N/A | MS-B | % | | - | 21-SEP-16 |
| NH3-F-VA | Water | | | | | | | |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-----------------------|-----------------|-------------------|---------|-----------|-------|-----|--------|-----------|
| NH3-F-VA | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3556361 | | | | | | | |
| WG2395963-2 | LCS | | | | | | | |
| Ammonia, Total (as N) | | | 103.9 | | % | | 85-115 | 24-SEP-16 |
| WG2395963-1 | MB | | | | | | | |
| Ammonia, Total (as N) | | | <0.0050 | | mg/L | | 0.005 | 24-SEP-16 |
| NO2-L-IC-N-VA | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3553819 | | | | | | | |
| WG2391409-12 | DUP | L1829581-3 | | | | | | |
| Nitrite (as N) | | 0.0081 | 0.0082 | | mg/L | 1.2 | 20 | 19-SEP-16 |
| WG2391409-15 | LCS | | | | | | | |
| Nitrite (as N) | | | 101.6 | | % | | 90-110 | 19-SEP-16 |
| WG2391409-2 | LCS | | | | | | | |
| Nitrite (as N) | | | 101.9 | | % | | 90-110 | 19-SEP-16 |
| WG2391409-1 | MB | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 19-SEP-16 |
| WG2391409-10 | MB | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 19-SEP-16 |
| WG2391409-13 | MB | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 19-SEP-16 |
| WG2391409-4 | MB | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 19-SEP-16 |
| WG2391409-7 | MB | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 19-SEP-16 |
| WG2391409-14 | MS | L1829581-1 | | | | | | |
| Nitrite (as N) | | | 96.3 | | % | | 75-125 | 19-SEP-16 |
| NO3-L-IC-N-VA | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3553819 | | | | | | | |
| WG2391409-12 | DUP | L1829581-3 | | | | | | |
| Nitrate (as N) | | 1.33 | 1.33 | | mg/L | 0.1 | 20 | 19-SEP-16 |
| WG2391409-15 | LCS | | | | | | | |
| Nitrate (as N) | | | 100.7 | | % | | 90-110 | 19-SEP-16 |
| WG2391409-2 | LCS | | | | | | | |
| Nitrate (as N) | | | 100.8 | | % | | 90-110 | 19-SEP-16 |
| WG2391409-1 | MB | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 19-SEP-16 |
| WG2391409-10 | MB | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 19-SEP-16 |
| WG2391409-13 | MB | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 19-SEP-16 |



Quality Control Report

Workorder: L1829581

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------|-----------------|-------------------|--------|-----------|-------|-----|--------|-----------|
| SO4-IC-N-VA | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3553819 | | | | | | | |
| WG2391409-1 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 19-SEP-16 |
| WG2391409-10 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 19-SEP-16 |
| WG2391409-13 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 19-SEP-16 |
| WG2391409-4 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 19-SEP-16 |
| WG2391409-7 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 19-SEP-16 |
| WG2391409-14 | MS | L1829581-1 | | | | | | |
| Sulfate (SO4) | | | 97.7 | | % | | 75-125 | 19-SEP-16 |
| TSS-VA | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3551905 | | | | | | | |
| WG2389862-8 | LCS | | | | | | | |
| Total Suspended Solids | | | 98.5 | | % | | 85-115 | 16-SEP-16 |
| WG2389862-7 | MB | | | | | | | |
| Total Suspended Solids | | | <3.0 | | mg/L | | 3 | 16-SEP-16 |

Quality Control Report

Workorder: L1829581

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Sample Parameter Qualifier Definitions:

| Qualifier | Description |
|-----------|--|
| B | Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable. |
| J | Duplicate results and limits are expressed in terms of absolute difference. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |
| RPD-NA | Relative Percent Difference Not Available due to result(s) being less than detection limit. |

Quality Control Report

Workorder: L1829581

Report Date: 20-DEC-17

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Hold Time Exceedances:

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|------------------------------------|-----------|-----------------|-----------------|---------|-----------|-------|-----------|
| Physical Tests | | | | | | | |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 12-SEP-16 08:30 | 24-SEP-16 08:20 | 0.25 | 288 | hours | EHTR-FM |
| | 2 | 12-SEP-16 08:46 | 24-SEP-16 08:20 | 0.25 | 288 | hours | EHTR-FM |
| | 3 | 12-SEP-16 09:15 | 24-SEP-16 08:20 | 0.25 | 287 | hours | EHTR-FM |
| Anions and Nutrients | | | | | | | |
| Nitrate in Water by IC (Low Level) | | | | | | | |
| | 1 | 12-SEP-16 08:30 | 19-SEP-16 07:13 | 3 | 7 | days | EHTR |
| | 2 | 12-SEP-16 08:46 | 19-SEP-16 07:13 | 3 | 7 | days | EHTR |
| | 3 | 12-SEP-16 09:15 | 19-SEP-16 07:13 | 3 | 7 | days | EHTR |
| Nitrite in Water by IC (Low Level) | | | | | | | |
| | 1 | 12-SEP-16 08:30 | 19-SEP-16 07:13 | 3 | 7 | days | EHTR |
| | 2 | 12-SEP-16 08:46 | 19-SEP-16 07:13 | 3 | 7 | days | EHTR |
| | 3 | 12-SEP-16 09:15 | 19-SEP-16 07:13 | 3 | 7 | days | EHTR |

Legend & Qualifier Definitions:

- EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
- EHTR: Exceeded ALS recommended hold time prior to sample receipt.
- EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
- EHT: Exceeded ALS recommended hold time prior to analysis.
- Rec. HT: ALS recommended hold time (see units).

Notes*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1829581 were received on 15-SEP-16 12:45.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|--|------------------|--|------------------------------|------------------------------|-------------------------------------|--|-------------------------|--|---------------------------|---|--|---|----------------------|--|--|--|---|--|--|---|-----|---|-----|---|-----|--|--|--|--|
| Contact and company name below will appear on the final report | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | | | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] <input type="checkbox"/> | | | 2 day [P2] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 2 | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | | | | <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td>P</td><td>F/P</td><td>P</td><td>F/P</td><td>P</td><td>F/P</td><td></td><td></td><td></td><td></td> </tr> </table> | | | | | | | | | | | | | | | | | | P | F/P | P | F/P | P | F/P | | | | |
| | | | | | | P | F/P | P | F/P | P | F/P | | | | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | pH / Conductivity / Alkalinity / Antons | Total Suspended Solids (TSS) | Total Dissolved Solids (TDS) | Total Metals (TM), Hardness | Dissolved Metals (DM) (Filtered and preserved) | Total Mercury, Hardness | Dissolved Mercury [1] (Filtered + preserved) | Total Nutrients (Ammonia) | | | | Number of Containers | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: 220405 (MMER) | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Ariel Tang | | Sampler: CB | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | | | | | | | | | |
| YRC | | | | 12-Sep-16 | 8:30 | Water | R | R | R | R | R | R | R | R | R | R | | | | 6 | | | | | | | | | | | | |
| E6 | | | | 12-Sep-16 | 8:46 | Water | R | R | R | R | R | R | R | R | R | R | | | | 6 | | | | | | | | | | | | |
| E3 | | | | 12-Sep-16 | 9:15 | Water | R | R | R | R | R | R | R | R | R | R | | | | 6 | | | | | | | | | | | | |

Short Holding Time

Rush Processing

| | | | | | | | | | | | | | | | | | | | |
|--|--|---|--|-------|--|------------------|--|-------------------|--|-------------|------------------------------|-----------------|--|-------------------|--|-------------|--|--|--|
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | |
| | | | | | 3, 0, 6, 9, 5, 0 | | | | | | 4, 4, 3 | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | |
| Released by: Colin Prentice | | Date: 2016-09-13 | | Time: | | Received by: EJP | | Date: 14 Sep 2016 | | Time: 13:19 | | Received by: JC | | Date: SEP 15 2016 | | Time: 12:45 | | | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 20-SEP-16
Report Date: 03-OCT-16 14:54 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1831166
Project P.O. #: 220405 (MMER)
Job Reference:
C of C Numbers: 2016-09-14 D
Legal Site Desc:

Ariel McDonnell, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1831166-1 | L1831166-2 | L1831166-3 | |
|------------------------------|---|----------------------------|------------|------------|------------|---------|
| | | Description | Water | Water | Water | |
| | | Sampled Date | 19-SEP-16 | 19-SEP-16 | 19-SEP-16 | |
| | | Sampled Time | 08:15 | 08:25 | 08:40 | |
| | | Client ID | YRC | E6 | E3 | |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 158 | 201 | 237 | |
| | Hardness (as CaCO3) (mg/L) | | 76.3 | 98.3 | 112 | |
| | pH (pH) | | 7.68 | 7.81 | 7.81 | |
| | Total Suspended Solids (mg/L) | | <3.0 | <3.0 | <3.0 | |
| | TDS (Calculated) (mg/L) | | 86.1 | 117 | 137 | |
| Anions and Nutrients | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 72.9 | 86.3 | 95.5 | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 72.9 | 86.3 | 95.5 | |
| | Ammonia, Total (as N) (mg/L) | | 0.411 | 0.320 | 0.576 | |
| | Chloride (Cl) (mg/L) | | <0.50 | 1.18 | 1.76 | |
| | Nitrate and Nitrite (as N) (mg/L) | | 0.0068 | 0.816 | 1.36 | |
| | Nitrate (as N) (mg/L) | | 0.0068 | 0.813 | 1.35 | |
| | Nitrite (as N) (mg/L) | | <0.0010 | 0.0031 | 0.0102 | |
| | Sulfate (SO4) (mg/L) | | 11.1 | 19.1 | 24.4 | |
| | Anion Sum (meq/L) | | 1.69 | 2.21 | 2.56 | |
| | Cation Sum (meq/L) | | 1.71 | 2.24 | 2.60 | |
| | Cation - Anion Balance (%) | | 0.8 | 0.6 | 0.7 | |
| | Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0622 | 0.0665 | 0.0623 |
| | | Antimony (Sb)-Total (mg/L) | | 0.00011 | 0.00010 | 0.00010 |
| Arsenic (As)-Total (mg/L) | | | 0.00063 | 0.00060 | 0.00060 | |
| Barium (Ba)-Total (mg/L) | | | 0.0431 | 0.0487 | 0.0506 | |
| Beryllium (Be)-Total (mg/L) | | | <0.000020 | <0.000020 | <0.000020 | |
| Bismuth (Bi)-Total (mg/L) | | | <0.000050 | <0.000050 | <0.000050 | |
| Boron (B)-Total (mg/L) | | | <0.010 | <0.010 | 0.013 | |
| Cadmium (Cd)-Total (mg/L) | | | 0.0000051 | 0.0000101 | 0.0000064 | |
| Calcium (Ca)-Total (mg/L) | | | 21.1 | 27.7 | 30.9 | |
| Chromium (Cr)-Total (mg/L) | | | 0.00023 | 0.00024 | 0.00025 | |
| Cobalt (Co)-Total (mg/L) | | | <0.00010 | <0.00010 | <0.00010 | |
| Copper (Cu)-Total (mg/L) | | | 0.00188 | 0.00552 | 0.00743 | |
| Iron (Fe)-Total (mg/L) | | | 0.109 | 0.127 | 0.128 | |
| Lead (Pb)-Total (mg/L) | | | 0.000067 | 0.000062 | 0.000092 | |
| Lithium (Li)-Total (mg/L) | | | 0.0011 | 0.0011 | 0.0011 | |
| Magnesium (Mg)-Total (mg/L) | | | 5.97 | 7.81 | 8.54 | |
| Manganese (Mn)-Total (mg/L) | | | 0.00713 | 0.0118 | 0.0140 | |
| Mercury (Hg)-Total (mg/L) | | | <0.0000050 | <0.0000050 | <0.0000050 | |
| Molybdenum (Mo)-Total (mg/L) | | | 0.00135 | 0.00181 | 0.00206 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1831166-1 | L1831166-2 | L1831166-3 |
|-------------------------|---------------------------------------|--------------|------------|------------|------------|
| | | Description | Water | Water | Water |
| | | Sampled Date | 19-SEP-16 | 19-SEP-16 | 19-SEP-16 |
| | | Sampled Time | 08:15 | 08:25 | 08:40 |
| | | Client ID | YRC | E6 | E3 |
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Nickel (Ni)-Total (mg/L) | | 0.00057 | 0.00062 | 0.00064 |
| | Phosphorus (P)-Total (mg/L) | | 0.060 | 0.083 | 0.112 |
| | Potassium (K)-Total (mg/L) | | 0.82 | 1.25 | 1.47 |
| | Selenium (Se)-Total (mg/L) | | 0.000196 | 0.000374 | 0.000455 |
| | Silicon (Si)-Total (mg/L) | | 3.51 | 3.63 | 3.32 |
| | Silver (Ag)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | | 3.14 | 5.13 | 6.12 |
| | Strontium (Sr)-Total (mg/L) | | 0.132 | 0.218 | 0.267 |
| | Sulfur (S)-Total (mg/L) | | 4.48 | 7.59 | 8.80 |
| | Thallium (Tl)-Total (mg/L) | | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | | 0.00231 | 0.00233 | 0.00226 |
| | Uranium (U)-Total (mg/L) | | 0.00112 | 0.00118 | 0.00116 |
| | Vanadium (V)-Total (mg/L) | | 0.00069 | 0.00065 | 0.00064 |
| | Zinc (Zn)-Total (mg/L) | | <0.0030 | 0.0065 | 0.0062 |
| | Zirconium (Zr)-Total (mg/L) | | <0.00030 | <0.00030 | <0.00030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0140 | 0.0135 | 0.0115 |
| | Antimony (Sb)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00057 | 0.00050 | 0.00053 |
| | Barium (Ba)-Dissolved (mg/L) | | 0.0431 | 0.0476 | 0.0516 |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.000020 | <0.000020 | <0.000020 |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | | <0.010 | <0.010 | 0.012 |
| | Cadmium (Cd)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | | 20.8 | 26.8 | 30.4 |
| | Chromium (Cr)-Dissolved (mg/L) | | 0.00013 | <0.00010 | 0.00012 |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | | 0.00112 | 0.00394 | 0.00573 |
| | Iron (Fe)-Dissolved (mg/L) | | 0.029 | 0.027 | 0.027 |
| | Lead (Pb)-Dissolved (mg/L) | | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | | 0.0010 | 0.0010 | 0.0011 |
| | Magnesium (Mg)-Dissolved (mg/L) | | 5.91 | 7.62 | 8.76 |
| | Manganese (Mn)-Dissolved (mg/L) | | 0.00352 | 0.00132 | 0.00151 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00125 | 0.00162 | 0.00187 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1831166-1 Water 19-SEP-16 08:15 YRC | L1831166-2 Water 19-SEP-16 08:25 E6 | L1831166-3 Water 19-SEP-16 08:40 E3 | |
|-------------------------|---|--|---|---|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | 0.00051 | 0.00055 | |
| | Phosphorus (P)-Dissolved (mg/L) | 0.050 | <0.050 | 0.098 | |
| | Potassium (K)-Dissolved (mg/L) | 0.83 | 1.26 | 1.53 | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000174 | 0.000388 | 0.000482 | |
| | Silicon (Si)-Dissolved (mg/L) | 3.32 | 3.36 | 3.27 | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Sodium (Na)-Dissolved (mg/L) | 3.11 | 5.08 | 6.34 | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.130 | 0.210 | 0.259 | |
| | Sulfur (S)-Dissolved (mg/L) | 3.75 | 6.95 | 8.83 | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.00030 | <0.00030 | <0.00030 | |
| | Uranium (U)-Dissolved (mg/L) | 0.00107 | 0.00108 | 0.00109 | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0021 | 0.0029 | 0.0055 | |
| | Zirconium (Zr)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|---------------------------|-----------|-----------------------------|
| Matrix Spike | Aluminum (Al)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Arsenic (As)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Arsenic (As)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1831166-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L1831166-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--------------------------------------|------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| ANIONS-N+N-CALC-WR | Water | Nitrite & Nitrate Nitrogen | EPA 300.1 |
| Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance. | | | |
| BE-D-L-CCMS-VA | Water | Diss. Be (low) in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| BE-T-L-CCMS-VA | Water | Total Be (Low) in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |

Reference Information

| | | | |
|---|-------|--|---|
| CL-IC-N-WR | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| IONBALANCE-VA | Water | Ion Balance Calculation | APHA 1030E |
| Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. | | | |
| Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: | | | |
| Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum] | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-N-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-CALC-VA | Water | TDS (Calculated) | APHA 1030E (20TH EDITION) |
| This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample. | | | |
| TSS-MAN-WR | Water | Total Suspended Solids by Gravimetric | APHA 2540 D |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

2016-09-14 D

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1831166

Report Date: 20-DEC-17

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Client: Minto Explorations Ltd.
 Suite 2100- 510 West Georgia St
 Vancouver BC V6B 0M3

Contact: Minto Environment - Coordinator

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|----------------------------|-----------|-----------|-------|-----|---------|-----------|
| ALK-TITR-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3560694 | | | | | | | |
| WG2400029-8 | CRM | VA-ALK-TITR-CONTROL | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 98.6 | | % | | 85-115 | 30-SEP-16 |
| WG2400029-6 | MB | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 30-SEP-16 |
| BE-D-L-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3554686 | | | | | | | |
| WG2394160-1 | MB | NP | | | | | | |
| Beryllium (Be)-Dissolved | | | <0.000020 | | mg/L | | 0.00002 | 22-SEP-16 |
| Batch | R3555590 | | | | | | | |
| WG2394160-2 | LCS | | | | | | | |
| Beryllium (Be)-Dissolved | | | 97.3 | | % | | 80-120 | 22-SEP-16 |
| BE-T-L-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3557341 | | | | | | | |
| WG2396138-2 | LCS | | | | | | | |
| Beryllium (Be)-Total | | | 103.9 | | % | | 80-120 | 25-SEP-16 |
| WG2396138-1 | MB | | | | | | | |
| Beryllium (Be)-Total | | | <0.000020 | | mg/L | | 0.00002 | 25-SEP-16 |
| CL-IC-N-WR | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3559896 | | | | | | | |
| WG2392673-2 | LCS | | | | | | | |
| Chloride (Cl) | | | 99.7 | | % | | 90-110 | 20-SEP-16 |
| WG2392673-1 | MB | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 20-SEP-16 |
| EC-PCT-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3560694 | | | | | | | |
| WG2400029-37 | CRM | VA-EC-PCT-CONTROL | | | | | | |
| Conductivity | | | 103.0 | | % | | 90-110 | 30-SEP-16 |
| WG2400029-9 | CRM | VA-EC-PCT-CONTROL | | | | | | |
| Conductivity | | | 100.5 | | % | | 90-110 | 30-SEP-16 |
| WG2400029-6 | MB | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 30-SEP-16 |
| HG-D-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |



Quality Control Report

Workorder: L1831166

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|------------|-----------|-------|-----|----------|-----------|
| HG-D-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3554683 | | | | | | | |
| WG2394220-2 | LCS | | | | | | | |
| Mercury (Hg)-Dissolved | | | 99.2 | | % | | 80-120 | 22-SEP-16 |
| WG2394220-1 | MB | NP | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000005C | | mg/L | | 0.000005 | 22-SEP-16 |
| HG-T-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3554120 | | | | | | | |
| WG2394237-2 | LCS | | | | | | | |
| Mercury (Hg)-Total | | | 98.5 | | % | | 80-120 | 21-SEP-16 |
| WG2394237-1 | MB | | | | | | | |
| Mercury (Hg)-Total | | | <0.000005C | | mg/L | | 0.000005 | 21-SEP-16 |
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3554686 | | | | | | | |
| WG2394160-1 | MB | NP | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 22-SEP-16 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 22-SEP-16 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 22-SEP-16 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 22-SEP-16 |
| Bismuth (Bi)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 22-SEP-16 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 22-SEP-16 |
| Cadmium (Cd)-Dissolved | | | <0.000005C | | mg/L | | 0.000005 | 22-SEP-16 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 22-SEP-16 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 22-SEP-16 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 22-SEP-16 |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 22-SEP-16 |
| Iron (Fe)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 22-SEP-16 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 22-SEP-16 |
| Lithium (Li)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 22-SEP-16 |
| Magnesium (Mg)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 22-SEP-16 |
| Manganese (Mn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 22-SEP-16 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 22-SEP-16 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 22-SEP-16 |
| Phosphorus (P)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 22-SEP-16 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 22-SEP-16 |
| Selenium (Se)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 22-SEP-16 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 22-SEP-16 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 22-SEP-16 |



Quality Control Report

Workorder: L1831166

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|-----------|-----------|-------|-----|---------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3554686 | | | | | | | |
| WG2394160-1 | MB | NP | | | | | | |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 22-SEP-16 |
| Strontium (Sr)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 22-SEP-16 |
| Sulfur (S)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 22-SEP-16 |
| Thallium (Tl)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 22-SEP-16 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 22-SEP-16 |
| Titanium (Ti)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 22-SEP-16 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 22-SEP-16 |
| Vanadium (V)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 22-SEP-16 |
| Zinc (Zn)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 22-SEP-16 |
| Zirconium (Zr)-Dissolved | | | <0.00030 | | mg/L | | 0.0003 | 22-SEP-16 |
| Batch | R3555590 | | | | | | | |
| WG2394160-2 | LCS | | | | | | | |
| Aluminum (Al)-Dissolved | | | 96.8 | | % | | 80-120 | 22-SEP-16 |
| Antimony (Sb)-Dissolved | | | 92.7 | | % | | 80-120 | 22-SEP-16 |
| Arsenic (As)-Dissolved | | | 99.6 | | % | | 80-120 | 22-SEP-16 |
| Barium (Ba)-Dissolved | | | 99.99 | | % | | 80-120 | 22-SEP-16 |
| Bismuth (Bi)-Dissolved | | | 97.6 | | % | | 80-120 | 22-SEP-16 |
| Boron (B)-Dissolved | | | 94.7 | | % | | 80-120 | 22-SEP-16 |
| Cadmium (Cd)-Dissolved | | | 93.3 | | % | | 80-120 | 22-SEP-16 |
| Calcium (Ca)-Dissolved | | | 98.9 | | % | | 80-120 | 22-SEP-16 |
| Chromium (Cr)-Dissolved | | | 97.0 | | % | | 80-120 | 22-SEP-16 |
| Cobalt (Co)-Dissolved | | | 95.8 | | % | | 80-120 | 22-SEP-16 |
| Copper (Cu)-Dissolved | | | 95.8 | | % | | 80-120 | 22-SEP-16 |
| Iron (Fe)-Dissolved | | | 92.9 | | % | | 80-120 | 22-SEP-16 |
| Lead (Pb)-Dissolved | | | 99.6 | | % | | 80-120 | 22-SEP-16 |
| Lithium (Li)-Dissolved | | | 97.2 | | % | | 80-120 | 22-SEP-16 |
| Magnesium (Mg)-Dissolved | | | 99.0 | | % | | 80-120 | 22-SEP-16 |
| Manganese (Mn)-Dissolved | | | 97.7 | | % | | 80-120 | 22-SEP-16 |
| Molybdenum (Mo)-Dissolved | | | 102.5 | | % | | 80-120 | 22-SEP-16 |
| Nickel (Ni)-Dissolved | | | 95.9 | | % | | 80-120 | 22-SEP-16 |
| Phosphorus (P)-Dissolved | | | 97.5 | | % | | 80-120 | 22-SEP-16 |
| Potassium (K)-Dissolved | | | 96.3 | | % | | 80-120 | 22-SEP-16 |
| Selenium (Se)-Dissolved | | | 101.8 | | % | | 80-120 | 22-SEP-16 |
| Silicon (Si)-Dissolved | | | 104.4 | | % | | 80-120 | 22-SEP-16 |



Quality Control Report

Workorder: L1831166

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|--------------|--------|-----------|-------|-----|--------|-----------|
| MET-D-CCMS-VA | | Water | | | | | | |
| Batch | R3555590 | | | | | | | |
| WG2394160-2 | LCS | | | | | | | |
| Silver (Ag)-Dissolved | | | 99.4 | | % | | 80-120 | 22-SEP-16 |
| Sodium (Na)-Dissolved | | | 101.7 | | % | | 80-120 | 22-SEP-16 |
| Strontium (Sr)-Dissolved | | | 96.9 | | % | | 80-120 | 22-SEP-16 |
| Sulfur (S)-Dissolved | | | 94.8 | | % | | 80-120 | 22-SEP-16 |
| Thallium (Tl)-Dissolved | | | 100.8 | | % | | 80-120 | 22-SEP-16 |
| Tin (Sn)-Dissolved | | | 98.0 | | % | | 80-120 | 22-SEP-16 |
| Titanium (Ti)-Dissolved | | | 94.1 | | % | | 80-120 | 22-SEP-16 |
| Uranium (U)-Dissolved | | | 100.1 | | % | | 80-120 | 22-SEP-16 |
| Vanadium (V)-Dissolved | | | 99.2 | | % | | 80-120 | 22-SEP-16 |
| Zinc (Zn)-Dissolved | | | 90.7 | | % | | 80-120 | 22-SEP-16 |
| Zirconium (Zr)-Dissolved | | | 92.9 | | % | | 80-120 | 22-SEP-16 |
| MET-T-CCMS-VA | | Water | | | | | | |
| Batch | R3557341 | | | | | | | |
| WG2396138-2 | LCS | | | | | | | |
| Aluminum (Al)-Total | | | 104.5 | | % | | 80-120 | 25-SEP-16 |
| Antimony (Sb)-Total | | | 111.9 | | % | | 80-120 | 25-SEP-16 |
| Arsenic (As)-Total | | | 106.9 | | % | | 80-120 | 25-SEP-16 |
| Barium (Ba)-Total | | | 106.7 | | % | | 80-120 | 25-SEP-16 |
| Bismuth (Bi)-Total | | | 110.7 | | % | | 80-120 | 25-SEP-16 |
| Boron (B)-Total | | | 99.9 | | % | | 80-120 | 25-SEP-16 |
| Cadmium (Cd)-Total | | | 102.1 | | % | | 80-120 | 25-SEP-16 |
| Calcium (Ca)-Total | | | 105.3 | | % | | 80-120 | 25-SEP-16 |
| Chromium (Cr)-Total | | | 101.9 | | % | | 80-120 | 25-SEP-16 |
| Cobalt (Co)-Total | | | 104.6 | | % | | 80-120 | 25-SEP-16 |
| Copper (Cu)-Total | | | 104.0 | | % | | 80-120 | 25-SEP-16 |
| Iron (Fe)-Total | | | 100.5 | | % | | 80-120 | 25-SEP-16 |
| Lead (Pb)-Total | | | 107.2 | | % | | 80-120 | 25-SEP-16 |
| Lithium (Li)-Total | | | 110.9 | | % | | 80-120 | 25-SEP-16 |
| Magnesium (Mg)-Total | | | 100.5 | | % | | 80-120 | 25-SEP-16 |
| Manganese (Mn)-Total | | | 105.2 | | % | | 80-120 | 25-SEP-16 |
| Molybdenum (Mo)-Total | | | 107.0 | | % | | 80-120 | 25-SEP-16 |
| Nickel (Ni)-Total | | | 105.8 | | % | | 80-120 | 25-SEP-16 |
| Phosphorus (P)-Total | | | 99.3 | | % | | 80-120 | 25-SEP-16 |
| Potassium (K)-Total | | | 109.1 | | % | | 80-120 | 25-SEP-16 |



Quality Control Report

Workorder: L1831166

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-----------------------|-----------------|--------------|------------|-----------|-------|-----|----------|-----------|
| MET-T-CCMS-VA | | Water | | | | | | |
| Batch | R3557341 | | | | | | | |
| WG2396138-2 | LCS | | | | | | | |
| Selenium (Se)-Total | | | 103.6 | | % | | 80-120 | 25-SEP-16 |
| Silicon (Si)-Total | | | 120.0 | | % | | 80-120 | 25-SEP-16 |
| Silver (Ag)-Total | | | 97.1 | | % | | 80-120 | 25-SEP-16 |
| Sodium (Na)-Total | | | 101.7 | | % | | 80-120 | 25-SEP-16 |
| Strontium (Sr)-Total | | | 103.2 | | % | | 80-120 | 25-SEP-16 |
| Sulfur (S)-Total | | | 92.2 | | % | | 80-120 | 25-SEP-16 |
| Thallium (Tl)-Total | | | 112.4 | | % | | 80-120 | 25-SEP-16 |
| Tin (Sn)-Total | | | 103.5 | | % | | 80-120 | 25-SEP-16 |
| Titanium (Ti)-Total | | | 105.0 | | % | | 80-120 | 25-SEP-16 |
| Uranium (U)-Total | | | 102.1 | | % | | 80-120 | 25-SEP-16 |
| Vanadium (V)-Total | | | 102.2 | | % | | 80-120 | 25-SEP-16 |
| Zinc (Zn)-Total | | | 97.2 | | % | | 80-120 | 25-SEP-16 |
| Zirconium (Zr)-Total | | | 98.0 | | % | | 80-120 | 25-SEP-16 |
| WG2396138-1 | MB | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 25-SEP-16 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 25-SEP-16 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 25-SEP-16 |
| Barium (Ba)-Total | | | <0.000050 | | mg/L | | 0.00005 | 25-SEP-16 |
| Bismuth (Bi)-Total | | | <0.000050 | | mg/L | | 0.00005 | 25-SEP-16 |
| Boron (B)-Total | | | <0.010 | | mg/L | | 0.01 | 25-SEP-16 |
| Cadmium (Cd)-Total | | | <0.0000050 | | mg/L | | 0.000005 | 25-SEP-16 |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 25-SEP-16 |
| Chromium (Cr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 25-SEP-16 |
| Cobalt (Co)-Total | | | <0.00010 | | mg/L | | 0.0001 | 25-SEP-16 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 25-SEP-16 |
| Iron (Fe)-Total | | | <0.010 | | mg/L | | 0.01 | 25-SEP-16 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 25-SEP-16 |
| Lithium (Li)-Total | | | <0.0010 | | mg/L | | 0.001 | 25-SEP-16 |
| Magnesium (Mg)-Total | | | <0.0050 | | mg/L | | 0.005 | 25-SEP-16 |
| Manganese (Mn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 25-SEP-16 |
| Molybdenum (Mo)-Total | | | <0.000050 | | mg/L | | 0.00005 | 25-SEP-16 |
| Nickel (Ni)-Total | | | <0.00050 | | mg/L | | 0.0005 | 25-SEP-16 |
| Phosphorus (P)-Total | | | <0.050 | | mg/L | | 0.05 | 25-SEP-16 |
| Potassium (K)-Total | | | <0.050 | | mg/L | | 0.05 | 25-SEP-16 |



Quality Control Report

Workorder: L1831166

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-------------------------|----------|--------------|-----------|-----------|-------|-----|---------|-----------|
| MET-T-CCMS-VA | | Water | | | | | | |
| Batch | R3557341 | | | | | | | |
| WG2396138-1 MB | | | | | | | | |
| Selenium (Se)-Total | | | <0.000050 | | mg/L | | 0.00005 | 25-SEP-16 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 25-SEP-16 |
| Silver (Ag)-Total | | | <0.000010 | | mg/L | | 0.00001 | 25-SEP-16 |
| Sodium (Na)-Total | | | <0.050 | | mg/L | | 0.05 | 25-SEP-16 |
| Strontium (Sr)-Total | | | <0.00020 | | mg/L | | 0.0002 | 25-SEP-16 |
| Sulfur (S)-Total | | | <0.50 | | mg/L | | 0.5 | 25-SEP-16 |
| Thallium (Tl)-Total | | | <0.000010 | | mg/L | | 0.00001 | 25-SEP-16 |
| Tin (Sn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 25-SEP-16 |
| Titanium (Ti)-Total | | | <0.00030 | | mg/L | | 0.0003 | 25-SEP-16 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 25-SEP-16 |
| Vanadium (V)-Total | | | <0.00050 | | mg/L | | 0.0005 | 25-SEP-16 |
| Zinc (Zn)-Total | | | <0.0030 | | mg/L | | 0.003 | 25-SEP-16 |
| Zirconium (Zr)-Total | | | <0.00030 | | mg/L | | 0.0003 | 25-SEP-16 |
| NH3-F-VA | | Water | | | | | | |
| Batch | R3559701 | | | | | | | |
| WG2399175-10 LCS | | | | | | | | |
| Ammonia, Total (as N) | | | 97.0 | | % | | 85-115 | 29-SEP-16 |
| WG2399175-9 MB | | | | | | | | |
| Ammonia, Total (as N) | | | <0.0050 | | mg/L | | 0.005 | 29-SEP-16 |
| NO2-L-IC-N-WR | | Water | | | | | | |
| Batch | R3559896 | | | | | | | |
| WG2392673-2 LCS | | | | | | | | |
| Nitrite (as N) | | | 101.8 | | % | | 90-110 | 20-SEP-16 |
| WG2392673-1 MB | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 20-SEP-16 |
| NO3-L-IC-N-WR | | Water | | | | | | |
| Batch | R3559896 | | | | | | | |
| WG2392673-2 LCS | | | | | | | | |
| Nitrate (as N) | | | 99.3 | | % | | 90-110 | 20-SEP-16 |
| WG2392673-1 MB | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 20-SEP-16 |
| PH-PCT-VA | | Water | | | | | | |



Quality Control Report

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------|--------------|-------------------|--------|-----------|-------|-----|---------|-----------|
| PH-PCT-VA | Water | | | | | | | |
| Batch | R3560694 | | | | | | | |
| WG2400029-7 | CRM | VA-PH7-BUF | | | | | | |
| pH | | | 7.01 | | pH | | 6.9-7.1 | 30-SEP-16 |
| SO4-IC-N-WR | Water | | | | | | | |
| Batch | R3559896 | | | | | | | |
| WG2392673-2 | LCS | | | | | | | |
| Sulfate (SO4) | | | 99.7 | | % | | 90-110 | 20-SEP-16 |
| WG2392673-1 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 20-SEP-16 |
| TSS-MAN-WR | Water | | | | | | | |
| Batch | R3558852 | | | | | | | |
| WG2394835-2 | LCS | | | | | | | |
| Total Suspended Solids | | | 95.1 | | % | | 85-115 | 22-SEP-16 |
| WG2394835-1 | MB | | | | | | | |
| Total Suspended Solids | | | <3.0 | | mg/L | | 3 | 22-SEP-16 |

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Quality Control Report

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Hold Time Exceedances:

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|-------------------------|-----------|-----------------|-----------------|---------|-----------|-------|-----------|
| Physical Tests | | | | | | | |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 19-SEP-16 08:15 | 30-SEP-16 06:50 | 0.25 | 263 | hours | EHTR-FM |
| | 2 | 19-SEP-16 08:25 | 30-SEP-16 06:50 | 0.25 | 262 | hours | EHTR-FM |
| | 3 | 19-SEP-16 08:40 | 30-SEP-16 06:50 | 0.25 | 262 | hours | EHTR-FM |

Legend & Qualifier Definitions:

| | |
|----------|---|
| EHTR-FM: | Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended. |
| EHTR: | Exceeded ALS recommended hold time prior to sample receipt. |
| EHTL: | Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry. |
| EHT: | Exceeded ALS recommended hold time prior to analysis. |
| Rec. HT: | ALS recommended hold time (see units). |

Notes*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1831166 were received on 20-SEP-16 09:00.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Chain of Custody (COC) / Analytical Request Form



L1831166-COFC

COC Number: 2016-09-14 D

Canada Toll Free: 1 800 668 9878

Page of

www.alsglobal.com

| Report To | | | | Report Format / Distribution | | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|-----|------------------------------|--|--------------|------------------------------|---|---|---|---|---|--|---|---|------------------------------|---|---|--|--|---|--|--|--|-------------------------|--|--|--|--|--|---------------------------|--|--|--|---|-----|--|---|-----|--|---|-----|--|---|-----|--|---|-----|--|---|-----|--|---|-----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----------------------|
| Company: Minto Explorations Ltd. Contact: Minto Environment - Coordinator Phone: 1-604-759-4659 Company address below will appear on the final report | | | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> | | | | | EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. City/Province: Vancouver, British Columbia Postal Code: V6B 0M3 | | | | Email 1 or Fax: minto_environment@mintomine.com Email 2 Email 3 | | | | Date and Time Required for all E&P TATs: _____ For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: ap@mintomine.com Email 2 | | | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information ALS Account # / Quote #: Job #: PO / AFE: 220405 (MMER) LSD: | | | | Oil and Gas Required Fields (client use) AFE/Cost Center: _____ PO# _____ Major/Minor Code: _____ Routing Code: _____ Requisitioner: _____ Location: _____ ALS Contact: Ariel Tang Sampler: CB | | | | <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3">pH / Conductivity / Alkalinity / Anions</th> <th colspan="3">Total Suspended Solids (TSS)</th> <th colspan="3">Total Dissolved Solids (TDS)</th> <th colspan="3">Total Metals (TM), Hardness</th> <th colspan="3">Dissolved Metals (DM) (Filtered and preserved)</th> <th colspan="3">Total Mercury, Hardness</th> <th colspan="3">Dissolved Mercury (1) (Filtered + preserved)</th> <th colspan="3">Total Nutrients (Ammonia)</th> </tr> <tr> <th></th><th>P</th><th>F/P</th><th></th><th>P</th><th>F/P</th><th></th><th>P</th><th>F/P</th><th></th><th>P</th><th>F/P</th><th></th><th>P</th><th>F/P</th><th></th><th>P</th><th>F/P</th><th></th><th>P</th><th>F/P</th> </tr> </thead> <tbody> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table> | pH / Conductivity / Alkalinity / Anions | | | Total Suspended Solids (TSS) | | | Total Dissolved Solids (TDS) | | | Total Metals (TM), Hardness | | | Dissolved Metals (DM) (Filtered and preserved) | | | Total Mercury, Hardness | | | Dissolved Mercury (1) (Filtered + preserved) | | | Total Nutrients (Ammonia) | | | | P | F/P | | P | F/P | | P | F/P | | P | F/P | | P | F/P | | P | F/P | | P | F/P | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Number of Containers |
| pH / Conductivity / Alkalinity / Anions | | | Total Suspended Solids (TSS) | | | Total Dissolved Solids (TDS) | | | Total Metals (TM), Hardness | | | Dissolved Metals (DM) (Filtered and preserved) | | | Total Mercury, Hardness | | | Dissolved Mercury (1) (Filtered + preserved) | | | Total Nutrients (Ammonia) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| ALS Lab Work Order # (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | YRC | | | 19-Sep-16 | 8:15 | Water | R | R | R | R | R | R | R | R | R | R | R | | | | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | E6 | | | 19-Sep-16 | 8:25 | Water | R | R | R | R | R | R | R | R | R | R | R | | | | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | E3 | | | 19-Sep-16 | 8:40 | Water | R | R | R | R | R | R | R | R | R | R | R | | | | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <div style="border: 2px solid black; padding: 10px; width: fit-content; margin: 20px auto;"> <h2 style="margin: 0;">Short Holding Time</h2> <ul style="list-style-type: none"> ● Rush Processing </div> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples (client use) Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input checked="" type="checkbox"/> INITIAL COOLER TEMPERATURES °C: 3.0 FINAL COOLER TEMPERATURES °C: 4 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) Released by: Chris Blurton Date: 2016-09-19 | | | | INITIAL SHIPMENT RECEPTION (lab use only) Time: 11:00 Received by: E+F | | | | FINAL SHIPMENT RECEPTION (lab use only) Time: 09:00 Received by: JC Date: 21/9/16 Time: 14:30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 WHITE - LABORATORY COPY YELLOW - CLIENT COPY
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



MINNOW ENVIRONMENTAL INC.
ATTN: Pierre Stecko
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 26-SEP-16
Report Date: 06-OCT-16 16:40 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1834209
Project P.O. #: NOT SUBMITTED
Job Reference: 15-87
C of C Numbers: 1, 2
Legal Site Desc:

Selam Worku
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1834209-1 | L1834209-2 | L1834209-3 | L1834209-4 | L1834209-5 |
|-----------------------------------|-------------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 22-SEP-16 | 22-SEP-16 | 22-SEP-16 | 25-SEP-16 | 24-SEP-16 |
| | | Sampled Time | | | | | |
| | | Client ID | UMC-1 | UMC-2 | UMC-3 | REF-1 | REF-2 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Hardness (as CaCO3) (mg/L) | | 119 | 124 | 122 | 64.2 | 58.2 |
| | Total Suspended Solids (mg/L) | | 6.3 | 8.7 | 4.1 | <3.0 | 3.9 |
| | Total Dissolved Solids (mg/L) | | 196 | 188 | 188 | 125 | 122 |
| Anions and Nutrients | Alkalinity, Total (as CaCO3) (mg/L) | | 105 | 105 | 105 | 65 | 76 |
| | Ammonia, Total (as N) (mg/L) | | <0.0050 | 0.0051 | <0.0050 | 0.0051 | 0.0060 |
| | Nitrate (as N) (mg/L) | | 1.88 | 1.90 | 1.88 | 0.0404 | 0.0213 |
| | Total Kjeldahl Nitrogen (mg/L) | | 0.814 | 2.17 | 0.275 | 0.366 | 0.406 |
| | Phosphorus (P)-Total (mg/L) | | 0.0132 | 0.0485 | 0.0158 | 0.0156 | 0.0115 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 5.51 | 5.36 | 5.48 | 15.4 | 14.6 |
| | Total Organic Carbon (mg/L) | | | | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0930 | 0.320 | 0.0848 | 0.0503 | 0.0627 |
| | Antimony (Sb)-Total (mg/L) | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Arsenic (As)-Total (mg/L) | | <0.00050 | <0.00050 | <0.00050 | 0.00055 | <0.00050 |
| | Barium (Ba)-Total (mg/L) | | 0.048 | 0.053 | 0.048 | 0.033 | <0.020 |
| | Beryllium (Be)-Total (mg/L) | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Boron (B)-Total (mg/L) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| | Cadmium (Cd)-Total (mg/L) | | <0.0000050 | 0.0000071 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Total (mg/L) | | 30.8 | 31.2 | 30.7 | 19.1 | 13.4 |
| | Chromium (Cr)-Total (mg/L) | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Cobalt (Co)-Total (mg/L) | | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Copper (Cu)-Total (mg/L) | | 0.0057 | 0.0068 | 0.0057 | 0.0015 | 0.0013 |
| | Iron (Fe)-Total (mg/L) | | 0.150 | 0.465 | 0.176 | 0.476 | 0.454 |
| | Lead (Pb)-Total (mg/L) | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Lithium (Li)-Total (mg/L) | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Magnesium (Mg)-Total (mg/L) | | 11.1 | 11.4 | 11.2 | 5.67 | 7.45 |
| | Manganese (Mn)-Total (mg/L) | | 0.0250 | 0.0479 | 0.0236 | 0.0295 | 0.0320 |
| | Mercury (Hg)-Total (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | | 0.0023 | 0.0023 | 0.0024 | <0.0010 | <0.0010 |
| | Nickel (Ni)-Total (mg/L) | | <0.0010 | 0.0012 | <0.0010 | 0.0012 | <0.0010 |
| | Potassium (K)-Total (mg/L) | | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Selenium (Se)-Total (mg/L) | | 0.000514 | 0.000498 | 0.000500 | 0.000264 | 0.000119 |
| | Silver (Ag)-Total (mg/L) | | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Sodium (Na)-Total (mg/L) | | 11.5 | 11.9 | 11.9 | 4.2 | 9.7 |
| | Thallium (Tl)-Total (mg/L) | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| | Tin (Sn)-Total (mg/L) | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Titanium (Ti)-Total (mg/L) | | <0.010 | 0.021 | <0.010 | <0.010 | <0.010 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1834209-6 | L1834209-7 | L1834209-8 | L1834209-9 | L1834209-10 |
|-----------------------------------|-------------------------------------|--------------|------------|------------|------------|------------|-------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 24-SEP-16 | 24-SEP-16 | 23-SEP-16 | 24-SEP-16 | 24-SEP-16 |
| | | Sampled Time | | | | | |
| | | Client ID | REF-3 | REF-4 | REF-5 | REF-6 | REF-7 |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Hardness (as CaCO3) (mg/L) | | 105 | 51.5 | 115 | 125 | 213 |
| | Total Suspended Solids (mg/L) | | 21.4 | 21.4 | <3.0 | <3.0 | <3.0 |
| | Total Dissolved Solids (mg/L) | | 175 | 101 | 171 | 202 | 299 |
| Anions and Nutrients | Alkalinity, Total (as CaCO3) (mg/L) | | 100 | 42.9 | 81 | 145 | 165 |
| | Ammonia, Total (as N) (mg/L) | | <0.0050 | 0.0189 | <0.0050 | 0.0054 | <0.0050 |
| | Nitrate (as N) (mg/L) | | 0.0718 | 0.0844 | 0.0781 | 0.0819 | 0.0323 |
| | Total Kjeldahl Nitrogen (mg/L) | | 0.420 | 0.480 | 0.189 | 0.433 | 0.412 |
| | Phosphorus (P)-Total (mg/L) | | 0.0111 | 0.0398 | 0.0073 | 0.0241 | 0.0106 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 14.6 | 13.4 | 6.58 | 14.0 | 14.7 |
| | Total Organic Carbon (mg/L) | | | | | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0916 | 0.522 | 0.0223 | 0.0289 | 0.0468 |
| | Antimony (Sb)-Total (mg/L) | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Arsenic (As)-Total (mg/L) | | 0.00058 | 0.00070 | <0.00050 | 0.00066 | <0.00050 |
| | Barium (Ba)-Total (mg/L) | | 0.070 | 0.057 | 0.051 | 0.039 | 0.056 |
| | Beryllium (Be)-Total (mg/L) | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Boron (B)-Total (mg/L) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| | Cadmium (Cd)-Total (mg/L) | | 0.0000057 | 0.0000154 | 0.0000074 | <0.0000050 | 0.0000062 |
| | Calcium (Ca)-Total (mg/L) | | 29.3 | 14.3 | 28.8 | 28.9 | 53.3 |
| | Chromium (Cr)-Total (mg/L) | | <0.0010 | 0.0012 | <0.0010 | <0.0010 | <0.0010 |
| | Cobalt (Co)-Total (mg/L) | | <0.00030 | 0.00083 | <0.00030 | <0.00030 | <0.00030 |
| | Copper (Cu)-Total (mg/L) | | 0.0018 | 0.0035 | <0.0010 | 0.0012 | 0.0014 |
| | Iron (Fe)-Total (mg/L) | | 0.275 | 1.67 | 0.133 | 0.194 | 0.236 |
| | Lead (Pb)-Total (mg/L) | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Lithium (Li)-Total (mg/L) | | <0.0010 | <0.0010 | 0.0052 | <0.0010 | 0.0013 |
| | Magnesium (Mg)-Total (mg/L) | | 7.14 | 5.20 | 10.7 | 12.8 | 19.9 |
| | Manganese (Mn)-Total (mg/L) | | 0.0360 | 0.128 | 0.0269 | 0.0169 | 0.0281 |
| | Mercury (Hg)-Total (mg/L) | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0016 |
| | Nickel (Ni)-Total (mg/L) | | 0.0014 | 0.0015 | <0.0010 | 0.0018 | 0.0032 |
| | Potassium (K)-Total (mg/L) | | <2.0 | <2.0 | <2.0 | <2.0 | 3.1 |
| | Selenium (Se)-Total (mg/L) | | 0.000079 | 0.000107 | 0.000511 | 0.000409 | 0.000146 |
| | Silver (Ag)-Total (mg/L) | | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Sodium (Na)-Total (mg/L) | | 6.5 | 4.1 | 4.8 | 17.7 | 4.9 |
| | Thallium (Tl)-Total (mg/L) | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Tin (Sn)-Total (mg/L) | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| Titanium (Ti)-Total (mg/L) | | <0.010 | 0.032 | <0.010 | <0.010 | <0.010 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1834209-11 | L1834209-12 | L1834209-13 | L1834209-14 | L1834209-15 |
|-----------------------------------|-------------------------------------|--------------|-------------|-------------|-------------|----------------------|--------------|
| | | Description | Water | Water | Water | Water | Water |
| | | Sampled Date | 25-SEP-16 | 23-SEP-16 | 23-SEP-16 | 23-SEP-16 | |
| | | Sampled Time | | | | | |
| | | Client ID | REF-8 | REF-9 | REF-10 | REF-9X | TRAVEL BLANK |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Physical Tests | Hardness (as CaCO3) (mg/L) | 116 | 154 | 32.9 | 157 | <0.50 ^{HTC} | |
| | Total Suspended Solids (mg/L) | 4.1 | <3.0 | <3.0 | <3.0 | <3.0 | |
| | Total Dissolved Solids (mg/L) | 170 | 181 | 75 | 214 | <10 | |
| Anions and Nutrients | Alkalinity, Total (as CaCO3) (mg/L) | 72 | 129 | 37.0 | 127 | <2.0 | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | |
| | Nitrate (as N) (mg/L) | 0.300 | 0.166 | 0.0423 | 0.165 | <0.0050 | |
| | Total Kjeldahl Nitrogen (mg/L) | 0.224 | 0.159 | 0.126 | 0.146 | <0.050 | |
| | Phosphorus (P)-Total (mg/L) | 0.0101 | 0.0076 | 0.0073 | 0.0034 | <0.0020 | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 6.62 | 4.25 | 4.23 | 4.34 | | |
| | Total Organic Carbon (mg/L) | | | | | <0.50 | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.117 | 0.0212 | 0.0656 | 0.0246 | <0.0050 | |
| | Antimony (Sb)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| | Arsenic (As)-Total (mg/L) | <0.00050 | 0.00099 | <0.00050 | 0.00102 | <0.00050 | |
| | Barium (Ba)-Total (mg/L) | 0.079 | 0.058 | 0.033 | 0.059 | <0.020 | |
| | Beryllium (Be)-Total (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| | Boron (B)-Total (mg/L) | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Calcium (Ca)-Total (mg/L) | 30.3 | 33.3 | 9.85 | 33.8 | <0.10 | |
| | Chromium (Cr)-Total (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| | Cobalt (Co)-Total (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | |
| | Copper (Cu)-Total (mg/L) | 0.0016 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| | Iron (Fe)-Total (mg/L) | 0.164 | 0.092 | 0.203 | 0.092 | <0.030 | |
| | Lead (Pb)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| | Lithium (Li)-Total (mg/L) | <0.0010 | 0.0012 | <0.0010 | 0.0011 | <0.0010 | |
| | Magnesium (Mg)-Total (mg/L) | 8.11 | 16.7 | 2.47 | 16.9 | <0.10 | |
| | Manganese (Mn)-Total (mg/L) | 0.0193 | 0.0360 | 0.00325 | 0.0370 | <0.00030 | |
| | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Total (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| | Nickel (Ni)-Total (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| | Potassium (K)-Total (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | |
| | Selenium (Se)-Total (mg/L) | 0.000150 | 0.000249 | 0.000063 | 0.000268 | <0.000050 | |
| | Silver (Ag)-Total (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | |
| | Sodium (Na)-Total (mg/L) | 3.8 | <2.0 | 3.0 | <2.0 | <2.0 | |
| | Thallium (Tl)-Total (mg/L) | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | |
| Tin (Sn)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | |
| Titanium (Ti)-Total (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1834209-1 Water 22-SEP-16 UMC-1 | L1834209-2 Water 22-SEP-16 UMC-2 | L1834209-3 Water 22-SEP-16 UMC-3 | L1834209-4 Water 25-SEP-16 REF-1 | L1834209-5 Water 24-SEP-16 REF-2 | |
|---|---|---|---|---|---|------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Uranium (U)-Total (mg/L) | 0.00069 | 0.00070 | 0.00068 | 0.00033 | 0.00036 |
| | Vanadium (V)-Total (mg/L) | 0.00079 | 0.00134 | 0.00067 | 0.00073 | 0.00247 |
| | Zinc (Zn)-Total (mg/L) | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | <0.0050 | <0.0050 | <0.0050 | 0.0312 | 0.0338 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Arsenic (As)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00051 | <0.00050 |
| | Barium (Ba)-Dissolved (mg/L) | 0.042 | 0.044 | 0.044 | 0.029 | <0.020 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Boron (B)-Dissolved (mg/L) | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 31.7 | 32.6 | 32.2 | 17.4 | 12.3 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0046 | 0.0047 | 0.0046 | 0.0016 | 0.0011 |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | <0.030 | <0.030 | 0.332 | 0.331 |
| | Lead (Pb)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Magnesium (Mg)-Dissolved (mg/L) | 9.74 | 10.2 | 10.1 | 5.04 | 6.67 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0121 | 0.0125 | 0.0125 | 0.0263 | 0.0289 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0022 | 0.0022 | 0.0022 | <0.0010 | <0.0010 |
| | Nickel (Ni)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | 0.0010 | <0.0010 |
| | Potassium (K)-Dissolved (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000486 | 0.000516 | 0.000518 | 0.000260 | 0.000117 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Sodium (Na)-Dissolved (mg/L) | 11.0 | 11.8 | 11.6 | 4.1 | 9.5 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.00064 | 0.00063 | 0.00064 | 0.00031 | 0.00033 |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00051 | 0.00193 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1834209-6 Water 24-SEP-16 REF-3 | L1834209-7 Water 24-SEP-16 REF-4 | L1834209-8 Water 23-SEP-16 REF-5 | L1834209-9 Water 24-SEP-16 REF-6 | L1834209-10 Water 24-SEP-16 REF-7 | |
|---|---|---|---|---|--|------------|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Uranium (U)-Total (mg/L) | 0.00039 | <0.00020 | 0.00085 | 0.00082 | 0.00059 |
| | Vanadium (V)-Total (mg/L) | 0.00114 | 0.00274 | <0.00050 | 0.00136 | 0.00064 |
| | Zinc (Zn)-Total (mg/L) | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0201 | 0.0523 | 0.0090 | 0.0117 | 0.0177 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Arsenic (As)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00064 | <0.00050 |
| | Barium (Ba)-Dissolved (mg/L) | 0.063 | 0.043 | 0.046 | 0.035 | 0.052 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Boron (B)-Dissolved (mg/L) | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | 0.0000056 | <0.0000050 | 0.0000053 |
| | Calcium (Ca)-Dissolved (mg/L) | 31.5 | 13.2 | 30.2 | 31.3 | 55.9 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00030 | 0.00048 | <0.00030 | <0.00030 | <0.00030 |
| | Copper (Cu)-Dissolved (mg/L) | 0.0014 | 0.0021 | <0.0010 | 0.0011 | 0.0013 |
| | Iron (Fe)-Dissolved (mg/L) | 0.141 | 0.565 | 0.082 | 0.148 | 0.152 |
| | Lead (Pb)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | <0.0010 | 0.0051 | <0.0010 | 0.0015 |
| | Magnesium (Mg)-Dissolved (mg/L) | 6.46 | 4.50 | 9.59 | 11.5 | 17.9 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0245 | 0.108 | 0.0239 | 0.0138 | 0.0225 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0016 |
| | Nickel (Ni)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | 0.0013 | 0.0028 |
| | Potassium (K)-Dissolved (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | 2.9 |
| | Selenium (Se)-Dissolved (mg/L) | 0.000077 | 0.000087 | 0.000457 | 0.000394 | 0.000141 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 |
| | Sodium (Na)-Dissolved (mg/L) | 6.3 | 3.9 | 4.6 | 17.0 | 4.7 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.00036 | <0.00020 | 0.00079 | 0.00081 | 0.00057 |
| | Vanadium (V)-Dissolved (mg/L) | 0.00067 | 0.00087 | <0.00050 | 0.00116 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1834209-11 Water 25-SEP-16 REF-8 | L1834209-12 Water 23-SEP-16 REF-9 | L1834209-13 Water 23-SEP-16 REF-10 | L1834209-14 Water 23-SEP-16 REF-9X | L1834209-15 Water TRAVEL BLANK |
|---|---------------------------------------|--|--|---|---|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Uranium (U)-Total (mg/L) | 0.00070 | 0.00090 | 0.00030 | 0.00091 | <0.00020 |
| | Vanadium (V)-Total (mg/L) | 0.00070 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0206 | 0.0094 | 0.0228 | 0.0091 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| | Arsenic (As)-Dissolved (mg/L) | <0.00050 | 0.00098 | <0.00050 | 0.00093 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.075 | 0.055 | 0.029 | 0.057 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| | Boron (B)-Dissolved (mg/L) | <0.10 | <0.10 | <0.10 | <0.10 | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Calcium (Ca)-Dissolved (mg/L) | 34.0 | 36.5 | 9.45 | 36.9 | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00030 | <0.00030 | <0.00030 | <0.00030 | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0014 | <0.0010 | <0.0010 | <0.0010 | |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | 0.056 | 0.040 | 0.057 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | 0.0014 | <0.0010 | 0.0013 | |
| | Magnesium (Mg)-Dissolved (mg/L) | 7.60 | 15.3 | 2.26 | 15.7 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0128 | 0.0323 | 0.00209 | 0.0319 | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | |
| | Molybdenum (Mo)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| | Potassium (K)-Dissolved (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000115 | 0.000260 | 0.000060 | 0.000293 | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 | <0.000020 | <0.000020 | <0.000020 | |
| | Sodium (Na)-Dissolved (mg/L) | 3.6 | <2.0 | 2.8 | <2.0 | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.00020 | <0.00020 | <0.00020 | <0.00020 | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | |
| | Uranium (U)-Dissolved (mg/L) | 0.00065 | 0.00088 | 0.00028 | 0.00089 | |
| | Vanadium (V)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0050 | <0.0050 | <0.0050 | <0.0050 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

| | Parameter | Qualifier | Applies to Sample Number(s) |
|--------------|-----------------------|-----------|--|
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1834209-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Zinc (Zn)-Dissolved | MS-B | L1834209-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Zinc (Zn)-Dissolved | MS-B | L1834209-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Zinc (Zn)-Dissolved | MS-B | L1834209-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Zinc (Zn)-Dissolved | MS-B | L1834209-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Zinc (Zn)-Dissolved | MS-B | L1834209-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Aluminum (Al)-Total | MS-B | L1834209-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1834209-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Phosphorus (P)-Total | MS-B | L1834209-15 |
| Matrix Spike | Phosphorus (P)-Total | MS-B | L1834209-14 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| HTC | Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable). |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-COL-VA | Water | Alkalinity by Colourimetric (Automated) | EPA 310.2 |
| This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CARBONS-TOC-VA | Water | Total organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-DIS-ICP-VA | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |

Reference Information

| | | | |
|---|-------|---------------------------------------|---|
| MET-TOT-ICP-VA | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO3-L-IC-N-VA | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| P-T-PRES-COL-VA | Water | Total P in Water by Colour | APHA 4500-P Phosphorus |
| This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample. Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples. Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis. | | | |
| TDS-VA | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius. | | | |
| TKN-F-VA | Water | TKN in Water by Fluorescence | APHA 4500-NORG D. |
| This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

1 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1834209

Report Date: 20-DEC-17

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Client: MINNOW ENVIRONMENTAL INC.
 101 - 1025 Hillside Ave.
 Victoria BC V8T 2A2

Contact: Pierre Stecko

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|--------------------|--------|-----------|-------|-----|--------|-----------|
| ALK-COL-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3563877 | | | | | | | |
| WG2403733-5 | DUP | L1834209-11 | | | | | | |
| Alkalinity, Total (as CaCO3) | | 72 | 72 | | mg/L | 0.0 | 20 | 04-OCT-16 |
| WG2403733-2 | LCS | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 105.2 | | % | | 85-115 | 04-OCT-16 |
| WG2403733-1 | MB | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 04-OCT-16 |
| WG2403733-4 | MB | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 04-OCT-16 |
| WG2403733-6 | MB | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 04-OCT-16 |
| WG2403733-8 | MB | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 04-OCT-16 |
| CARBONS-DOC-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3561181 | | | | | | | |
| WG2399600-12 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 100.4 | | % | | 80-120 | 29-SEP-16 |
| WG2399600-16 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 100.6 | | % | | 80-120 | 29-SEP-16 |
| WG2399600-4 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 97.4 | | % | | 80-120 | 29-SEP-16 |
| WG2399600-8 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 99.9 | | % | | 80-120 | 29-SEP-16 |
| WG2399600-11 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 29-SEP-16 |
| WG2399600-15 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 29-SEP-16 |
| WG2399600-3 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 29-SEP-16 |
| WG2399600-7 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 29-SEP-16 |
| WG2399600-10 | MS | L1834209-1 | | | | | | |
| Dissolved Organic Carbon | | | N/A | MS-B | % | | - | 29-SEP-16 |
| Batch | R3562668 | | | | | | | |
| WG2401835-4 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 99.6 | | % | | 80-120 | 02-OCT-16 |
| WG2401835-8 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 97.8 | | % | | 80-120 | 02-OCT-16 |
| WG2401835-3 | MB | | | | | | | |



Quality Control Report

Workorder: L1834209

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|--------------------|-------------|-----------|-------|-----|----------|-----------|
| CARBONS-DOC-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3562668 | | | | | | | |
| WG2401835-3 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 02-OCT-16 |
| WG2401835-7 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 02-OCT-16 |
| CARBONS-TOC-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3561180 | | | | | | | |
| WG2399598-1 | LCS | | | | | | | |
| Total Organic Carbon | | | 99.7 | | % | | 80-120 | 29-SEP-16 |
| WG2399598-13 | LCS | | | | | | | |
| Total Organic Carbon | | | 103.0 | | % | | 80-120 | 29-SEP-16 |
| WG2399598-5 | LCS | | | | | | | |
| Total Organic Carbon | | | 99.6 | | % | | 80-120 | 29-SEP-16 |
| WG2399598-9 | LCS | | | | | | | |
| Total Organic Carbon | | | 102.8 | | % | | 80-120 | 29-SEP-16 |
| WG2399598-12 | MB | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 29-SEP-16 |
| WG2399598-4 | MB | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 29-SEP-16 |
| WG2399598-8 | MB | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 29-SEP-16 |
| HG-D-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3559239 | | | | | | | |
| WG2398449-5 | DUP | L1834209-6 | | | | | | |
| Mercury (Hg)-Dissolved | | <0.0000050 | <0.0000050C | RPD-NA | mg/L | N/A | 20 | 28-SEP-16 |
| WG2398449-2 | LCS | | | | | | | |
| Mercury (Hg)-Dissolved | | | 97.9 | | % | | 80-120 | 28-SEP-16 |
| WG2398449-1 | MB | NP | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.0000050C | | mg/L | | 0.000005 | 28-SEP-16 |
| WG2398449-8 | MS | L1834209-13 | | | | | | |
| Mercury (Hg)-Dissolved | | | 92.9 | | % | | 70-130 | 28-SEP-16 |
| HG-T-CVAA-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3558480 | | | | | | | |
| WG2398404-2 | LCS | | | | | | | |
| Mercury (Hg)-Total | | | 93.9 | | % | | 80-120 | 27-SEP-16 |
| WG2398404-1 | MB | | | | | | | |
| Mercury (Hg)-Total | | | <0.0000050C | | mg/L | | 0.000005 | 27-SEP-16 |
| WG2398404-6 | MS | L1834209-5 | | | | | | |
| Mercury (Hg)-Total | | | 84.5 | | % | | 70-130 | 27-SEP-16 |



Quality Control Report

Workorder: L1834209

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-----------|------------|-----------|-------|-----|----------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3558938 | | | | | | | |
| WG2398468-2 | LCS | | | | | | | |
| Aluminum (Al)-Dissolved | | | 102.0 | | % | | 80-120 | 28-SEP-16 |
| Antimony (Sb)-Dissolved | | | 96.4 | | % | | 80-120 | 28-SEP-16 |
| Arsenic (As)-Dissolved | | | 99.7 | | % | | 80-120 | 28-SEP-16 |
| Beryllium (Be)-Dissolved | | | 103.3 | | % | | 80-120 | 28-SEP-16 |
| Cadmium (Cd)-Dissolved | | | 99.6 | | % | | 80-120 | 28-SEP-16 |
| Chromium (Cr)-Dissolved | | | 99.4 | | % | | 80-120 | 28-SEP-16 |
| Cobalt (Co)-Dissolved | | | 100.6 | | % | | 80-120 | 28-SEP-16 |
| Copper (Cu)-Dissolved | | | 97.0 | | % | | 80-120 | 28-SEP-16 |
| Lead (Pb)-Dissolved | | | 99.99 | | % | | 80-120 | 28-SEP-16 |
| Lithium (Li)-Dissolved | | | 101.3 | | % | | 80-120 | 28-SEP-16 |
| Manganese (Mn)-Dissolved | | | 101.9 | | % | | 80-120 | 28-SEP-16 |
| Molybdenum (Mo)-Dissolved | | | 103.8 | | % | | 80-120 | 28-SEP-16 |
| Nickel (Ni)-Dissolved | | | 99.9 | | % | | 80-120 | 28-SEP-16 |
| Selenium (Se)-Dissolved | | | 98.4 | | % | | 80-120 | 28-SEP-16 |
| Silver (Ag)-Dissolved | | | 92.8 | | % | | 80-120 | 28-SEP-16 |
| Thallium (Tl)-Dissolved | | | 105.5 | | % | | 80-120 | 28-SEP-16 |
| Tin (Sn)-Dissolved | | | 90.8 | | % | | 80-120 | 28-SEP-16 |
| Uranium (U)-Dissolved | | | 98.2 | | % | | 80-120 | 28-SEP-16 |
| Vanadium (V)-Dissolved | | | 100.1 | | % | | 80-120 | 28-SEP-16 |
| WG2398468-1 | MB | NP | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 28-SEP-16 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 28-SEP-16 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 28-SEP-16 |
| Beryllium (Be)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 28-SEP-16 |
| Cadmium (Cd)-Dissolved | | | <0.0000050 | | mg/L | | 0.000005 | 28-SEP-16 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 28-SEP-16 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 28-SEP-16 |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 28-SEP-16 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 28-SEP-16 |
| Lithium (Li)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 28-SEP-16 |
| Manganese (Mn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 28-SEP-16 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 28-SEP-16 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 28-SEP-16 |
| Selenium (Se)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 28-SEP-16 |



Quality Control Report

Workorder: L1834209

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-------------------|------------|-----------|-------|-----|---------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3558938 | | | | | | | |
| WG2398468-1 | MB | NP | | | | | | |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 28-SEP-16 |
| Thallium (Tl)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 28-SEP-16 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 28-SEP-16 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 28-SEP-16 |
| Vanadium (V)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 28-SEP-16 |
| Batch | R3562796 | | | | | | | |
| WG2398468-7 | DUP | L1834209-8 | | | | | | |
| Aluminum (Al)-Dissolved | | 0.0090 | 0.0081 | | mg/L | 9.6 | 20 | 01-OCT-16 |
| Antimony (Sb)-Dissolved | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Arsenic (As)-Dissolved | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Beryllium (Be)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Cadmium (Cd)-Dissolved | | 0.0000056 | <0.0000050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Chromium (Cr)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Cobalt (Co)-Dissolved | | <0.00030 | <0.00030 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Copper (Cu)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Lead (Pb)-Dissolved | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Lithium (Li)-Dissolved | | 0.0051 | 0.0053 | | mg/L | 3.0 | 20 | 01-OCT-16 |
| Manganese (Mn)-Dissolved | | 0.0239 | 0.0235 | | mg/L | 1.5 | 20 | 01-OCT-16 |
| Molybdenum (Mo)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Nickel (Ni)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Selenium (Se)-Dissolved | | 0.000457 | 0.000452 | | mg/L | 1.2 | 20 | 01-OCT-16 |
| Silver (Ag)-Dissolved | | <0.000020 | <0.000020 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Thallium (Tl)-Dissolved | | <0.00020 | <0.00020 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Tin (Sn)-Dissolved | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Uranium (U)-Dissolved | | 0.00079 | 0.00079 | | mg/L | 0.5 | 20 | 01-OCT-16 |
| Vanadium (V)-Dissolved | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| WG2398468-8 | DUP | L1834209-4 | | | | | | |
| Aluminum (Al)-Dissolved | | 0.0312 | 0.0291 | | mg/L | 7.0 | 20 | 01-OCT-16 |
| Antimony (Sb)-Dissolved | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Arsenic (As)-Dissolved | | 0.00051 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Beryllium (Be)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Cadmium (Cd)-Dissolved | | <0.0000050 | 0.0000086 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Chromium (Cr)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Cobalt (Co)-Dissolved | | <0.00030 | <0.00030 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Copper (Cu)-Dissolved | | 0.0016 | 0.0015 | | mg/L | 3.1 | 20 | 01-OCT-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---------------------------|-----------------|-------------------|-----------|-----------|-------|-----|--------|-----------|
| MET-D-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3562796 | | | | | | | |
| WG2398468-8 | DUP | L1834209-4 | | | | | | |
| Lead (Pb)-Dissolved | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Lithium (Li)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Manganese (Mn)-Dissolved | | 0.0263 | 0.0260 | | mg/L | 1.3 | 20 | 01-OCT-16 |
| Molybdenum (Mo)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Nickel (Ni)-Dissolved | | 0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Selenium (Se)-Dissolved | | 0.000260 | 0.000218 | | mg/L | 17 | 20 | 01-OCT-16 |
| Silver (Ag)-Dissolved | | <0.000020 | <0.000020 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Thallium (Tl)-Dissolved | | <0.00020 | <0.00020 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Tin (Sn)-Dissolved | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Uranium (U)-Dissolved | | 0.00031 | 0.00031 | | mg/L | 0.3 | 20 | 01-OCT-16 |
| Vanadium (V)-Dissolved | | 0.00051 | 0.00050 | | mg/L | 1.0 | 20 | 01-OCT-16 |
| MET-DIS-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3559265 | | | | | | | |
| WG2398468-7 | DUP | L1834209-8 | | | | | | |
| Barium (Ba)-Dissolved | | 0.046 | 0.046 | | mg/L | 1.7 | 20 | 28-SEP-16 |
| Boron (B)-Dissolved | | <0.10 | <0.10 | RPD-NA | mg/L | N/A | 20 | 28-SEP-16 |
| Calcium (Ca)-Dissolved | | 30.2 | 30.3 | | mg/L | 0.4 | 20 | 28-SEP-16 |
| Iron (Fe)-Dissolved | | 0.082 | 0.083 | | mg/L | 0.9 | 20 | 28-SEP-16 |
| Magnesium (Mg)-Dissolved | | 9.59 | 9.57 | | mg/L | 0.2 | 20 | 28-SEP-16 |
| Potassium (K)-Dissolved | | <2.0 | <2.0 | RPD-NA | mg/L | N/A | 20 | 28-SEP-16 |
| Sodium (Na)-Dissolved | | 4.6 | 4.5 | | mg/L | 2.0 | 20 | 28-SEP-16 |
| Titanium (Ti)-Dissolved | | <0.010 | <0.010 | RPD-NA | mg/L | N/A | 20 | 28-SEP-16 |
| Zinc (Zn)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 28-SEP-16 |
| WG2398468-8 | DUP | L1834209-4 | | | | | | |
| Barium (Ba)-Dissolved | | 0.029 | 0.029 | | mg/L | 0.2 | 20 | 28-SEP-16 |
| Boron (B)-Dissolved | | <0.10 | <0.10 | RPD-NA | mg/L | N/A | 20 | 28-SEP-16 |
| Calcium (Ca)-Dissolved | | 17.4 | 17.7 | | mg/L | 1.5 | 20 | 28-SEP-16 |
| Iron (Fe)-Dissolved | | 0.332 | 0.335 | | mg/L | 0.8 | 20 | 28-SEP-16 |
| Magnesium (Mg)-Dissolved | | 5.04 | 5.06 | | mg/L | 0.4 | 20 | 28-SEP-16 |
| Potassium (K)-Dissolved | | <2.0 | <2.0 | RPD-NA | mg/L | N/A | 20 | 28-SEP-16 |
| Sodium (Na)-Dissolved | | 4.1 | 4.1 | | mg/L | 0.3 | 20 | 28-SEP-16 |
| Titanium (Ti)-Dissolved | | <0.010 | <0.010 | RPD-NA | mg/L | N/A | 20 | 28-SEP-16 |
| Zinc (Zn)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 28-SEP-16 |
| WG2398468-2 | LCS | | | | | | | |
| Barium (Ba)-Dissolved | | | 100.2 | | % | | 80-120 | 28-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|-----------|---------|-----------|-------|-----|--------|-----------|
| MET-DIS-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3559265 | | | | | | | |
| WG2398468-2 | LCS | | | | | | | |
| Boron (B)-Dissolved | | | 94.9 | | % | | 80-120 | 28-SEP-16 |
| Calcium (Ca)-Dissolved | | | 102.7 | | % | | 80-120 | 28-SEP-16 |
| Iron (Fe)-Dissolved | | | 95.2 | | % | | 80-120 | 28-SEP-16 |
| Magnesium (Mg)-Dissolved | | | 97.9 | | % | | 80-120 | 28-SEP-16 |
| Potassium (K)-Dissolved | | | 104.2 | | % | | 80-120 | 28-SEP-16 |
| Sodium (Na)-Dissolved | | | 97.2 | | % | | 80-120 | 28-SEP-16 |
| Titanium (Ti)-Dissolved | | | 101.9 | | % | | 80-120 | 28-SEP-16 |
| Zinc (Zn)-Dissolved | | | 94.3 | | % | | 80-120 | 28-SEP-16 |
| WG2398468-1 | MB | NP | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 28-SEP-16 |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 28-SEP-16 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 28-SEP-16 |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 28-SEP-16 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 28-SEP-16 |
| Potassium (K)-Dissolved | | | <2.0 | | mg/L | | 2 | 28-SEP-16 |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 28-SEP-16 |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 28-SEP-16 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 28-SEP-16 |
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3562782 | | | | | | | |
| WG2400648-2 | LCS | | | | | | | |
| Aluminum (Al)-Total | | | 116.0 | | % | | 80-120 | 30-SEP-16 |
| Antimony (Sb)-Total | | | 110.6 | | % | | 80-120 | 30-SEP-16 |
| Arsenic (As)-Total | | | 111.3 | | % | | 80-120 | 30-SEP-16 |
| Beryllium (Be)-Total | | | 109.1 | | % | | 80-120 | 30-SEP-16 |
| Cadmium (Cd)-Total | | | 107.7 | | % | | 80-120 | 30-SEP-16 |
| Chromium (Cr)-Total | | | 111.8 | | % | | 80-120 | 30-SEP-16 |
| Cobalt (Co)-Total | | | 108.5 | | % | | 80-120 | 30-SEP-16 |
| Copper (Cu)-Total | | | 108.1 | | % | | 80-120 | 30-SEP-16 |
| Lead (Pb)-Total | | | 111.0 | | % | | 80-120 | 30-SEP-16 |
| Lithium (Li)-Total | | | 110.6 | | % | | 80-120 | 30-SEP-16 |
| Molybdenum (Mo)-Total | | | 112.4 | | % | | 80-120 | 30-SEP-16 |
| Nickel (Ni)-Total | | | 109.1 | | % | | 80-120 | 30-SEP-16 |
| Selenium (Se)-Total | | | 108.3 | | % | | 80-120 | 30-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-----------------------|-----------------|-------------------|------------|-----------|-------|-----|----------|-----------|
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3562782 | | | | | | | |
| WG2400648-2 | LCS | | | | | | | |
| Silver (Ag)-Total | | | 111.3 | | % | | 80-120 | 30-SEP-16 |
| Thallium (Tl)-Total | | | 110.2 | | % | | 80-120 | 30-SEP-16 |
| Tin (Sn)-Total | | | 109.7 | | % | | 80-120 | 30-SEP-16 |
| Uranium (U)-Total | | | 113.6 | | % | | 80-120 | 30-SEP-16 |
| Vanadium (V)-Total | | | 111.3 | | % | | 80-120 | 30-SEP-16 |
| WG2400648-1 | MB | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 30-SEP-16 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 30-SEP-16 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 30-SEP-16 |
| Beryllium (Be)-Total | | | <0.00010 | | mg/L | | 0.0001 | 30-SEP-16 |
| Cadmium (Cd)-Total | | | <0.0000050 | | mg/L | | 0.000005 | 30-SEP-16 |
| Chromium (Cr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 30-SEP-16 |
| Cobalt (Co)-Total | | | <0.00010 | | mg/L | | 0.0001 | 30-SEP-16 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 30-SEP-16 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 30-SEP-16 |
| Lithium (Li)-Total | | | <0.0010 | | mg/L | | 0.001 | 30-SEP-16 |
| Manganese (Mn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 30-SEP-16 |
| Molybdenum (Mo)-Total | | | <0.000050 | | mg/L | | 0.00005 | 30-SEP-16 |
| Nickel (Ni)-Total | | | <0.00050 | | mg/L | | 0.0005 | 30-SEP-16 |
| Selenium (Se)-Total | | | <0.000050 | | mg/L | | 0.00005 | 30-SEP-16 |
| Silver (Ag)-Total | | | <0.000010 | | mg/L | | 0.00001 | 30-SEP-16 |
| Tin (Sn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 30-SEP-16 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 30-SEP-16 |
| Vanadium (V)-Total | | | <0.00050 | | mg/L | | 0.0005 | 30-SEP-16 |
| Batch | R3562796 | | | | | | | |
| WG2400648-3 | DUP | L1834209-1 | | | | | | |
| Aluminum (Al)-Total | | 0.0930 | 0.0931 | | mg/L | 0.1 | 20 | 01-OCT-16 |
| Antimony (Sb)-Total | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Arsenic (As)-Total | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Beryllium (Be)-Total | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Cadmium (Cd)-Total | | <0.0000050 | <0.0000050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Chromium (Cr)-Total | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Cobalt (Co)-Total | | <0.00030 | <0.00030 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Copper (Cu)-Total | | 0.0057 | 0.0059 | | mg/L | 3.0 | 20 | 01-OCT-16 |
| Lead (Pb)-Total | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-----------------------|-----------------|-------------------|-----------|-----------|-------|-----|---------|-----------|
| MET-T-CCMS-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3562796 | | | | | | | |
| WG2400648-3 | DUP | L1834209-1 | | | | | | |
| Lithium (Li)-Total | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Manganese (Mn)-Total | | 0.0250 | 0.0248 | | mg/L | 0.7 | 20 | 01-OCT-16 |
| Molybdenum (Mo)-Total | | 0.0023 | 0.0024 | | mg/L | 2.3 | 20 | 01-OCT-16 |
| Nickel (Ni)-Total | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Selenium (Se)-Total | | 0.000514 | 0.000484 | | mg/L | 5.9 | 20 | 01-OCT-16 |
| Silver (Ag)-Total | | <0.000020 | <0.000020 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Thallium (Tl)-Total | | <0.00020 | <0.00020 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Tin (Sn)-Total | | <0.00050 | <0.00050 | RPD-NA | mg/L | N/A | 20 | 01-OCT-16 |
| Uranium (U)-Total | | 0.00069 | 0.00069 | | mg/L | 0.8 | 20 | 01-OCT-16 |
| Vanadium (V)-Total | | 0.00079 | 0.00075 | | mg/L | 4.2 | 20 | 01-OCT-16 |
| WG2400648-4 | MS | L1834209-2 | | | | | | |
| Aluminum (Al)-Total | | | N/A | MS-B | % | | - | 01-OCT-16 |
| Antimony (Sb)-Total | | | 101.4 | | % | | 70-130 | 01-OCT-16 |
| Arsenic (As)-Total | | | 101.9 | | % | | 70-130 | 01-OCT-16 |
| Beryllium (Be)-Total | | | 97.8 | | % | | 70-130 | 01-OCT-16 |
| Cadmium (Cd)-Total | | | 95.2 | | % | | 70-130 | 01-OCT-16 |
| Chromium (Cr)-Total | | | 100.5 | | % | | 70-130 | 01-OCT-16 |
| Cobalt (Co)-Total | | | 101.7 | | % | | 70-130 | 01-OCT-16 |
| Copper (Cu)-Total | | | 97.3 | | % | | 70-130 | 01-OCT-16 |
| Lead (Pb)-Total | | | 94.9 | | % | | 70-130 | 01-OCT-16 |
| Lithium (Li)-Total | | | 102.7 | | % | | 70-130 | 01-OCT-16 |
| Manganese (Mn)-Total | | | N/A | MS-B | % | | - | 01-OCT-16 |
| Molybdenum (Mo)-Total | | | 100.5 | | % | | 70-130 | 01-OCT-16 |
| Nickel (Ni)-Total | | | 104.7 | | % | | 70-130 | 01-OCT-16 |
| Selenium (Se)-Total | | | 99.6 | | % | | 70-130 | 01-OCT-16 |
| Silver (Ag)-Total | | | 100.7 | | % | | 70-130 | 01-OCT-16 |
| Thallium (Tl)-Total | | | 94.1 | | % | | 70-130 | 01-OCT-16 |
| Tin (Sn)-Total | | | 96.4 | | % | | 70-130 | 01-OCT-16 |
| Uranium (U)-Total | | | 94.4 | | % | | 70-130 | 01-OCT-16 |
| Vanadium (V)-Total | | | 102.4 | | % | | 70-130 | 01-OCT-16 |
| Batch | R3563808 | | | | | | | |
| WG2400648-2 | LCS | | | | | | | |
| Manganese (Mn)-Total | | | 105.4 | | % | | 80-120 | 03-OCT-16 |
| WG2400648-1 | MB | | | | | | | |
| Thallium (Tl)-Total | | | 0.000029 | MB-LOR | mg/L | | 0.00001 | 03-OCT-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------|-----------------|-------------------|---------|-----------|-------|-----|--------|-----------|
| MET-TOT-ICP-VA | | Water | | | | | | |
| Batch | R3561082 | | | | | | | |
| WG2400648-2 LCS | | | | | | | | |
| Barium (Ba)-Total | | | 101.7 | | % | | 80-120 | 30-SEP-16 |
| Boron (B)-Total | | | 96.9 | | % | | 80-120 | 30-SEP-16 |
| Calcium (Ca)-Total | | | 98.3 | | % | | 80-120 | 30-SEP-16 |
| Iron (Fe)-Total | | | 96.4 | | % | | 80-120 | 30-SEP-16 |
| Magnesium (Mg)-Total | | | 98.6 | | % | | 80-120 | 30-SEP-16 |
| Potassium (K)-Total | | | 101.6 | | % | | 80-120 | 30-SEP-16 |
| Sodium (Na)-Total | | | 100.4 | | % | | 80-120 | 30-SEP-16 |
| Titanium (Ti)-Total | | | 100.5 | | % | | 80-120 | 30-SEP-16 |
| Zinc (Zn)-Total | | | 94.2 | | % | | 80-120 | 30-SEP-16 |
| WG2400648-1 MB | | | | | | | | |
| Barium (Ba)-Total | | | <0.010 | | mg/L | | 0.01 | 30-SEP-16 |
| Boron (B)-Total | | | <0.10 | | mg/L | | 0.1 | 30-SEP-16 |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 30-SEP-16 |
| Iron (Fe)-Total | | | <0.030 | | mg/L | | 0.03 | 30-SEP-16 |
| Magnesium (Mg)-Total | | | <0.10 | | mg/L | | 0.1 | 30-SEP-16 |
| Potassium (K)-Total | | | <2.0 | | mg/L | | 2 | 30-SEP-16 |
| Sodium (Na)-Total | | | <2.0 | | mg/L | | 2 | 30-SEP-16 |
| Titanium (Ti)-Total | | | <0.010 | | mg/L | | 0.01 | 30-SEP-16 |
| Zinc (Zn)-Total | | | <0.0050 | | mg/L | | 0.005 | 30-SEP-16 |
| Batch | R3561135 | | | | | | | |
| WG2400648-3 DUP | | L1834209-1 | | | | | | |
| Barium (Ba)-Total | | 0.048 | 0.049 | | mg/L | 2.2 | 20 | 30-SEP-16 |
| Boron (B)-Total | | <0.10 | <0.10 | RPD-NA | mg/L | N/A | 20 | 30-SEP-16 |
| Calcium (Ca)-Total | | 30.8 | 30.9 | | mg/L | 0.3 | 20 | 30-SEP-16 |
| Iron (Fe)-Total | | 0.150 | 0.176 | | mg/L | 16 | 20 | 30-SEP-16 |
| Magnesium (Mg)-Total | | 11.1 | 11.2 | | mg/L | 1.4 | 20 | 30-SEP-16 |
| Potassium (K)-Total | | <2.0 | <2.0 | RPD-NA | mg/L | N/A | 20 | 30-SEP-16 |
| Sodium (Na)-Total | | 11.5 | 11.7 | | mg/L | 2.1 | 20 | 30-SEP-16 |
| Titanium (Ti)-Total | | <0.010 | <0.010 | RPD-NA | mg/L | N/A | 20 | 30-SEP-16 |
| Zinc (Zn)-Total | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 30-SEP-16 |
| WG2400648-4 MS | | L1834209-2 | | | | | | |
| Barium (Ba)-Total | | | 98.2 | | % | | 70-130 | 30-SEP-16 |
| Boron (B)-Total | | | 97.9 | | % | | 70-130 | 30-SEP-16 |
| Calcium (Ca)-Total | | | 88.3 | | % | | 70-130 | 30-SEP-16 |
| Iron (Fe)-Total | | | 80.6 | | % | | 70-130 | 30-SEP-16 |



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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|-------------------------|-----------------|--------------------|---------|-----------|-------|-----|--------|-----------|
| MET-TOT-ICP-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3561135 | | | | | | | |
| WG2400648-4 MS | | L1834209-2 | | | | | | |
| Magnesium (Mg)-Total | | | 98.4 | | % | | 70-130 | 30-SEP-16 |
| Potassium (K)-Total | | | 103.5 | | % | | 70-130 | 30-SEP-16 |
| Sodium (Na)-Total | | | 102.9 | | % | | 70-130 | 30-SEP-16 |
| Titanium (Ti)-Total | | | 93.2 | | % | | 70-130 | 30-SEP-16 |
| Zinc (Zn)-Total | | | 93.5 | | % | | 70-130 | 30-SEP-16 |
| NH3-F-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3564905 | | | | | | | |
| WG2403831-7 DUP | | L1834209-12 | | | | | | |
| Ammonia, Total (as N) | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 05-OCT-16 |
| WG2403831-2 LCS | | | | | | | | |
| Ammonia, Total (as N) | | | 97.9 | | % | | 85-115 | 05-OCT-16 |
| WG2403831-6 LCS | | | | | | | | |
| Ammonia, Total (as N) | | | 95.4 | | % | | 85-115 | 05-OCT-16 |
| WG2403831-1 MB | | | | | | | | |
| Ammonia, Total (as N) | | | <0.0050 | | mg/L | | 0.005 | 05-OCT-16 |
| WG2403831-5 MB | | | | | | | | |
| Ammonia, Total (as N) | | | <0.0050 | | mg/L | | 0.005 | 05-OCT-16 |
| WG2403831-8 MS | | L1834209-12 | | | | | | |
| Ammonia, Total (as N) | | | 88.0 | | % | | 75-125 | 05-OCT-16 |
| NO3-L-IC-N-VA | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3560087 | | | | | | | |
| WG2398050-18 LCS | | | | | | | | |
| Nitrate (as N) | | | 100.5 | | % | | 90-110 | 27-SEP-16 |
| WG2398050-2 LCS | | | | | | | | |
| Nitrate (as N) | | | 100.5 | | % | | 90-110 | 27-SEP-16 |
| WG2398050-1 MB | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 27-SEP-16 |
| WG2398050-10 MB | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 27-SEP-16 |
| WG2398050-13 MB | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 27-SEP-16 |
| WG2398050-16 MB | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 27-SEP-16 |
| WG2398050-4 MB | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 27-SEP-16 |
| WG2398050-7 MB | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 27-SEP-16 |



Quality Control Report

Workorder: L1834209

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------|-----------------|--------------------|---------|-----------|-------|-----|--------|-----------|
| NO3-L-IC-N-WR | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3558094 | | | | | | | |
| WG2397916-17 | DUP | L1834209-2 | | | | | | |
| Nitrate (as N) | | 1.90 | 1.86 | | mg/L | 1.9 | 20 | 26-SEP-16 |
| WG2397916-18 | DUP | L1834209-14 | | | | | | |
| Nitrate (as N) | | 0.165 | 0.170 | | mg/L | 3.5 | 20 | 26-SEP-16 |
| WG2397916-29 | LCS | | | | | | | |
| Nitrate (as N) | | | 97.5 | | % | | 90-110 | 26-SEP-16 |
| WG2397916-31 | LCS | | | | | | | |
| Nitrate (as N) | | | 98.3 | | % | | 90-110 | 26-SEP-16 |
| WG2397916-33 | LCS | | | | | | | |
| Nitrate (as N) | | | 98.6 | | % | | 90-110 | 26-SEP-16 |
| WG2397916-28 | MB | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 26-SEP-16 |
| WG2397916-30 | MB | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 26-SEP-16 |
| WG2397916-32 | MB | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 26-SEP-16 |
| WG2397916-22 | MS | L1834209-1 | | | | | | |
| Nitrate (as N) | | | 79.0 | | % | | 75-125 | 26-SEP-16 |
| WG2397916-25 | MS | L1834209-13 | | | | | | |
| Nitrate (as N) | | | 94.7 | | % | | 75-125 | 26-SEP-16 |
| P-T-PRES-COL-VA | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3559549 | | | | | | | |
| WG2398740-6 | CRM | VA-ERA-PO4 | | | | | | |
| Phosphorus (P)-Total | | | 101.1 | | % | | 80-120 | 29-SEP-16 |
| WG2398740-7 | DUP | L1834209-1 | | | | | | |
| Phosphorus (P)-Total | | 0.0132 | 0.0121 | | mg/L | 9.1 | 20 | 29-SEP-16 |
| WG2398740-5 | MB | | | | | | | |
| Phosphorus (P)-Total | | | <0.0020 | | mg/L | | 0.002 | 29-SEP-16 |
| WG2398740-8 | MS | L1834209-2 | | | | | | |
| Phosphorus (P)-Total | | | 84.3 | | % | | 70-130 | 29-SEP-16 |
| Batch | R3559703 | | | | | | | |
| WG2398969-2 | CRM | VA-ERA-PO4 | | | | | | |
| Phosphorus (P)-Total | | | 99.4 | | % | | 80-120 | 29-SEP-16 |
| WG2398969-1 | MB | | | | | | | |
| Phosphorus (P)-Total | | | <0.0020 | | mg/L | | 0.002 | 29-SEP-16 |



Quality Control Report

Workorder: L1834209

Report Date: 20-DEC-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------|----------|-----------|--------|-----------|-------|-----|-------|-----------|
| TSS-VA | Water | | | | | | | |
| Batch | R3561167 | | | | | | | |
| WG2400526-4 | MB | | | | | | | |
| Total Suspended Solids | | | <3.0 | | mg/L | | 3 | 30-SEP-16 |

Quality Control Report

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Sample Parameter Qualifier Definitions:

| Qualifier | Description |
|-----------|---|
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |
| RPD-NA | Relative Percent Difference Not Available due to result(s) being less than detection limit. |

Quality Control Report

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Hold Time Exceedances:

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|------------------------------------|-----------|---------------|-----------------|---------|-----------|-------|-----------|
| Anions and Nutrients | | | | | | | |
| Nitrate in Water by IC (Low Level) | | | | | | | |
| | 1 | 22-SEP-16 | 26-SEP-16 14:02 | 3 | 4 | days | EHTR |
| | 2 | 22-SEP-16 | 26-SEP-16 14:02 | 3 | 4 | days | EHTR |
| | 3 | 22-SEP-16 | 26-SEP-16 14:02 | 3 | 4 | days | EHTR |

Legend & Qualifier Definitions:

| | |
|----------|---|
| EHTR-FM: | Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended. |
| EHTR: | Exceeded ALS recommended hold time prior to sample receipt. |
| EHTL: | Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry. |
| EHT: | Exceeded ALS recommended hold time prior to analysis. |
| Rec. HT: | ALS recommended hold time (see units). |

Notes*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1834209 were received on 26-SEP-16 09:55.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

COC Number: 14 -



www.alsglobal.com

Canada Toll Free: 1 800 668 9878



L1834209-COFC

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| Report To | | | | Report Format / Distribution | | | | Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Company: Minnow Environmental Inc. | | | | Select Report Format: <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL) | | | | R <input checked="" type="checkbox"/> Regular (Standard TAT if received by 3 pm - business days) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Pierre Stecko | | | | Quality Control (QC) Report with Report <input type="checkbox"/> Yes <input type="checkbox"/> No | | | | P <input type="checkbox"/> Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Address: 101 - 1025 Hillside Ave. Victoria, BC, V8T 2A2 | | | | <input type="checkbox"/> Criteria on Report - provide details below if box checked | | | | E <input type="checkbox"/> Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: (250) 595-1627 x24 (250) 709-5533 | | | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | E2 <input type="checkbox"/> Same day or weekend emergency - contact ALS to confirm TAT and surcharge | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To Same as Report To <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | | | | Invoice Distribution | | | | Specify Date Required for E2,E or P: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | | | | Select Invoice Distribution: <input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Capstone - Minto Mine | | | | Email 1 or Fax RyanH@mintomine.com | | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ryan Herbert | | | | Email 2 | | | | <table border="1"> <tr> <td></td><td>F</td><td></td><td>P</td><td>P</td><td>P</td><td>P</td><td>F/P</td><td>F/P</td><td>P</td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table> | | | | | | | | | | | | | F | | P | P | P | P | F/P | F/P | P | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | F | | P | P | P | P | F/P | F/P | P | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Project Information | | | | Oil and Gas Required Fields (client use) | | | | <table border="1"> <tr> <td></td><td>ALK-COL-VA</td><td>TDS-VA</td><td>TSS-VA</td><td>NO3-L-IC-N-VA</td><td>TKN-F-VA</td><td>NH3-F-VA</td><td>P-T-PRES-COL-VA</td><td>CARBONS-DOC-VA</td><td>MET-DIS-COME-VA</td><td>MET-TOT-COME-VA</td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table> | | | | | | | | | | | | | ALK-COL-VA | TDS-VA | TSS-VA | NO3-L-IC-N-VA | TKN-F-VA | NH3-F-VA | P-T-PRES-COL-VA | CARBONS-DOC-VA | MET-DIS-COME-VA | MET-TOT-COME-VA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ALK-COL-VA | TDS-VA | TSS-VA | NO3-L-IC-N-VA | TKN-F-VA | NH3-F-VA | P-T-PRES-COL-VA | | | | | | | | | | | | | CARBONS-DOC-VA | MET-DIS-COME-VA | MET-TOT-COME-VA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| ALS Quote #: Q58355 | | | | Approver ID: | | Cost Center: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: 15-87 | | | | GL Account: | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: | | | | Activity Code: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | | | ALS Contact: Selam Worku | | Sampler: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1"> <thead> <tr> <th>ALS Sample # (lab use only)</th> <th>Sample Identification and/or Coordinates (This description will appear on the report)</th> <th>Date (dd-mmm-yy)</th> <th>Time (hh:mm)</th> <th>Sample Type</th> <th>ALK-COL-VA</th> <th>TDS-VA</th> <th>TSS-VA</th> <th>NO3-L-IC-N-VA</th> <th>TKN-F-VA</th> <th>NH3-F-VA</th> <th>P-T-PRES-COL-VA</th> <th>CARBONS-DOC-VA</th> <th>MET-DIS-COME-VA</th> <th>MET-TOT-COME-VA</th> <th>Number of Containers</th> </tr> </thead> <tbody> <tr> <td></td><td>UMC-1</td><td>22-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td></td><td>UMC-2</td><td>22-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td></td><td>UMC-3</td><td>22-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td></td><td>REF-1</td><td>25-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td></td><td>REF-2</td><td>24-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td></td><td>REF-3</td><td>24-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td></td><td>REF-4</td><td>24-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td></td><td>REF-5</td><td>23-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td></td><td>REF-6</td><td>24-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td></td><td>REF-7</td><td>24-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td></td><td>REF-8</td><td>25-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> <tr> <td></td><td>REF-9</td><td>23-09-16</td><td></td><td>Water</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>7</td> </tr> </tbody> </table> | | | | | | | | | | | | | | | | ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | ALK-COL-VA | TDS-VA | TSS-VA | NO3-L-IC-N-VA | TKN-F-VA | NH3-F-VA | P-T-PRES-COL-VA | CARBONS-DOC-VA | MET-DIS-COME-VA | MET-TOT-COME-VA | Number of Containers | | UMC-1 | 22-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | UMC-2 | 22-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | UMC-3 | 22-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | REF-1 | 25-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | REF-2 | 24-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | REF-3 | 24-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | REF-4 | 24-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | REF-5 | 23-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | REF-6 | 24-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | REF-7 | 24-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | REF-8 | 25-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | REF-9 | 23-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | ALK-COL-VA | TDS-VA | TSS-VA | NO3-L-IC-N-VA | TKN-F-VA | NH3-F-VA | P-T-PRES-COL-VA | CARBONS-DOC-VA | MET-DIS-COME-VA | MET-TOT-COME-VA | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | UMC-1 | 22-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | UMC-2 | 22-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | UMC-3 | 22-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | REF-1 | 25-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | REF-2 | 24-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | REF-3 | 24-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | REF-4 | 24-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | REF-5 | 23-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | REF-6 | 24-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | REF-7 | 24-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | REF-8 | 25-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | REF-9 | 23-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | | | Special Instructions / Specify Criteria to add on report (client Use) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | | | | | | | | Ice packs Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | INITIAL COOLER TEMPERATURES °C: 25.09 1.2 0.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | FINAL COOLER TEMPERATURES °C: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: [Signature] | | Date: Sept 26 | Time: 10:00 | Received by: [Signature] | | Date: 26-SEP-16 | Time: 4:55 | Received by: | | | | Date: | Time: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

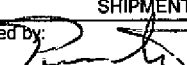

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-00266 v09 From 04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



| Report To | | Report Format / Distribution | | | | Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests) | | | | | | | | | | | | | |
|--|---|--|--|---|---------------|--|------------|---|--------|--------------|----------|--------------|-----------------|----------------|-----------------|-----------------|----------------------|-------|--|
| Company: Minnow Environmental Inc. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL) | | | | R <input checked="" type="checkbox"/> Regular (Standard TAT if received by 3 pm - business days) | | | | | | | | | | | | | |
| Contact: Pierre Stecko | | Quality Control (QC) Report with Report <input type="checkbox"/> Yes <input type="checkbox"/> No | | | | P <input type="checkbox"/> Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT | | | | | | | | | | | | | |
| Address: 101 - 1025 Hillside Ave. Victoria, BC, V8T 2A2 | | <input type="checkbox"/> Criteria on Report - provide details below if box checked | | | | E <input type="checkbox"/> Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT | | | | | | | | | | | | | |
| Phone: (250) 595-1627 x24 (250) 709-5533 | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | E2 <input type="checkbox"/> Same day or weekend emergency - contact ALS to confirm TAT and surcharge | | | | | | | | | | | | | |
| Invoice To Same as Report To <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | | Email 1 or Fax pstecko@minnow.ca | | | | Specify Date Required for E2,E or P: | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | | Email 2 RyanH@mintomine.com | | | | Analysis Request | | | | | | | | | | | | | |
| Company: Capstone - Minto Mine | | Invoice Distribution | | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | |
| Contact: Ryan Herbert | | Select Invoice Distribution: <input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | |
| ALS Quote #: Q58355 | | Approver ID: | | Cost Center: | | | | | | | | | | | | | | | |
| Job #: 15-87 | | GL Account: | | Routing Code: | | | | | | | | | | | | | | | |
| PO / AFE: | | Activity Code: | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Selam Worku | | Sampler: | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (h:k:mm) | Sample Type | ALK-COL-VA | TDS-VA | TSS-VA | NO3-L-IC-NVA | TKN-F-VA | NH3-F-VA | P-T-PRES-COL-VA | CARBONS-DOC-VA | MET-DIS-COME-VA | MET-TOT-COME-VA | Number of Containers | | |
| | REF-10 | | | 23-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | |
| | REF-9x | | | 23-09-16 | | Water | R | R | R | R | R | R | R | R | R | R | 7 | | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report (client Use) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | | | | | | Ice packs Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | |
| | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | | | | | | | | |
| | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | |
| | | | | | | 0.8, 0.9, 1.2 0.6 | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | |
| Released by:  | | Date: Sept 26 | | Time: 10:00 | | Received by:  | | Date: 26-SEP-16 | | Time: 9:55 | | Received by: | | | | Date: | | Time: | |

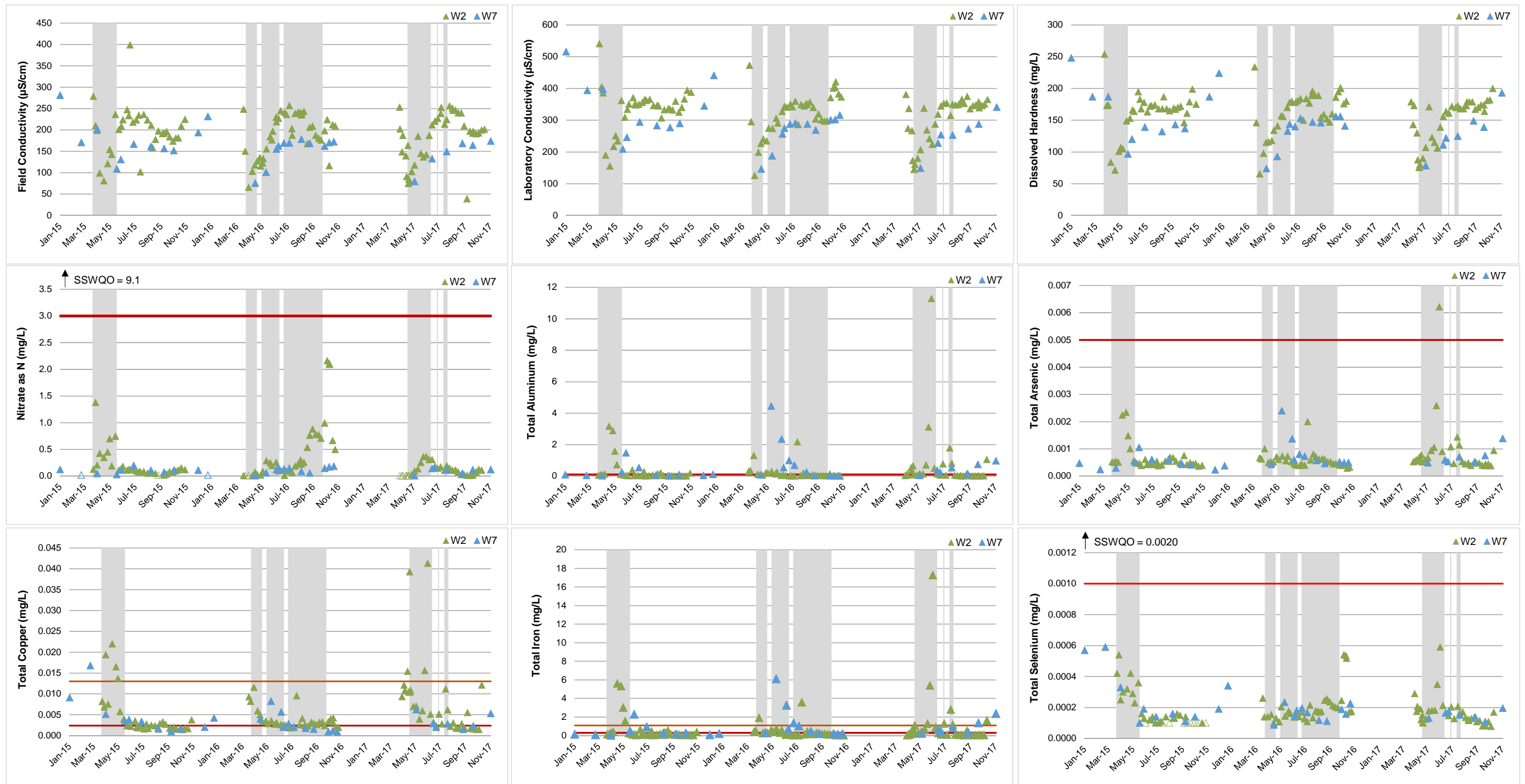


Figure C.1: Concentrations of Key Analytes of Routine Water Quality Monitoring under MMER at Lower Minto Creek (Station W2) and the Reference Tributary (Station W7), 2015 - 2017

Notes: Grey shading indicates periods of Water Storage Pond discharge.

Symbols that are unfilled are less than method detection limits.

Red line represents water quality (WQ) guidelines (CCME 1999 with updates). For total aluminum and arsenic, this line represents both WQ guidelines and site-specific water quality objectives (SSWQ).

Orange line represents SSWQ for Station W2 per the Minto Mine Water Use Licence. The SSWQ are applicable on a dissolved basis only for metals

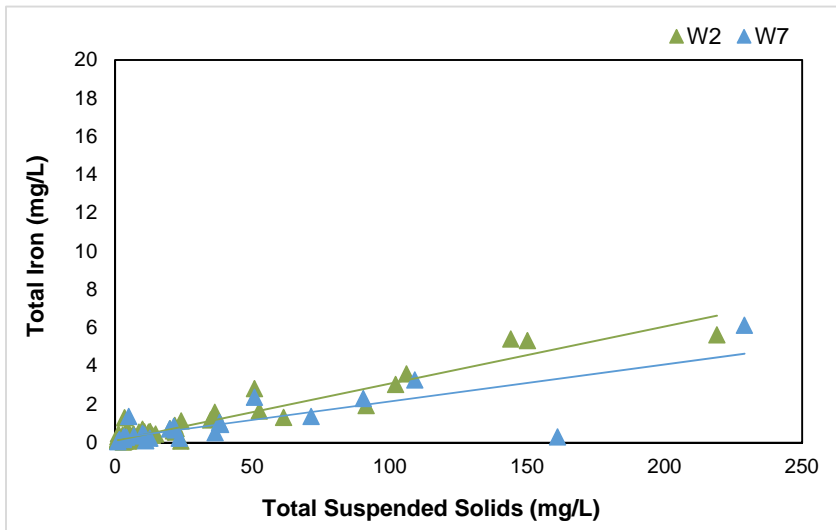
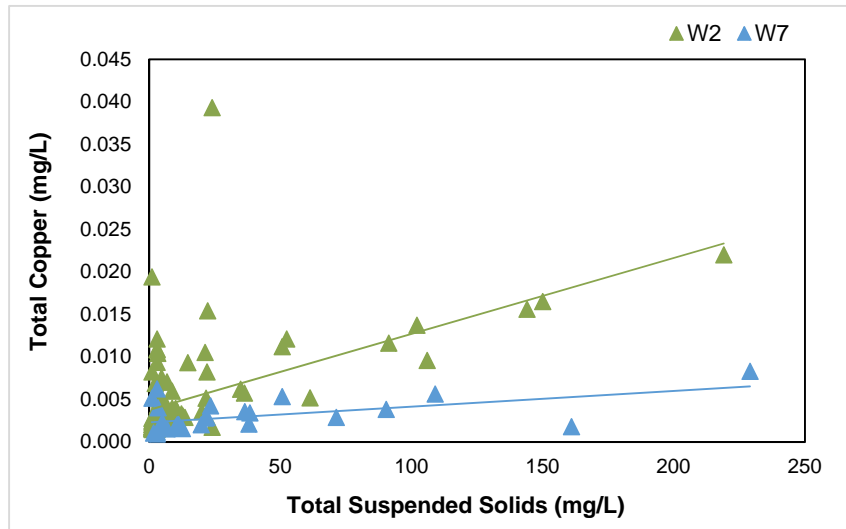
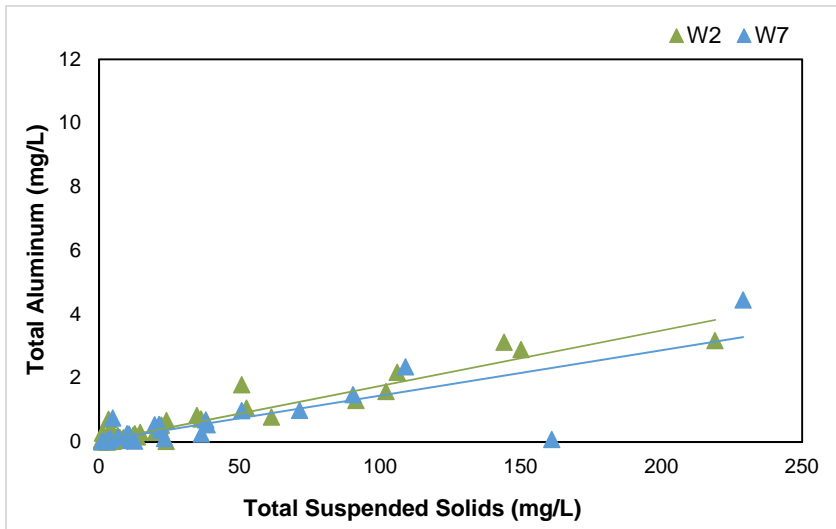


Figure C.2: Regression of Total Metal Concentrations (mg/L) relative to Total Suspended Solids (mg/L) in Routine Water Quality Monitoring Samples under MMER at Lower Minto Creek (Station W2) and the Reference Tributary (Station W7), 2015-2017

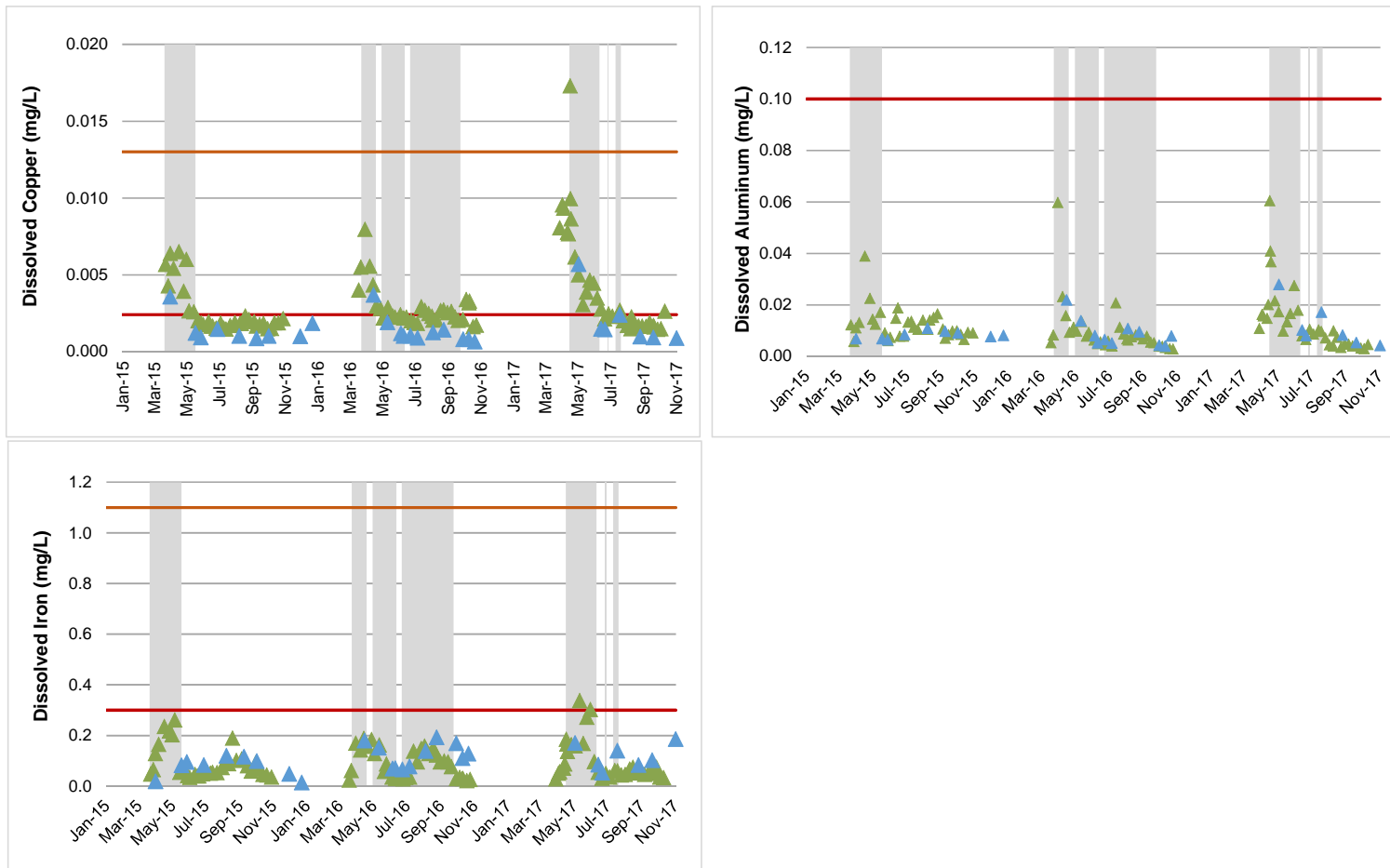


Figure C.3: Concentrations of Dissolved Metals of Routine Water Quality Monitoring under MMER at Lower Minto Creek (Station W2) and the Reference Tributary (Station W7), 2015 - 2017

Notes: Grey shading indicates periods of Water Storage Pond discharge.

Symbols that are unfilled are less than method detection limits.

Red line represents water quality (WQ) guidelines (CCME 1999 with updates). For dissolved aluminum, this line represents both WQ guidelines and site-specific water quality objectives (SSWQO). WQ guidelines are applicable on a total basis only for metals.

Orange line represents SSWQO for Station W2 per the Minto Mine Water Use Licence.

Table C.1: Minto Mine Routine EEM Water Quality Monitoring Data, 2014-2017

| Analytes | | Station W7 (Reference) | | | | | | | | | |
|-------------------------|----------|------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | | 2014 | | | | | 2015 | | | | |
| | | 5-May-14 | 30-Jun-14 | 9-Aug-14 | 31-Oct-14 | 2014 MEAN | 31-May-15 | 11-Jul-15 | 21-Aug-15 | 15-Oct-15 | 2015 MEAN |
| Water Temperature | °C | -0.1 | 2.5 | 2.3 | -1.6 | 0.8 | 0 | 1.2 | 3.0 | 0 | 1.1 |
| Field Conductivity | µS/cm | 59 | 171 | 186 | 199 | 153 | 109 | 167 | 161 | 152 | 147 |
| Laboratory Conductivity | µS/cm | 105 | 278 | 291 | 304 | 245 | 209 | 294 | 283 | 290 | 269 |
| Dissolved Oxygen | mg/L | 14.4 | 12.1 | 12.9 | 13.4 | 13.2 | 13.3 | 10.7 | 11.8 | 12.3 | 12.0 |
| pH | pH units | 8.19 | 8.11 | 7.92 | 7.29 | 7.88 | 7.51 | 7.67 | 7.85 | 7.53 | 7.64 |
| Total Hardness | mg/L | 52 | 135 | 143 | 164 | 124 | 104 | 145 | 164 | 154 | 142 |
| Dissolved Hardness | mg/L | 53 | 129 | 133 | 159 | 119 | 97 | 139 | 132 | 137 | 126 |
| Total Alkalinity | mg/L | 48 | 130 | 142 | 150 | 118 | 100 | 143 | 140 | 138 | 130 |
| Total Ammonia | mg/L | 0.014 | 0.025 | 0.025 | 0.022 | 0.022 | 0.014 | 0.039 | 0.043 | 0.038 | 0.034 |
| Nitrate | mg/L | <0.02 | 0.20 | 0.16 | 0.20 | 0.15 | 0.0290 | 0.20 | 0.11 | 0.11 | 0.11 |
| TSS | mg/L | 3.5 | 4.5 | 2.9 | 2.6 | 3.4 | 36.4 | 38.4 | 161 | 4.1 | 60.0 |
| Total Aluminum | mg/L | 0.12 | 0.10 | 0.032 | 0.010 | 0.065 | 0.25 | 0.53 | 0.074 | 0.097 | 0.24 |
| Total Arsenic | mg/L | 0.00049 | 0.00040 | 0.00049 | 0.00044 | 0.00046 | 0.00051 | 0.00061 | 0.00062 | 0.00041 | 0.00054 |
| Total Cadmium | mg/L | 0.000026 | 0.000012 | <0.000010 | <0.000010 | 0.000015 | <0.00001 | 0.000011 | <0.00001 | <0.00001 | 0.000010 |
| Total Copper | mg/L | 0.0062 | 0.0021 | 0.0012 | 0.00098 | 0.0026 | 0.0035 | 0.0034 | 0.0018 | 0.0016 | 0.0026 |
| Total Iron | mg/L | 0.40 | 0.18 | 0.18 | 0.15 | 0.23 | 0.50 | 0.95 | 0.29 | 0.27 | 0.50 |
| Total Lead | mg/L | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0002 | <0.0002 | 0.00027 | <0.0002 | <0.0002 | 0.00022 |
| Total Mercury | mg/L | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 |
| Total Molybdenum | mg/L | <0.0010 | 0.0015 | 0.0016 | 0.0015 | 0.0014 | 0.0013 | 0.0015 | 0.0019 | 0.0014 | 0.0015 |
| Total Nickel | mg/L | 0.0019 | <0.0010 | <0.0010 | <0.0010 | 0.0012 | 0.0014 | 0.0023 | 0.0014 | 0.0010 | 0.0015 |
| Total Selenium | mg/L | 0.00011 | 0.00018 | 0.00030 | 0.00016 | 0.00019 | 0.00010 | 0.00014 | 0.00016 | 0.00014 | 0.00014 |
| Total Zinc | mg/L | 0.0059 | <0.0050 | <0.0050 | <0.0050 | 0.0052 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |

| Analytes | | Station W2 (Effluent-Exposed) | | | | | | | | | |
|-------------------------|----------|-------------------------------|-----------|-----------|-----------|-----------|----------|-----------|-----------|----------|-----------|
| | | 2014 | | | | | 2015 | | | | |
| | | 5-May-14 | 30-Jun-14 | 7-Aug-14 | 31-Oct-14 | 2014 MEAN | 9-May-15 | 15-Jun-15 | 13-Aug-15 | 5-Oct-15 | 2015 MEAN |
| Water Temperature | °C | 0.3 | 8.7 | 6.6 | -1.4 | 3.6 | 2.5 | 6.5 | 6.7 | 0 | 3.9 |
| Field Conductivity | µS/cm | 77 | 239 | 237 | 188 | 185 | 121 | 224 | 223 | 184 | 188 |
| Laboratory Conductivity | µS/cm | 77 | 239 | 237 | 188 | 185 | 217 | 351 | 346 | 360 | 319 |
| Dissolved Oxygen | mg/L | 14.4 | 11.0 | 13.7 | 14.3 | 13.4 | 14.3 | 10.8 | 11.6 | 14.5 | 12.8 |
| pH | pH units | 8.22 | 8.30 | 8.08 | 7.69 | 8.07 | 7.60 | 7.87 | 8.09 | 7.92 | 7.87 |
| Total Hardness | mg/L | 69 | 167 | 180 | 176 | 148 | 115 | 172 | 176 | 178 | 160 |
| Dissolved Hardness | mg/L | 66 | 158 | 164 | 204 | 148 | 101 | 164 | 168 | 172 | 151 |
| Total Alkalinity | mg/L | 61 | 151 | 154 | 181 | 137 | 85 | 154 | 164 | 165 | 142 |
| Total Ammonia | mg/L | 0.021 | 0.040 | 0.014 | 0.0091 | 0.021 | 0.028 | 0.030 | 0.039 | 0.013 | 0.028 |
| Nitrate | mg/L | 0.0540 | 0.0490 | 0.12 | 0.18 | 0.10 | 0.45 | 0.18 | 0.0520 | 0.0860 | 0.19 |
| TSS | mg/L | 54.4 | <1.0 | 4.2 | <1.0 | 15.2 | 150 | 1.3 | 2.6 | <1.0 | 38.7 |
| Total Aluminum | mg/L | 0.90 | 0.051 | 0.16 | 0.014 | 0.28 | 2.9 | 0.020 | 0.058 | 0.007 | 0.74 |
| Total Arsenic | mg/L | 0.00096 | 0.00052 | 0.00072 | 0.00032 | 0.00063 | 0.0023 | 0.00039 | 0.00055 | 0.00043 | 0.00093 |
| Total Cadmium | mg/L | 0.000028 | 0.000020 | <0.000010 | <0.000010 | 0.000017 | 0.000054 | <0.00001 | <0.00001 | <0.00001 | 0.000021 |
| Total Copper | mg/L | 0.0070 | 0.0034 | 0.0022 | 0.0016 | 0.0036 | 0.017 | 0.0022 | 0.0024 | 0.0015 | 0.0057 |
| Total Iron | mg/L | 1.7 | 0.12 | 0.49 | 0.083 | 0.60 | 5.3 | 0.069 | 0.21 | 0.065 | 1.4 |
| Total Lead | mg/L | 0.00049 | <0.00020 | <0.00020 | <0.00020 | 0.00027 | 0.00154 | <0.0002 | <0.0002 | <0.0002 | 0.00054 |
| Total Mercury | mg/L | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 |
| Total Molybdenum | mg/L | <0.0010 | 0.0016 | 0.0015 | 0.0012 | 0.0013 | 0.0015 | 0.0015 | 0.0016 | 0.0014 | 0.0015 |
| Total Nickel | mg/L | 0.0032 | 0.0011 | 0.0013 | 0.0011 | 0.0017 | 0.0069 | <0.001 | 0.0010 | <0.001 | 0.0025 |
| Total Selenium | mg/L | 0.00014 | 0.00013 | 0.00010 | <0.00010 | 0.00012 | 0.00042 | <0.0001 | <0.0001 | <0.0001 | 0.00018 |
| Total Zinc | mg/L | 0.0060 | 0.0053 | <0.0050 | <0.0050 | 0.0053 | 0.013 | <0.005 | <0.005 | <0.005 | 0.0071 |

¹ If greater than 50% of samples were less than method detection limit, the mean was presented with a less than symbol (<)

Note: Only water quality data presented for 2015 to 2017 pertain to the Phase 4 EEM. Water quality data from 2014 collected following the completion of the Phase 3 EEM are included herein for informational purposes only.

Table C.1: Minto Mine Routine EEM Water Quality Monitoring Data, 2014-2017

| Analytes | | Station W7 (Reference) | | | | | | | | | | | | |
|-------------------------|----------|------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|-----------|--------------|----------------|-----------------|
| | | 2016 | | | | | 2017 | | | | | 2015 to 2017 | | |
| | | 28-Apr-16 | 23-Jun-16 | 17-Aug-16 | 23-Oct-16 | 2016 MEAN | 16-May-17 | 27-Jun-17 | 1-Aug-17 | 3-Oct-17 | 2017 MEAN | MEAN | 5th Percentile | 95th Percentile |
| Water Temperature | °C | 0.1 | 3.1 | 4.5 | -0.1 | 1.9 | -0.1 | 2.3 | 4.0 | 0.8 | 1.8 | 1.6 | -0.10 | 4.5 |
| Field Conductivity | µS/cm | 76 | 163 | 178 | 170 | 147 | 80 | 133 | 149 | 164 | 132 | 142 | 76 | 178 |
| Laboratory Conductivity | µS/cm | 146 | 275 | 288 | 302 | 253 | 149 | 228 | 253 | 288 | 230 | 250 | 146 | 302 |
| Dissolved Oxygen | mg/L | 15.4 | 11.4 | 11.8 | 12.0 | 12.7 | 15.0 | 12.5 | 11.9 | 13.7 | 13.3 | 12.6 | 10.7 | 15.4 |
| pH | pH units | 7.72 | 7.62 | 7.81 | 7.68 | 7.71 | 7.58 | 8.13 | 7.58 | 7.50 | 7.70 | 7.68 | 7.50 | 8.13 |
| Total Hardness | mg/L | - | - | - | - | - | - | - | - | - | - | 142 | - | - |
| Dissolved Hardness | mg/L | 74 | 144 | 147 | 156 | 130 | 78 | 111 | 125 | 139 | 113 | 123 | 74 | 156 |
| Total Alkalinity | mg/L | 70 | 134 | 157 | 164 | 131 | 76 | 118 | 127 | 150 | 118 | 126 | 70 | 164 |
| Total Ammonia | mg/L | 0.0069 | 0.015 | 0.016 | 0.027 | 0.016 | 0.0070 | 0.011 | 0.014 | 0.015 | 0.012 | 0.020 | 0.0069 | 0.043 |
| Nitrate | mg/L | 0.0063 | 0.15 | 0.0883 | 0.17 | 0.10 | 0.0050 | 0.14 | 0.12 | 0.12 | 0.10 | 0.10 | 0.0050 | 0.20 |
| TSS | mg/L | 3.3 | 19.8 | 10.0 | <3.0 | 9.0 | <3.0 | 22.0 | 21.4 | 4.9 | 12.8 | 27.3 | <3.0 | 161 |
| Total Aluminum | mg/L | 0.073 | 0.54 | 0.26 | 0.014 | 0.22 | 0.041 | 0.37 | 0.54 | 0.74 | 0.42 | 0.29 | 0.014 | 0.74 |
| Total Arsenic | mg/L | 0.00043 | 0.00059 | 0.00057 | 0.00049 | 0.00052 | 0.00049 | 0.00059 | 0.00071 | 0.00075 | 0.00064 | 0.00056 | 0.00041 | 0.00075 |
| Total Cadmium | mg/L | 0.0000091 | 0.0000058 | <0.000005 | <0.000005 | 0.0000062 | 0.0000082 | 0.000010 | 0.000011 | 0.000014 | 0.000011 | 0.0000083 | <0.000005 | 0.000014 |
| Total Copper | mg/L | 0.0040 | 0.0020 | 0.0018 | 0.0012 | 0.0022 | 0.0062 | 0.0029 | 0.0028 | 0.0023 | 0.0035 | 0.0028 | 0.0012 | 0.0062 |
| Total Iron | mg/L | 0.31 | 0.70 | 0.47 | 0.15 | 0.41 | 0.23 | 0.66 | 0.85 | 1.4 | 0.77 | 0.56 | 0.15 | 1.4 |
| Total Lead | mg/L | <0.000050 | 0.00026 | 0.00014 | <0.000050 | 0.00013 | <0.00005 | 0.00019 | 0.00021 | 0.00039 | 0.00021 | 0.00016 | <0.00005 | 0.00039 |
| Total Mercury | mg/L | 0.000012 | <0.000005 | <0.000005 | <0.000005 | 0.0000068 | <0.000005 | <0.000005 | <0.000005 | <0.0000050 | <0.000005 | 0.0000056 | <0.000005 | 0.000012 |
| Total Molybdenum | mg/L | 0.00073 | 0.0016 | 0.0016 | 0.0013 | 0.0013 | 0.00081 | 0.0016 | 0.0014 | 0.0013 | 0.0013 | 0.0014 | 0.00073 | 0.0019 |
| Total Nickel | mg/L | 0.0015 | 0.0018 | 0.0017 | 0.00088 | 0.0015 | 0.0018 | 0.0020 | 0.0021 | 0.0028 | 0.0022 | 0.0017 | 0.00088 | 0.0028 |
| Total Selenium | mg/L | 0.000087 | 0.00018 | 0.00012 | 0.00016 | 0.00014 | 0.00013 | 0.00016 | 0.00015 | 0.00011 | 0.00014 | 0.00014 | 0.000087 | 0.00018 |
| Total Zinc | mg/L | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.003 | <0.003 | <0.003 | 0.0032 | 0.0055 | 0.0037 | 0.0032 | <0.003 | 0.0055 |

| Analytes | | Station W7 (Reference) | | | | | | | | | |
|-------------------------|----------|------------------------|------------|------------|------------|-----------|-----------|-----------|-----------|------------|-----------|
| | | 2016 | | | | | 2017 | | | | |
| | | 27-Apr-16 | 23-Jun-16 | 17-Aug-16 | 23-Oct-16 | 2016 MEAN | 16-May-17 | 27-Jun-17 | 1-Aug-17 | 3-Oct-17 | 2017 MEAN |
| Water Temperature | °C | 0.2 | 6.8 | 7.0 | 0 | 3.5 | 1.5 | 6.0 | 6.7 | 0.8 | 3.8 |
| Field Conductivity | µS/cm | 118 | 227 | 235 | 117 | 174 | 118 | 212 | 224 | 193 | 187 |
| Laboratory Conductivity | µS/cm | 227 | 344 | 349 | 404 | 331 | 207 | 319 | 350 | 358 | 309 |
| Dissolved Oxygen | mg/L | 14.4 | 10.8 | 11.9 | 13.1 | 12.6 | 14.6 | 10.9 | 11.8 | 14.4 | 12.9 |
| pH | pH units | 7.95 | 7.81 | 8.06 | 7.87 | 7.92 | 7.69 | 7.96 | 7.81 | 7.47 | 7.73 |
| Total Hardness | mg/L | - | - | - | - | - | - | - | - | - | - |
| Dissolved Hardness | mg/L | 115 | 178 | 196 | 201 | 173 | 107 | 156 | 173 | 174 | 153 |
| Total Alkalinity | mg/L | 95 | 158 | 176 | 176 | 151 | 99 | 150 | 168 | 174 | 148 |
| Total Ammonia | mg/L | <0.005 | <0.005 | 0.0061 | 0.0055 | 0.0054 | 0.0062 | 0.013 | 0.0061 | <0.005 | 0.0077 |
| Nitrate | mg/L | 0.0717 | 0.10 | 0.22 | 2.11 | 0.63 | 0.0935 | 0.31 | 0.20 | 0.0162 | 0.15 |
| TSS | mg/L | 4.0 | 8.0 | <3.0 | <3.0 | 4.5 | 6.7 | 7.4 | 34.8 | 23.9 | 18.2 |
| Total Aluminum | mg/L | 0.10 | 0.071 | 0.041 | 0.029 | 0.061 | 0.16 | 0.14 | 0.82 | 0.010 | 0.28 |
| Total Arsenic | mg/L | 0.00053 | 0.00045 | 0.00058 | 0.00045 | 0.00050 | 0.00068 | 0.00061 | 0.0011 | 0.00038 | 0.00070 |
| Total Cadmium | mg/L | 0.0000091 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000060 | 0.000016 | <0.000005 | 0.000015 | 0.0000068 | 0.000011 |
| Total Copper | mg/L | 0.0050 | 0.0025 | 0.0023 | 0.0032 | 0.0033 | 0.0071 | 0.0032 | 0.0062 | 0.0017 | 0.0045 |
| Total Iron | mg/L | 0.35 | 0.14 | 0.23 | 0.081 | 0.20 | 0.44 | 0.28 | 1.2 | 0.078 | 0.49 |
| Total Lead | mg/L | 0.000065 | <0.000050 | <0.000050 | <0.000050 | 0.000054 | 0.000083 | 0.000077 | 0.00032 | <0.000050 | 0.00013 |
| Total Mercury | mg/L | 0.000010 | <0.000005 | <0.000005 | <0.000005 | 0.0000063 | <0.000005 | <0.000005 | <0.000005 | <0.0000050 | <0.000005 |
| Total Molybdenum | mg/L | 0.0012 | 0.0014 | 0.0017 | 0.0022 | 0.0016 | 0.0011 | 0.0019 | 0.0018 | 0.0014 | 0.0015 |
| Total Nickel | mg/L | 0.0015 | 0.0012 | 0.0012 | 0.00084 | 0.0012 | 0.0018 | 0.0014 | 0.0028 | 0.0010 | 0.0018 |
| Total Selenium | mg/L | 0.00010 | 0.00014 | 0.00017 | 0.00054 | 0.00024 | 0.00018 | 0.00017 | 0.00016 | 0.000085 | 0.00015 |
| Total Zinc | mg/L | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.003 | 0.0056 | <0.003 | 0.0042 | <0.0030 | 0.0040 |

¹ If greater than 50% of samples were less than method detection limit, the mean was presented with a less than symbol (<)

Note: Only water quality data presented for 2015 to 2017 pertain to the Phase 4 EEM. Water quality data from 2014 collected following the completion of the Phase 3 EEM are included herein for informational purposes only.

Table C.2: In-situ Water Quality and Physical Measures at Benthic Community Sites, Minto Mine Phase 4 EEM, September 2016

| Area | Station | Temperature (°C) | Specific Conductance (µs/cm) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (%) | pH (pH units) | Water Velocity (m/s) | Mean Depth (m) | Median Intermediate Axis (cm) | |
|-------------------------------------|--------------------|------------------|------------------------------|-------------------------|----------------------|---------------|----------------------|----------------|-------------------------------|----|
| Water Quality Guidelines | | - | - | 6.5 | - | 6.5 - 9.0 | - | - | - | |
| Reference Creeks | REF-1 | 0.0 | 131.6 | 12.86 | 88.1 | 7.74 | 0.48 | 0.11 | 4.2 | |
| | REF-2 | 0.8 | 137.2 | 13.45 | 93.9 | 8.07 | 0.56 | 0.15 | 4.2 | |
| | REF-3 | 0.5 | 209.2 | 13.65 | 94.7 | 7.94 | 0.65 | 0.09 | 4.9 | |
| | REF-4 | 1.3 | 110.7 | 13.44 | 95.3 | 7.69 | 0.42 | 0.22 | 3.5 | |
| | REF-5 | 0.9 | 232.1 | 13.32 | 93.5 | 7.91 | 0.68 | 0.13 | 4.5 | |
| | REF-6 | 0.1 | 265.1 | 13.63 | 93.6 | 8.05 | 0.37 | 0.22 | 3.1 | |
| | REF-7 | 2.0 | 389.1 | 13.50 | 97.6 | 8.32 | 0.57 | 0.10 | 4.8 | |
| | REF-8 | 0.0 | 221.2 | 13.66 | 93.4 | 7.97 | 0.52 | 0.15 | 4.5 | |
| | REF-9 | 3.0 | 275.1 | 13.01 | 96.7 | 8.26 | 0.55 | 0.11 | 5.5 | |
| | REF-10 | 1.3 | 73.9 | 13.67 | 96.2 | 7.66 | 0.63 | 0.12 | 4.2 | |
| | n | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | mean | 0.99 | 205 | 13.4 | 94.3 | 7.96 | 0.54 | 0.14 | 4.3 | |
| | median | 0.85 | 215 | 13.5 | 94.3 | 7.96 | 0.56 | 0.13 | 4.4 | |
| | minimum | 0.00 | 74 | 12.9 | 88.1 | 7.66 | 0.37 | 0.09 | 3.1 | |
| maximum | 3.00 | 389 | 13.7 | 97.6 | 8.32 | 0.68 | 0.22 | 5.5 | | |
| standard deviation | 0.96 | 94 | 0.28 | 2.6 | 0.22 | 0.10 | 0.05 | 0.7 | | |
| standard error | 0.30 | 30 | 0.09 | 0.83 | 0.07 | 0.03 | 0.01 | 0.2 | | |
| Upper Minto Creek (Exposure) | UMC-1 | 9.0 | 267.9 | 10.07 | 87.1 | 7.91 | 0.60 | 0.12 | 4.7 | |
| | UMC-2 | 8.9 | 268.1 | 10.20 | 88.1 | 7.92 | 0.61 | 0.12 | 3.5 | |
| | UMC-3 | 8.9 | 264.4 | 10.27 | 88.7 | 7.81 | 0.56 | 0.11 | 3.5 | |
| | UMC-4 | 7.1 | 273.0 | 11.08 | 91.5 | 7.98 | 0.58 | 0.13 | 4.1 | |
| | UMC-5 | 9.1 | 267.7 | 10.14 | 88.0 | 7.96 | 0.65 | 0.09 | 3.8 | |
| | n | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | |
| | mean | 8.60 | 268 | 10.4 | 88.7 | 7.92 | 0.60 | 0.11 | 3.9 | |
| | median | 8.90 | 268 | 10.2 | 88.1 | 7.92 | 0.60 | 0.12 | 3.8 | |
| | minimum | 7.10 | 264 | 10.1 | 87.1 | 7.81 | 0.56 | 0.09 | 3.5 | |
| | maximum | 9.10 | 273 | 11.1 | 91.5 | 7.98 | 0.65 | 0.13 | 4.7 | |
| | standard deviation | 0.84 | 3.08 | 0.41 | 1.7 | 0.07 | 0.03 | 0.02 | 0.5 | |
| standard error | 0.38 | 1.38 | 0.18 | 0.7 | 0.03 | 0.02 | 0.01 | 0.2 | | |

Table C.3: Intermediate Axis Length and Embeddedness of 100 Cobble Washed during Surber Sampling at Benthic Invertebrate Stations, Minto Mine Phase 4 EEM, 2016

| Cobble Number | Ref-1 | | Ref-2 | | Ref-3 | | Ref-4 | | Ref-5 | |
|-----------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|
| | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) |
| 1 | 6.3 | - | 3.4 | - | 3.4 | - | 5.0 | - | 8.7 | - |
| 2 | 4.6 | - | 4.3 | - | 8.4 | - | 2.7 | - | 10.6 | - |
| 3 | 4.0 | - | 7.4 | - | 10.5 | - | 3.5 | - | 3.2 | - |
| 4 | 7.0 | - | 5.7 | - | 9.0 | - | 3.0 | - | 9.1 | - |
| 5 | 7.8 | - | 7.7 | - | 8.9 | - | 5.4 | - | 4.5 | - |
| 6 | 7.6 | - | 5.7 | - | 6.8 | - | 2.8 | - | 6.3 | - |
| 7 | 5.0 | - | 5.6 | - | 4.9 | - | 3.3 | - | 5.7 | - |
| 8 | 3.3 | - | 3.4 | - | 5.3 | - | 4.8 | - | 6.5 | - |
| 9 | 4.6 | - | 6.7 | - | 4.0 | - | 2.7 | - | 7.5 | - |
| 10 | 4.0 | 25 | 5.5 | 50 | 3.5 | 75 | 3.3 | 50 | 6.0 | 50 |
| 11 | 4.5 | - | 6.6 | - | 3.8 | - | 3.4 | - | 3.4 | - |
| 12 | 6.7 | - | 8.5 | - | 3.8 | - | 5.6 | - | 3.4 | - |
| 13 | 4.5 | - | 6.5 | - | 2.5 | - | 2.8 | - | 5.1 | - |
| 14 | 5.5 | - | 7.9 | - | 7.0 | - | 4.7 | - | 3.3 | - |
| 15 | 4.4 | - | 6.2 | - | 6.0 | - | 3.3 | - | 11.6 | - |
| 16 | 3.3 | - | 5.5 | - | 3.8 | - | 3.5 | - | 5.2 | - |
| 17 | 3.3 | - | 4.6 | - | 2.0 | - | 3.0 | - | 3.1 | - |
| 18 | 5.4 | - | 3.2 | - | 3.0 | - | 2.7 | - | 3.1 | - |
| 19 | 10.2 | - | 9.0 | - | 3.5 | - | 5.4 | - | 2.1 | - |
| 20 | 3.5 | 25 | 3.3 | 0 | 4.7 | 25 | 2.2 | 0 | 2.7 | 0 |
| 21 | 4.5 | - | 2.6 | - | 5.4 | - | 4.0 | - | 3.6 | - |
| 22 | 3.0 | - | 12.5 | - | 8.8 | - | 3.5 | - | 2.7 | - |
| 23 | 3.0 | - | 5.0 | - | 6.7 | - | 2.8 | - | 3.4 | - |
| 24 | 3.0 | - | 3.8 | - | 5.8 | - | 4.6 | - | 1.8 | - |
| 25 | 4.6 | - | 4.9 | - | 7.8 | - | 3.0 | - | 6.8 | - |
| 26 | 4.9 | - | 6.5 | - | 4.9 | - | 5.2 | - | 5.6 | - |
| 27 | 7.4 | - | 3.2 | - | 14.0 | - | 4.6 | - | 9.4 | - |
| 28 | 3.3 | - | 6.1 | - | 5.3 | - | 2.5 | - | 4.0 | - |
| 29 | 5.6 | - | 3.9 | - | 7.1 | - | 3.4 | - | 11.7 | - |
| 30 | 6.3 | 50 | 4.9 | 75 | 7.8 | 50 | 3.4 | 0 | 2.1 | 0 |
| 31 | 4.5 | - | 5.3 | - | 3.8 | - | 3.0 | - | 11.1 | - |
| 32 | 6.3 | - | 7.2 | - | 3.2 | - | 3.2 | - | 7.4 | - |
| 33 | 2.4 | - | 6.4 | - | 2.9 | - | 2.3 | - | 6.3 | - |
| 34 | 2.2 | - | 5.5 | - | 9.5 | - | 4.1 | - | 7.2 | - |
| 35 | 2.2 | - | 7.0 | - | 3.9 | - | 4.9 | - | 5.5 | - |
| 36 | 2.6 | - | 5.5 | - | 13.5 | - | 2.9 | - | 4.6 | - |
| 37 | 4.6 | - | 3.0 | - | 5.7 | - | 3.1 | - | 3.7 | - |
| 38 | 3.1 | - | 6.9 | - | 9.0 | - | 5.0 | - | 4.0 | - |
| 39 | 3.4 | - | 2.6 | - | 6.4 | - | 4.1 | - | 4.6 | - |
| 40 | 4.3 | 50 | 8.4 | 0 | 5.4 | 75 | 3.5 | 0 | 4.5 | - |
| 41 | 4.0 | - | 5.4 | - | 5.7 | - | 2.8 | - | 3.3 | - |
| 42 | 3.6 | - | 6.6 | - | 4.9 | - | 2.4 | - | 4.1 | - |
| 43 | 3.0 | - | 3.1 | - | 10.5 | - | 3.6 | - | 2.4 | - |
| 44 | 3.3 | - | 5.4 | - | 3.3 | - | 3.9 | - | 3.5 | - |
| 45 | 3.8 | - | 9.7 | - | 5.2 | - | 4.7 | - | 2.6 | - |
| 46 | 2.5 | - | 4.0 | - | 5.3 | - | 3.0 | - | 4.7 | - |
| 47 | 3.6 | - | 5.1 | - | 3.6 | - | 4.5 | - | 8.9 | - |
| 48 | 2.3 | - | 9.0 | - | 3.4 | - | 3.5 | - | 3.8 | - |
| 49 | 2.4 | - | 3.9 | - | 4.3 | - | 6.2 | - | 9.6 | - |
| 50 | 3.0 | 25 | 4.6 | 75 | 4.6 | 25 | 3.8 | 0 | 6.2 | - |
| 51 | 6.0 | - | 4.2 | - | 2.8 | - | 2.5 | - | 3.1 | - |
| 52 | 4.3 | - | 6.2 | - | 2.5 | - | 3.0 | - | 3.7 | - |
| 53 | 6.1 | - | 3.1 | - | 3.4 | - | 4.7 | - | 4.0 | - |
| 54 | 4.5 | - | 4.6 | - | 3.5 | - | 3.2 | - | 2.9 | - |
| 55 | 4.3 | - | 4.3 | - | 3.9 | - | 3.5 | - | 4.5 | - |
| 56 | 8.3 | - | 2.9 | - | 2.9 | - | 3.0 | - | 5.0 | - |
| 57 | 3.7 | - | 3.6 | - | 7.6 | - | 3.5 | - | 4.3 | - |
| 58 | 4.4 | - | 3.2 | - | 3.3 | - | 2.5 | - | 6.7 | - |
| 59 | 9.0 | - | 2.8 | - | 4.8 | - | 4.0 | - | 9.0 | - |
| 60 | 5.5 | 0 | 2.4 | 75 | 7.5 | 0 | 3.5 | 25 | 5.2 | 75 |
| 61 | 6.2 | - | 3.4 | - | 7.3 | - | 2.7 | - | 7.8 | - |
| 62 | 3.9 | - | 3.1 | - | 6.3 | - | 2.8 | - | 3.0 | - |
| 63 | 3.3 | - | 3.3 | - | 6.5 | - | 7.5 | - | 5.1 | - |
| 64 | 3.4 | - | 3.1 | - | 3.5 | - | 2.0 | - | 2.4 | - |
| 65 | 4.5 | - | 4.1 | - | 3.3 | - | 3.8 | - | 4.4 | - |
| 66 | 3.8 | - | 2.9 | - | 4.1 | - | 2.5 | - | 4.1 | - |
| 67 | 4.4 | - | 2.7 | - | 2.9 | - | 6.7 | - | 4.0 | - |
| 68 | 4.0 | - | 4.0 | - | 5.0 | - | 2.6 | - | 2.9 | - |
| 69 | 4.8 | - | 3.3 | - | 7.2 | - | 5.2 | - | 3.2 | - |
| 70 | 3.7 | 50 | 2.9 | 0 | 13.5 | 25 | 3.4 | 25 | 3.4 | 0 |
| 71 | 2.8 | - | 4.0 | - | 3.7 | - | 3.8 | - | 3.4 | - |
| 72 | 3.6 | - | 9.1 | - | 3.1 | - | 4.9 | - | 2.5 | - |
| 73 | 4.5 | - | 3.7 | - | 2.0 | - | 5.0 | - | 2.5 | - |
| 74 | 2.8 | - | 2.5 | - | 1.9 | - | 3.5 | - | 4.5 | - |
| 75 | 3.0 | - | 5.2 | - | 4.4 | - | 4.0 | - | 11.5 | - |
| 76 | 5.2 | - | 3.3 | - | 2.2 | - | 3.4 | - | 4.4 | - |
| 77 | 3.6 | - | 5.9 | - | 1.8 | - | 4.3 | - | 4.0 | - |
| 78 | 3.5 | - | 2.5 | - | 4.8 | - | 3.3 | - | 7.5 | - |
| 79 | 10.7 | - | 3.7 | - | 4.9 | - | 7.2 | - | 3.6 | - |
| 80 | 2.8 | 25 | 2.7 | 25 | 4.1 | 0 | 6.3 | 0 | 11.0 | 0 |
| 81 | 5.7 | - | 4.5 | - | 4.7 | - | 4.3 | - | 4.1 | - |
| 82 | 3.1 | - | 2.8 | - | 6.0 | - | 5.1 | - | 5.4 | - |
| 83 | 4.2 | - | 2.9 | - | 4.0 | - | 3.0 | - | 3.5 | - |
| 84 | 5.4 | - | 2.9 | - | 8.8 | - | 3.1 | - | 6.0 | - |
| 85 | 6.3 | - | 4.0 | - | 4.9 | - | 3.8 | - | 3.8 | - |
| 86 | 6.5 | - | 4.4 | - | 13.6 | - | 3.9 | - | 2.0 | - |
| 87 | 3.6 | - | 2.7 | - | 9.0 | - | 4.0 | - | 6.6 | - |
| 88 | 3.2 | - | 2.8 | - | 5.1 | - | 3.4 | - | 7.5 | - |
| 89 | 5.8 | - | 2.5 | - | 5.5 | - | 3.0 | - | 7.7 | - |
| 90 | 3.4 | 0 | 1.8 | 25 | 4.9 | 50 | 3.9 | 75 | 3.2 | 50 |
| 91 | 4.0 | - | 2.3 | - | 11.6 | - | 5.3 | - | 11.5 | - |
| 92 | 4.2 | - | 2.0 | - | 7.5 | - | 3.8 | - | 5.1 | - |
| 93 | 3.7 | - | 7.0 | - | 4.1 | - | 3.3 | - | 2.1 | - |
| 94 | 4.2 | - | 5.6 | - | 10.3 | - | 4.0 | - | 17.0 | - |
| 95 | 3.7 | - | 3.2 | - | 5.9 | - | 2.8 | - | 11.1 | - |
| 96 | 4.3 | - | 4.2 | - | 4.7 | - | 3.4 | - | 10.5 | - |
| 97 | 3.0 | - | 3.4 | - | 6.2 | - | 2.6 | - | 10.5 | - |
| 98 | 3.1 | - | 4.0 | - | 4.0 | - | 1.9 | - | 4.1 | - |
| 99 | 4.5 | - | 8.7 | - | 3.5 | - | 2.5 | - | 15.2 | - |
| 100 | 4.2 | 0 | 3.9 | 0 | 3.5 | 75 | 3.5 | 0 | 2.0 | 50 |
| Minimum | 2.2 | - | 1.8 | - | 1.8 | - | 1.9 | - | 1.8 | - |
| Maximum | 10.7 | - | 12.5 | - | 14.0 | - | 7.5 | - | 17.0 | - |
| Mean | 4.4 | - | 4.7 | - | 5.6 | - | 3.7 | - | 5.5 | - |
| Geometric mean | 4.2 | - | 4.4 | - | 5.0 | - | 3.6 | - | 4.8 | - |
| Median | 4.2 | 25.0 | 4.2 | 25.0 | 4.9 | 37.5 | 3.5 | 0.0 | 4.5 | 25.0 |

Note: intermediate axis length is the second longest axis on a cobble. Embeddedness refers to how deeply the cobble is surrounded or buried by other substrate.

Table C.3: Intermediate Axis Length and Embeddedness of 100 Cobble Washed during Surber Sampling at Benthic Invertebrate Stations, Minto Mine Phase 4 EEM, 2016

| Cobble Number | Ref-6 | | Ref-7 | | Ref-8 | | Ref-9 | | Ref-10 | |
|-----------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|
| | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) |
| 1 | 7.1 | - | 5.9 | - | 6.5 | - | 15.3 | - | 7.2 | - |
| 2 | 6.6 | - | 7.3 | - | 3.4 | - | 7.5 | - | 9.8 | - |
| 3 | 2.8 | - | 6.6 | - | 3.0 | - | 5.4 | - | 2.8 | - |
| 4 | 6.1 | - | 12.5 | - | 3.2 | - | 4.4 | - | 3.3 | - |
| 5 | 4.0 | - | 5.0 | - | 2.7 | - | 2.9 | - | 2.9 | - |
| 6 | 3.5 | - | 5.1 | - | 3.5 | - | 3.2 | - | 5.5 | - |
| 7 | 2.8 | - | 5.1 | - | 3.8 | - | 5.0 | - | 4.4 | - |
| 8 | 4.0 | - | 5.5 | - | 4.4 | - | 2.3 | - | 2.5 | - |
| 9 | 3.3 | - | 5.0 | - | 8.2 | - | 4.5 | - | 4.2 | - |
| 10 | 2.5 | 0 | 2.8 | 0 | 8.2 | 75 | 5.2 | 25 | 4.8 | 0 |
| 11 | 2.4 | - | 5.0 | - | 5.0 | - | 3.3 | - | 5.5 | - |
| 12 | 3.0 | - | 5.9 | - | 4.2 | - | 3.7 | - | 2.5 | - |
| 13 | 3.2 | - | 5.8 | - | 3.8 | - | 3.1 | - | 10.9 | - |
| 14 | 3.8 | - | 6.0 | - | 3.1 | - | 3.9 | - | 3.4 | - |
| 15 | 3.1 | - | 4.7 | - | 5.2 | - | 4.4 | - | 5.6 | - |
| 16 | 5.7 | - | 6.1 | - | 6.4 | - | 2.8 | - | 4.4 | - |
| 17 | 1.7 | - | 4.8 | - | 4.8 | - | 3.4 | - | 3.1 | - |
| 18 | 8.7 | - | 10.2 | - | 4.9 | - | 2.3 | - | 4.3 | - |
| 19 | 3.3 | - | 3.8 | - | 4.6 | - | 8.0 | - | 7.3 | - |
| 20 | 5.5 | 50 | 6.4 | 50 | 4.5 | 0 | 13.2 | 0 | 6.8 | 0 |
| 21 | 3.3 | - | 10.8 | - | 4.4 | - | 8.7 | - | 5.4 | - |
| 22 | 3.0 | - | 5.3 | - | 9.5 | - | 13.6 | - | 5.8 | - |
| 23 | 5.0 | - | 6.6 | - | 2.0 | - | 7.3 | - | 2.6 | - |
| 24 | 2.3 | - | 3.9 | - | 5.5 | - | 8.5 | - | 3.5 | - |
| 25 | 2.6 | - | 4.7 | - | 5.2 | - | 11.0 | - | 7.5 | - |
| 26 | 2.8 | - | 3.3 | - | 3.4 | - | 10.7 | - | 2.4 | - |
| 27 | 3.9 | - | 3.7 | - | 5.5 | - | 7.7 | - | 2.4 | - |
| 28 | 3.3 | - | 3.1 | - | 3.7 | - | 8.6 | - | 6.5 | - |
| 29 | 2.4 | - | 3.3 | - | 3.4 | - | 4.0 | - | 3.0 | - |
| 30 | 5.0 | 0 | 3.6 | 75 | 4.3 | 75 | 3.0 | 25 | 8.0 | 75 |
| 31 | 3.2 | - | 5.1 | - | 2.7 | - | 3.3 | - | 2.0 | - |
| 32 | 3.3 | - | 6.6 | - | 3.7 | - | 2.6 | - | 8.5 | - |
| 33 | 3.0 | - | 7.0 | - | 5.5 | - | 6.3 | - | 5.8 | - |
| 34 | 2.2 | - | 7.5 | - | 3.5 | - | 5.9 | - | 4.3 | - |
| 35 | 2.4 | - | 2.9 | - | 4.2 | - | 5.7 | - | 2.7 | - |
| 36 | 3.0 | - | 7.2 | - | 4.5 | - | 2.8 | - | 10.1 | - |
| 37 | 2.3 | - | 3.1 | - | 3.1 | - | 3.3 | - | 7.7 | - |
| 38 | 2.7 | - | 11.5 | - | 2.9 | - | 5.7 | - | 4.8 | - |
| 39 | 2.2 | - | 12.3 | - | 3.9 | - | 8.5 | - | 4.5 | - |
| 40 | 2.5 | 0 | 6.0 | 25 | 2.8 | 75 | 2.4 | 0 | 3.2 | 25 |
| 41 | 2.0 | - | 4.8 | - | 2.7 | - | 11.9 | - | 3.8 | - |
| 42 | 2.1 | - | 5.8 | - | 2.7 | - | 5.4 | - | 2.5 | - |
| 43 | 2.3 | - | 3.3 | - | 3.1 | - | 8.9 | - | 3.8 | - |
| 44 | 2.2 | - | 4.8 | - | 3.3 | - | 2.9 | - | 15.0 | - |
| 45 | 4.2 | - | 3.7 | - | 2.5 | - | 3.1 | - | 8.7 | - |
| 46 | 4.0 | - | 5.3 | - | 6.8 | - | 3.2 | - | 3.6 | - |
| 47 | 3.2 | - | 2.8 | - | 4.2 | - | 5.3 | - | 5.0 | - |
| 48 | 6.2 | - | 2.7 | - | 7.1 | - | 4.3 | - | 4.5 | - |
| 49 | 2.7 | - | 2.7 | - | 5.7 | - | 5.2 | - | 3.2 | - |
| 50 | 6.2 | 25 | 9.3 | 50 | 3.7 | 0 | 9.5 | 25 | 3.3 | 0 |
| 51 | 2.3 | - | 6.5 | - | 4.4 | - | 3.9 | - | 10.4 | - |
| 52 | 7.0 | - | 8.4 | - | 7.4 | - | 3.1 | - | 2.7 | - |
| 53 | 6.5 | - | 7.1 | - | 9.5 | - | 6.8 | - | 4.9 | - |
| 54 | 5.5 | - | 9.4 | - | 7.6 | - | 4.3 | - | 4.2 | - |
| 55 | 3.7 | - | 6.3 | - | 15.5 | - | 3.4 | - | 1.9 | - |
| 56 | 4.8 | - | 3.7 | - | 9.5 | - | 5.5 | - | 12.2 | - |
| 57 | 5.9 | - | 4.2 | - | 3.8 | - | 4.8 | - | 5.1 | - |
| 58 | 4.0 | - | 5.1 | - | 4.7 | - | 1.7 | - | 4.6 | - |
| 59 | 4.1 | - | 4.2 | - | 4.2 | - | 9.6 | - | 6.8 | - |
| 60 | 3.1 | 25 | 5.0 | 25 | 5.5 | 0 | 9.2 | 25 | 6.5 | 0 |
| 61 | 4.5 | - | 4.4 | - | 4.6 | - | 3.1 | - | 4.8 | - |
| 62 | 4.3 | - | 3.9 | - | 2.9 | - | 4.7 | - | 4.9 | - |
| 63 | 2.5 | - | 3.4 | - | 3.0 | - | 8.5 | - | 2.7 | - |
| 64 | 3.0 | - | 3.7 | - | 2.3 | - | 12.5 | - | 8.6 | - |
| 65 | 1.9 | - | 2.2 | - | 2.6 | - | 2.5 | - | 12.0 | - |
| 66 | 4.9 | - | 3.8 | - | 2.4 | - | 11.0 | - | 7.5 | - |
| 67 | 3.0 | - | 2.3 | - | 6.1 | - | 5.2 | - | 4.5 | - |
| 68 | 6.1 | - | 2.1 | - | 11.3 | - | 5.5 | - | 2.8 | - |
| 69 | 3.1 | - | 2.2 | - | 9.8 | - | 5.3 | - | 5.5 | - |
| 70 | 5.7 | 25 | 2.1 | 75 | 4.3 | 0 | 12.0 | 75 | 4.5 | 0 |
| 71 | 4.9 | - | 6.0 | - | 6.3 | - | 13.4 | - | 2.4 | - |
| 72 | 4.0 | - | 5.1 | - | 5.0 | - | 8.8 | - | 3.5 | - |
| 73 | 2.9 | - | 7.0 | - | 6.1 | - | 15.0 | - | 4.4 | - |
| 74 | 4.4 | - | 10.5 | - | 5.5 | - | 5.0 | - | 4.0 | - |
| 75 | 3.8 | - | 2.7 | - | 6.2 | - | 9.8 | - | 16.7 | - |
| 76 | 3.4 | - | 4.9 | - | 2.4 | - | 2.3 | - | 4.8 | - |
| 77 | 3.5 | - | 4.0 | - | 4.7 | - | 3.4 | - | 2.3 | - |
| 78 | 3.1 | - | 5.0 | - | 5.4 | - | 8.5 | - | 2.2 | - |
| 79 | 2.9 | - | 4.4 | - | 10.1 | - | 4.2 | - | 2.6 | - |
| 80 | 3.6 | 50 | 4.7 | 50 | 4.7 | 25 | 6.0 | 0 | 2.3 | 50 |
| 81 | 1.6 | - | 4.2 | - | 7.4 | - | 5.5 | - | 3.1 | - |
| 82 | 2.3 | - | 4.1 | - | 2.9 | - | 7.0 | - | 3.0 | - |
| 83 | 2.9 | - | 3.5 | - | 4.8 | - | 4.4 | - | 2.5 | - |
| 84 | 2.6 | - | 3.9 | - | 3.9 | - | 3.4 | - | 2.8 | - |
| 85 | 2.9 | - | 3.1 | - | 5.1 | - | 8.4 | - | 3.8 | - |
| 86 | 3.2 | - | 12.3 | - | 4.9 | - | 11.8 | - | 2.0 | - |
| 87 | 2.9 | - | 5.5 | - | 3.1 | - | 3.2 | - | 2.0 | - |
| 88 | 2.9 | - | 5.6 | - | 3.6 | - | 9.7 | - | 3.0 | - |
| 89 | 2.3 | - | 3.7 | - | 1.9 | - | 6.4 | - | 2.7 | - |
| 90 | 2.0 | 50 | 3.2 | 0 | 2.9 | 50 | 5.8 | 0 | 2.3 | 0 |
| 91 | 2.4 | - | 3.3 | - | 4.9 | - | 8.1 | - | 1.7 | - |
| 92 | 2.3 | - | 3.4 | - | 9.8 | - | 10.2 | - | 1.1 | - |
| 93 | 1.4 | - | 3.1 | - | 6.5 | - | 15.9 | - | 2.8 | - |
| 94 | 2.5 | - | 4.4 | - | 4.2 | - | 8.1 | - | 1.6 | - |
| 95 | 2.5 | - | 3.9 | - | 5.5 | - | 4.6 | - | 1.6 | - |
| 96 | 2.8 | - | 4.0 | - | 4.5 | - | 6.0 | - | 1.6 | - |
| 97 | 2.5 | - | 2.8 | - | 5.2 | - | 7.4 | - | 6.4 | - |
| 98 | 3.3 | - | 4.7 | - | 5.5 | - | 8.0 | - | 4.5 | - |
| 99 | 2.7 | - | 5.1 | - | 3.4 | - | 8.6 | - | 5.5 | - |
| 100 | 2.6 | 50 | 5.7 | 25 | 3.3 | 25 | 10.5 | 50 | 3.7 | 0 |
| Minimum | 1.4 | - | 2.1 | - | 1.9 | - | 1.7 | - | 1.1 | - |
| Maximum | 8.7 | - | 12.5 | - | 15.5 | - | 15.9 | - | 16.7 | - |
| Mean | 3.5 | - | 5.2 | - | 4.9 | - | 6.5 | - | 4.8 | - |
| Geometric mean | 3.3 | - | 4.7 | - | 4.5 | - | 5.6 | - | 4.1 | - |
| Median | 3.1 | 25.0 | 4.8 | 37.5 | 4.5 | 25.0 | 5.5 | 25.0 | 4.2 | 0.0 |

Note: intermediate axis length is the second longest axis on a cobble. Embeddedness refers to how deeply the cobble is surrounded or buried by other substrate.

Table C.3: Intermediate Axis Length and Embeddedness of 100 Cobble Washed during Surber Sampling at Benthic Invertebrate Stations, Minto Mine Phase 4 EEM, 2016

| Cobble Number | UMC-1 | | UMC-2 | | UMC-3 | | UMC-4 | | UMC-5 | |
|-----------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|
| | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) |
| 1 | 8.2 | - | 5.4 | - | 3.5 | - | 7.7 | - | 4.9 | - |
| 2 | 4.5 | - | 8.3 | - | 5.2 | - | 9.5 | - | 3.2 | - |
| 3 | 3.3 | - | 4.3 | - | 3.9 | - | 4.7 | - | 4.1 | - |
| 4 | 3.8 | - | 5.2 | - | 2.2 | - | 3.3 | - | 2.6 | - |
| 5 | 4.9 | - | 3.0 | - | 4.0 | - | 4.8 | - | 4.6 | - |
| 6 | 3.1 | - | 8.0 | - | 2.0 | - | 5.5 | - | 2.1 | - |
| 7 | 3.7 | - | 4.2 | - | 4.5 | - | 3.5 | - | 4.7 | - |
| 8 | 5.5 | - | 2.4 | - | 2.8 | - | 5.2 | - | 3.9 | - |
| 9 | 2.2 | - | 5.2 | - | 3.0 | - | 2.5 | - | 3.4 | - |
| 10 | 7.6 | 0 | 3.6 | 0 | 5.5 | 25 | 6.6 | 25 | 5.5 | 75 |
| 11 | 3.8 | - | 3.5 | - | 2.3 | - | 3.1 | - | 2.2 | - |
| 12 | 3.7 | - | 2.7 | - | 2.5 | - | 4.1 | - | 3.8 | - |
| 13 | 4.7 | - | 2.7 | - | 4.3 | - | 3.4 | - | 5.0 | - |
| 14 | 3.7 | - | 1.5 | - | 5.1 | - | 4.4 | - | 3.4 | - |
| 15 | 4.2 | - | 7.3 | - | 3.5 | - | 3.2 | - | 4.4 | - |
| 16 | 2.7 | - | 3.4 | - | 4.5 | - | 2.5 | - | 3.4 | - |
| 17 | 8.5 | - | 3.2 | - | 4.0 | - | 3.4 | - | 3.5 | - |
| 18 | 9.8 | - | 3.7 | - | 3.3 | - | 7.0 | - | 3.4 | - |
| 19 | 4.6 | - | 2.5 | - | 2.0 | - | 4.4 | - | 3.8 | - |
| 20 | 9.1 | 25 | 2.5 | 0 | 3.3 | 25 | 3.7 | 0 | 2.1 | 50 |
| 21 | 3.3 | - | 3.8 | - | 4.1 | - | 3.4 | - | 2.4 | - |
| 22 | 8.2 | - | 1.9 | - | 1.3 | - | 4.1 | - | 3.7 | - |
| 23 | 7.4 | - | 6.8 | - | 2.6 | - | 3.0 | - | 3.4 | - |
| 24 | 2.6 | - | 4.1 | - | 2.8 | - | 6.5 | - | 4.2 | - |
| 25 | 10.3 | - | 3.0 | - | 3.0 | - | 3.7 | - | 2.7 | - |
| 26 | 3.7 | - | 4.5 | - | 2.1 | - | 4.1 | - | 4.1 | - |
| 27 | 2.4 | - | 6.8 | - | 3.7 | - | 3.0 | - | 2.8 | - |
| 28 | 7.3 | - | 3.4 | - | 3.5 | - | 2.2 | - | 3.4 | - |
| 29 | 5.6 | - | 5.0 | - | 6.5 | - | 2.4 | - | 5.1 | - |
| 30 | 8.1 | 25 | 3.4 | 50 | 5.5 | 0 | 2.2 | 50 | 3.2 | 0 |
| 31 | 5.0 | - | 2.8 | - | 5.5 | - | 3.0 | - | 4.4 | - |
| 32 | 6.6 | - | 1.8 | - | 6.7 | - | 2.5 | - | 3.6 | - |
| 33 | 4.7 | - | 1.8 | - | 2.7 | - | 2.2 | - | 3.7 | - |
| 34 | 7.1 | - | 2.8 | - | 2.0 | - | 2.7 | - | 4.7 | - |
| 35 | 7.5 | - | 2.6 | - | 2.4 | - | 2.4 | - | 5.4 | - |
| 36 | 4.1 | - | 2.6 | - | 3.2 | - | 2.2 | - | 5.8 | - |
| 37 | 5.7 | - | 2.1 | - | 2.2 | - | 2.8 | - | 3.6 | - |
| 38 | 6.5 | - | 2.5 | - | 5.6 | - | 2.1 | - | 3.0 | - |
| 39 | 3.9 | - | 3.3 | - | 2.5 | - | 2.2 | - | 2.9 | - |
| 40 | 7.2 | 75 | 3.0 | 25 | 7.5 | 50 | 10.3 | 0 | 3.2 | 0 |
| 41 | 3.7 | - | 3.3 | - | 3.0 | - | 6.3 | - | 5.5 | - |
| 42 | 4.4 | - | 2.5 | - | 2.0 | - | 3.8 | - | 2.5 | - |
| 43 | 3.6 | - | 3.1 | - | 4.7 | - | 4.8 | - | 1.9 | - |
| 44 | 3.8 | - | 1.0 | - | 2.0 | - | 1.9 | - | 2.8 | - |
| 45 | 4.3 | - | 1.2 | - | 3.4 | - | 3.8 | - | 2.0 | - |
| 46 | 2.6 | - | 7.5 | - | 3.4 | - | 5.2 | - | 4.0 | - |
| 47 | 2.6 | - | 10.0 | - | 2.6 | - | 12.4 | - | 3.5 | - |
| 48 | 2.9 | - | 7.5 | - | 3.6 | - | 7.9 | - | 1.5 | - |
| 49 | 3.3 | - | 3.8 | - | 7.9 | - | 7.5 | - | 1.4 | - |
| 50 | 2.7 | 75 | 3.3 | 0 | 3.7 | 0 | 8.1 | 25 | 1.5 | 25 |
| 51 | 2.9 | - | 3.4 | - | 5.0 | - | 7.2 | - | 1.1 | - |
| 52 | 2.7 | - | 4.8 | - | 6.0 | - | 6.2 | - | 1.5 | - |
| 53 | 2.7 | - | 3.8 | - | 2.7 | - | 5.6 | - | 6.2 | - |
| 54 | 2.6 | - | 3.0 | - | 2.9 | - | 4.7 | - | 4.4 | - |
| 55 | 1.7 | - | 6.5 | - | 5.3 | - | 3.1 | - | 5.2 | - |
| 56 | 2.2 | - | 3.7 | - | 2.0 | - | 4.6 | - | 4.0 | - |
| 57 | 8.8 | - | 8.1 | - | 3.0 | - | 3.3 | - | 2.6 | - |
| 58 | 7.7 | - | 3.8 | - | 4.3 | - | 2.6 | - | 4.5 | - |
| 59 | 6.0 | - | 3.2 | - | 5.6 | - | 3.8 | - | 5.0 | - |
| 60 | 6.8 | 50 | 4.6 | 25 | 2.6 | 0 | 2.9 | 0 | 3.3 | 25 |
| 61 | 6.5 | - | 4.3 | - | 7.3 | - | 6.1 | - | 4.1 | - |
| 62 | 5.3 | - | 9.3 | - | 3.0 | - | 6.9 | - | 5.8 | - |
| 63 | 9.0 | - | 4.1 | - | 8.0 | - | 4.6 | - | 4.7 | - |
| 64 | 8.4 | - | 3.8 | - | 4.3 | - | 3.7 | - | 4.8 | - |
| 65 | 6.5 | - | 5.1 | - | 2.5 | - | 3.0 | - | 3.5 | - |
| 66 | 6.5 | - | 5.7 | - | 4.1 | - | 2.5 | - | 5.0 | - |
| 67 | 4.0 | - | 7.0 | - | 2.7 | - | 2.1 | - | 3.7 | - |
| 68 | 4.4 | - | 3.7 | - | 5.7 | - | 3.4 | - | 3.2 | - |
| 69 | 3.5 | - | 3.0 | - | 5.5 | - | 6.9 | - | 4.0 | - |
| 70 | 6.5 | 0 | 3.5 | 0 | 3.0 | 50 | 4.3 | 25 | 3.0 | 0 |
| 71 | 5.9 | - | 3.3 | - | 2.9 | - | 6.7 | - | 3.3 | - |
| 72 | 5.0 | - | 11.0 | - | 7.4 | - | 8.3 | - | 5.6 | - |
| 73 | 7.5 | - | 5.2 | - | 2.1 | - | 3.8 | - | 3.4 | - |
| 74 | 7.8 | - | 2.6 | - | 6.0 | - | 5.1 | - | 6.0 | - |
| 75 | 2.9 | - | 6.5 | - | 2.6 | - | 7.8 | - | 8.4 | - |
| 76 | 4.1 | - | 3.4 | - | 2.7 | - | 3.0 | - | 8.2 | - |
| 77 | 4.0 | - | 3.8 | - | 3.3 | - | 2.7 | - | 4.8 | - |
| 78 | 2.9 | - | 4.7 | - | 4.3 | - | 3.8 | - | 3.9 | - |
| 79 | 4.0 | - | 8.7 | - | 4.9 | - | 3.1 | - | 3.5 | - |
| 80 | 2.3 | 50 | 2.8 | 0 | 3.9 | 25 | 4.2 | 50 | 5.3 | 0 |
| 81 | 4.9 | - | 3.1 | - | 6.5 | - | 7.9 | - | 5.5 | - |
| 82 | 3.7 | - | 10.2 | - | 4.3 | - | 5.7 | - | 11.3 | - |
| 83 | 2.8 | - | 5.8 | - | 2.3 | - | 5.5 | - | 6.3 | - |
| 84 | 5.1 | - | 7.0 | - | 3.3 | - | 8.4 | - | 7.0 | - |
| 85 | 5.4 | - | 3.6 | - | 3.1 | - | 10.2 | - | 5.1 | - |
| 86 | 9.2 | - | 2.2 | - | 5.3 | - | 9.4 | - | 3.1 | - |
| 87 | 6.3 | - | 3.4 | - | 2.9 | - | 6.3 | - | 3.3 | - |
| 88 | 7.1 | - | 5.7 | - | 4.2 | - | 7.9 | - | 5.4 | - |
| 89 | 4.7 | - | 4.0 | - | 5.0 | - | 9.7 | - | 3.3 | - |
| 90 | 3.6 | 25 | 2.2 | 50 | 6.2 | 25 | 8.3 | 50 | 5.4 | 25 |
| 91 | 3.2 | - | 2.9 | - | 3.9 | - | 6.1 | - | 3.4 | - |
| 92 | 4.1 | - | 2.8 | - | 2.6 | - | 7.8 | - | 3.1 | - |
| 93 | 3.2 | - | 2.9 | - | 4.6 | - | 2.5 | - | 3.0 | - |
| 94 | 11.5 | - | 5.0 | - | 2.5 | - | 3.0 | - | 6.3 | - |
| 95 | 12.0 | - | 4.8 | - | 3.1 | - | 7.4 | - | 7.3 | - |
| 96 | 7.4 | - | 3.5 | - | 3.5 | - | 4.5 | - | 5.9 | - |
| 97 | 10.6 | - | 2.5 | - | 3.0 | - | 4.1 | - | 4.8 | - |
| 98 | 7.5 | - | 3.4 | - | 2.6 | - | 2.7 | - | 4.8 | - |
| 99 | 8.3 | - | 1.9 | - | 4.6 | - | 3.4 | - | 5.2 | - |
| 100 | 4.0 | 50 | 2.0 | 25 | 4.4 | 25 | 2.5 | 25 | 3.4 | 0 |
| Minimum | 1.7 | - | 1.0 | - | 1.3 | - | 1.9 | - | 1.1 | - |
| Maximum | 12.0 | - | 11.0 | - | 8.0 | - | 12.4 | - | 11.3 | - |
| Mean | 5.3 | - | 4.2 | - | 3.9 | - | 4.8 | - | 4.1 | - |
| Geometric mean | 4.8 | - | 3.8 | - | 3.6 | - | 4.3 | - | 3.8 | - |
| Median | 4.7 | 37.5 | 3.5 | 12.5 | 3.5 | 25.0 | 4.1 | 25.0 | 3.8 | 12.5 |

Note: intermediate axis length is the second longest axis on a cobble. Embeddedness refers to how deeply the cobble is surrounded or buried by other substrate.

Table C.4: Raw In situ Water Quality Measures for the Fish Exposure Study, August to September, 2016

| Date | Control | | | | | | E6 | | | | | | E3 | | | | | |
|-----------|------------------|------|------------------|-------|-------------------------------|----------------|------------------|------|------------------|-------|-------------------------------|----------------|------------------|------|------------------|-------|-------------------------------|----------------|
| | Temperature (°C) | pH | Dissolved Oxygen | | Specific Conductivity (µS/cm) | Ammonia (mg/L) | Temperature (°C) | pH | Dissolved Oxygen | | Specific Conductivity (µS/cm) | Ammonia (mg/L) | Temperature (°C) | pH | Dissolved Oxygen | | Specific Conductivity (µS/cm) | Ammonia (mg/L) |
| | | | % | mg/L | | | | | % | mg/L | | | | | % | mg/L | | |
| 7-Aug-16 | 15.0 | 8.00 | 73.2 | 7.75 | 292.3 | - | 14.9 | 7.94 | 76.2 | 7.76 | 326.2 | - | 15.5 | 7.84 | 78.1 | 7.41 | 321.0 | - |
| | - | - | - | - | - | - | 14.9 | - | - | 7.92 | - | - | 15.4 | 7.82 | - | - | - | - |
| 8-Aug-16 | 14.3 | 8.11 | 68.1 | 6.97 | 281.7 | - | 14.1 | 8.00 | 64.2 | 6.60 | 324.1 | - | 13.8 | 8.01 | 66.3 | 6.81 | 328.2 | - |
| | 14.5 | 7.85 | 80.4 | 8.11 | 286.9 | 0.06 | 14.3 | 7.71 | 72.7 | 7.41 | 331.9 | 0.09 | 14.2 | 7.73 | 73.0 | 7.45 | 334.0 | 0.11 |
| | 15.6 | 7.48 | 64.4 | 6.44 | 290.1 | - | 15.2 | 7.58 | 71.9 | 7.08 | 335.5 | - | 15.1 | 7.65 | 75.3 | 7.54 | 336.9 | - |
| 9-Aug-16 | 13.8 | 7.47 | 66.6 | 6.89 | 288.9 | 0.16 | 13.8 | 7.54 | 74.9 | 7.73 | 332.2 | 0.17 | 13.7 | 7.63 | 72.6 | 7.51 | 334.3 | 0.19 |
| | 14.0 | 7.75 | 64.4 | 6.66 | 225.2 | - | 13.9 | 7.70 | 69.1 | 7.13 | 273.3 | - | 13.8 | 7.74 | 58.2 | 6.02 | 287.6 | - |
| 10-Aug-16 | 12.7 | 7.84 | 73.6 | 7.77 | 216.6 | 0.10 | 12.5 | 7.80 | 71.1 | 7.55 | 262.2 | 0.11 | 12.6 | 7.81 | 66.5 | 7.03 | 276.9 | 0.18 |
| | 14.3 | 7.82 | 100.2 | 10.28 | 195.7 | - | 14.1 | 7.65 | 110.7 | 11.24 | 234.5 | - | 14.2 | 7.69 | 108.9 | 10.72 | 257.7 | - |
| | 13.9 | 7.41 | 80.8 | 8.36 | 187.4 | - | 13.9 | 7.50 | 98.0 | 10.11 | 239.9 | - | 13.9 | 7.60 | 73.6 | 7.60 | 253.8 | - |
| 11-Aug-16 | 11.2 | 7.33 | 81.9 | 8.84 | 180.4 | 0.29 | 11.3 | 7.49 | 103.9 | 11.36 | 227.8 | 0.34 | 10.6 | 7.71 | 81.9 | 9.10 | 239.1 | 0.49 |
| | 12.8 | 7.70 | 87.3 | 9.25 | 178.5 | - | 12.4 | 7.54 | 72.7 | 7.76 | 226.6 | - | 12.3 | 7.58 | 79.7 | 8.52 | 240.2 | - |
| | 11.5 | 7.38 | 108.1 | 11.86 | 177.1 | 0.35 | 11.4 | 7.43 | 135.2 | 13.79 | 228.8 | 0.46 | 11.2 | 7.52 | 103.2 | 11.40 | 239.7 | 0.57 |
| 12-Aug-16 | 11.4 | 7.47 | 88.0 | 9.58 | 179.5 | - | 11.5 | 7.53 | 98.3 | 10.71 | 226.5 | - | 11.4 | 7.58 | 82.3 | 9.00 | 238.9 | - |
| | 12.3 | 7.41 | 76.3 | 8.23 | 178.8 | - | 12.5 | 7.48 | 88.3 | 9.34 | 222.4 | - | 12.6 | 7.54 | 83.2 | 8.91 | 239.4 | - |
| 13-Aug-16 | 11.7 | 7.54 | 62.2 | 6.73 | 178.1 | 0.48 | 11.8 | 7.23 | 66.3 | 7.18 | 226.6 | 0.46 | 11.6 | 7.43 | 64.2 | 6.95 | 240.5 | 0.65 |
| | 12.7 | 7.65 | 71.2 | 7.55 | 178.5 | - | 12.7 | 7.43 | 70.7 | 6.98 | 217.0 | - | 12.9 | 7.55 | 75.1 | 7.92 | 237.7 | - |
| | 11.7 | 7.63 | 63.5 | 6.91 | 169.1 | 0.51 | 11.5 | 7.34 | 62.9 | 6.85 | 214.5 | 0.47 | 11.4 | 7.37 | 69.0 | 7.51 | 240.2 | 0.55 |
| 14-Aug-16 | 12.9 | 7.23 | 89.5 | 9.52 | 171.1 | - | 12.6 | 7.38 | 59.0 | 6.27 | 213.9 | - | 12.8 | 7.38 | 96.9 | 10.25 | 238.4 | - |
| | 11.7 | 7.26 | 83.1 | 9.04 | 170.9 | 0.45 | 11.5 | 7.39 | 106.7 | 11.66 | 211.1 | 0.56 | 11.2 | 7.44 | 71.1 | 7.87 | 237.7 | 0.61 |
| | 12.7 | 7.12 | 79.1 | 8.39 | 170.0 | - | 12.6 | 7.42 | 89.1 | 9.48 | 210.3 | - | 12.8 | 7.38 | 96.9 | 10.25 | 238.4 | - |
| 16-Aug-16 | 11.4 | 7.05 | 81.9 | 8.95 | 170.3 | 0.49 | 11.3 | 7.33 | 97.7 | 10.70 | 211.3 | 0.60 | 11.0 | 7.44 | 97.4 | 10.72 | 234.1 | 0.43 |
| | 12.5 | 7.22 | 83.1 | 8.83 | 167.2 | - | 12.4 | 7.46 | 69.1 | 7.37 | 205.8 | - | 12.8 | 7.42 | 84.4 | 8.95 | 235.1 | - |
| | 11.3 | 7.11 | 66.4 | 7.27 | 167.5 | 0.43 | 11.3 | 7.23 | 99.5 | 10.90 | 205.0 | 0.55 | 10.9 | 7.28 | 72.1 | 7.96 | 235.5 | 0.56 |
| 17-Aug-16 | 12.4 | 7.08 | 68.9 | 7.35 | 166.4 | - | 12.3 | 7.32 | 85.7 | 9.17 | 205.4 | - | 12.2 | 7.31 | 76.6 | 8.31 | 236.1 | - |
| | 11.7 | 7.03 | 66.5 | 7.22 | 165.5 | 0.46 | 11.6 | 7.20 | 83.0 | 9.02 | 205.4 | 0.52 | 11.4 | 7.35 | 75.5 | 8.24 | 234.4 | 0.61 |
| | 11.4 | 7.18 | 68.2 | 7.44 | 170.8 | - | 11.3 | 7.29 | 76.3 | 8.36 | 206.4 | - | 11.2 | 7.35 | 76.8 | 8.41 | 236.0 | - |
| 19-Aug-16 | 10.4 | 7.06 | 78.1 | 8.73 | 165.1 | 0.53 | 10.3 | 7.26 | 89.5 | 10.03 | 205.9 | 0.59 | 10.2 | 7.29 | 83.0 | 9.33 | 235.5 | 0.58 |
| | 11.8 | 7.08 | 75.5 | 8.17 | 165.7 | - | 11.8 | 7.31 | 88.5 | 9.55 | 206.4 | - | 11.9 | 7.33 | 80.7 | 8.71 | 236.0 | - |
| | 10.5 | 7.01 | 72.9 | 8.11 | 164.1 | 0.38 | 10.3 | 7.13 | 76.3 | 8.51 | 208.5 | 0.63 | 10.1 | 7.27 | 72.6 | 8.17 | 236.6 | 0.58 |
| 20-Aug-16 | 11.8 | 7.07 | 72.4 | 7.84 | 165.6 | - | 11.8 | 7.24 | 75.9 | 8.20 | 208.1 | - | 11.8 | 7.26 | 69.9 | 7.74 | 237.0 | - |
| | 10.4 | 7.03 | 90.5 | 10.15 | 165.4 | 0.51 | 10.3 | 7.21 | 88.6 | 9.91 | 207.9 | 0.56 | 10.1 | 7.27 | 82.7 | 9.31 | 236.7 | 0.61 |
| | 12.0 | 7.08 | 82.8 | 8.91 | 165.5 | - | 11.8 | 7.23 | 90.9 | 8.74 | 208.3 | - | 11.9 | 7.24 | 81.1 | 8.75 | 236.8 | - |
| 22-Aug-16 | 11.0 | 7.13 | 80.7 | 8.85 | 165.4 | 0.47 | 10.9 | 7.20 | 80.3 | 8.86 | 207.8 | 0.55 | 10.9 | 7.19 | 71.0 | 7.85 | 237.8 | 0.55 |
| | 12.0 | 7.01 | 80.1 | 8.63 | 165.0 | - | 11.9 | 7.27 | 78.2 | 8.43 | 208.3 | - | 11.9 | 7.22 | 74.7 | 8.06 | 237.1 | - |
| | 11.5 | 7.20 | 74.2 | 8.08 | 163.9 | 0.42 | 11.3 | 7.30 | 82.3 | 9.01 | 204.7 | 0.48 | 11.1 | 7.26 | 72.9 | 8.03 | 237.1 | 0.54 |
| 23-Aug-16 | 12.1 | 7.06 | 74.2 | 7.99 | 165.5 | - | 11.8 | 7.21 | 80.1 | 8.64 | 214.5 | - | 11.9 | 7.19 | 72.2 | 7.78 | 237.9 | - |
| | 10.8 | 7.01 | 75.8 | 8.39 | 165.9 | 0.50 | 10.7 | 7.17 | 84.3 | 9.33 | 215.0 | 0.65 | 10.6 | 7.27 | 65.7 | 7.29 | 236.0 | 0.60 |
| | 11.7 | 8.02 | 89.1 | 9.57 | 172.8 | - | 11.9 | 7.38 | 79.9 | 8.65 | 216.5 | - | 11.7 | 7.27 | 77.8 | 8.35 | 235.8 | - |
| 25-Aug-16 | 11.5 | 7.36 | 78.1 | 8.38 | 172.9 | 0.61 | 11.3 | 7.08 | 72.9 | 7.95 | 215.5 | 0.64 | 11.3 | 7.14 | 63.9 | 7.03 | 237.3 | 0.54 |
| | 12.0 | 7.70 | 73.0 | 7.87 | 174.5 | - | 11.8 | 7.20 | 78.2 | 8.46 | 215.1 | - | 11.8 | 7.17 | 70.8 | 7.72 | 237.2 | - |
| 26-Aug-16 | 11.0 | 7.32 | 74.4 | 8.09 | 168.3 | 0.48 | 10.9 | 6.87 | 76.2 | 8.42 | 212.9 | 0.64 | 10.7 | 6.90 | 66.7 | 7.39 | 241.1 | 0.60 |
| | 11.8 | 7.62 | 71.5 | 7.74 | 169.5 | - | 11.5 | 7.70 | 76.3 | 8.31 | 213.2 | - | 12.0 | 7.58 | 59.5 | 6.39 | 243.8 | - |
| 27-Aug-16 | 10.4 | 7.52 | 80.7 | 9.00 | 212.8 | 0.52 | 10.4 | 7.52 | 80.7 | 9.00 | 212.8 | 0.63 | 10.3 | - | - | - | - | 0.61 |
| | 11.5 | 6.92 | 83.8 | 9.13 | 210.7 | - | 11.5 | 6.92 | 83.8 | 9.13 | 210.7 | - | 11.7 | 7.14 | 59.6 | 6.47 | 248.1 | - |
| 28-Aug-16 | 12.1 | 7.05 | 80.2 | 9.02 | 216.4 | 0.52 | 12.1 | 7.05 | 80.2 | 9.02 | 216.4 | 0.66 | 9.9 | 7.15 | 53.2 | 6.74 | 246.6 | 0.35 |
| | 10.9 | 8.03 | 86.0 | 9.37 | 212.4 | - | 10.9 | 8.03 | 86.0 | 9.37 | 212.4 | - | 10.9 | 7.76 | 102.5 | 11.26 | 252.7 | - |
| | 9.3 | 7.88 | 87.3 | 10.02 | 210.8 | 0.30 | 9.3 | 7.88 | 87.3 | 10.02 | 210.8 | 0.47 | 9.1 | 7.55 | 112.2 | 12.90 | 252.0 | 1.02 |
| 29-Aug-16 | 10.1 | 7.28 | 88.9 | 10.00 | 218.0 | - | 10.1 | 7.28 | 88.9 | 10.00 | 218.0 | - | 10.1 | 7.19 | 122.3 | 13.76 | 250.8 | - |
| | 8.8 | 7.89 | 85.3 | 9.88 | 216.4 | 0.58 | 8.8 | 7.89 | 85.3 | 9.88 | 216.4 | 0.70 | 8.7 | 7.66 | 112.1 | 13.00 | 251.9 | 0.80 |
| | 10.2 | 6.80 | 77.3 | 8.68 | 216.2 | - | 10.2 | 6.80 | 77.3 | 8.68 | 216.2 | - | 10.2 | 6.88 | 64.0 | 7.15 | 249.5 | - |
| 31-Aug-16 | 9.3 | 7.66 | 76.9 | 8.80 | 218.9 | 0.74 | 9.3 | 7.66 | 76.9 | 8.80 | 218.9 | 0.87 | 9.2 | 7.60 | 120.5 | 13.76 | 248.1 | 0.80 |
| | 10.9 | 6.83 | 78.5 | 8.69 | 217.8 | - | 10.9 | 6.83 | 78.5 | 8.69 | 217.8 | - | 10.7 | 6.89 | 131.7 | 14.61 | 253.6 | - |
| | 9.8 | 7.70 | 80.1 | 9.12 | 217.9 | 0.61 | 9.8 | 7.70 | 80.1 | 9.12 | 217.9 | 0.55 | 9.4 | 7.17 | 124.6 | 14.32 | 247.3 | 0.68 |
| 1-Sep-16 | 10.3 | 7.69 | 80.8 | 9.05 | 217.9 | - | 10.3 | 7.69 | 80.8 | 9.05 | 217.9 | - | 9.9 | 7.64 | 125.5 | 14.00 | 248.7 | - |
| | 9.4 | 7.47 | 78.4 | 8.97 | 218.3 | 0.44 | 9.4 | 7.47 | 78.4 | 8.97 | 218.3 | 0.60 | 9.0 | 7.51 | 117.7 | 13.54 | 242.5 | 0.82 |
| | 10.5 | 7.69 | 82.4 | 9.18 | 217.6 | - | 10.5 | 7.69 | 82.4 | 9.18 | 217.6 | - | 10.6 | 7.56 | 116.6 | 12.96 | 247.1 | - |
| 3-Sep-16 | 9.2 | 7.80 | 79.8 | 9.07 | 169.1 | 0.41 | 9.1 | 7.24 | 78.5 | 9.05 | 216.1 | 0.38 | 9.0 | 7.25 | 122.6 | 14.12 | 244.9 | 0.60 |
| | 11.0 | 7.88 | 67.8 | 7.43 | 169.8 | - | 10.9 | 7.67 | 73.2 | 8.08 | 217.8 | - | 11.0 | 7.55 | 101.9 | 11.23 | 247.0 | - |
| | 8.7 | 7.73 | 68.2 | 7.93 | 181.1 | 0.66 | 8.6 | 7.34 | 82.9 | 9.69 | 222.2 | 0.72 | 8.3 | 7.20 | 111.7 | 13.11 | 244.8 | 1.01 |
| 4-Sep-16 | 11.0 | 7.71 | 65.4 | 7.23 | 177.1 | - | 11.1 | 7.21 | 77.3 | 8.50 | 222.3 | - | 11.3 | 7.21 | 105.4 | 11.51 | 249.4 | - |
| | 9.8 | 7.98 | 67.9 | 7.67 | 168.1 | 0.52 | 9.8 | 7.50 | 68.3 | 7.75 | 217.0 | 0.51 | 9.7 | 7.53 | 101.3 | 11.47 | 246.4 | 0.87 |
| | 10.1 | 7.41 | 54.1 | 6.09 | 172.5 | - | 10.3 | 7.60 | 74.1 | 8.32 | 228.5 | - | 10.4 | 7.45 | 95.9 | 10.71 | 246.4 | - |
| 6-Sep-16 | 9.6 | 7.98 | 69.8 | 7.76 | 167.9 | 0.44 | 9.6 | 7.64 | 62.7 | 7.13 | 224.7 | 0.59 | 9.4 | 7.57 | 106.1 | 12.11 | 260.0 | 0.33 |
| | 10.6 | 7.43 | 68.0 | 7.57 | 180.2 | - | 10.6 | 7.16 | 78.8 | 8.76 | 217.1 | - | 10.6 | 7.17 | 113.8 | 12.66 | 241.5 | - |
| | 9.4 | 8.27 | 78.4 | 8.92 | 172.7 | 0.61 | 9.2 | 7.83 | 67.3 | 7.74 | 218.5 | 0.72 | 9.1 | 7.66 | 108.2 | 12.46 | 255.8 | 1.00 |
| 7-Sep-16 | 9.2 | 6.78 | 70.6 | 8.14 | 167.7 | - | 9.4 | 7.27 | 84.9 | 9.71 | 213.7 | - | 9.5 | 7.22 | 111.6 | 12.76 | 249.0 | - |
| | 8.9 | 6.72 | 82.0 | 9.46 | 165.9 | <0.010 | 9.0 | 6.99 | 84.2 | 9.66 | 213.9 | <0.010 | 8.9 | 7.11 | 134.1 | 15.56 | 251.3 | - |
| | 10.0 | 6.70 | 77.5 | 8.67 | 168.1 | - | 10.2 | 7.00 | 86.9 | 9.77 | 214.4 | - | 10.2 | 7.15 | 72.2 | 8.07 | - | - |
| 9-Sep-16 | 8.4 | 6.79 | 70.8 | 8.43 | 165.0 | <0.010 | 8.6 | 6.90 | 74.4 | 8.70 | 214.5 | <0.010 | 8.4 | 7.10 | 92.6 | 10.85 | 246.4 | - |
| | 9.1 | 6.98 | 62.2 | 7.17 | 169.1 | 0.69 | 9.2 | 7.04 | 92.6 | 10.5 | | | | | | | | |

Table C.5: Raw Supporting Water Quality Results for Laboratory Fish Exposure Study, Minto Mine Phase 4 EEM, 2016

| Analyte | Units | Guideline ^a | SSWQO | Control | | | | | | | |
|---|----------|------------------------------|---------------------------|------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|
| | | | | 8-Aug-16 | 15-Aug-16 | 22-Aug-16 | 29-Aug-16 | 5-Sep-16 | 12-Sep-16 | 19-Sep-16 | MEAN |
| Physical | | | | | | | | | | | |
| Water Temperature | °C | - | - | 14.5 | 11.7 | 11.0 | 9.40 | 9.80 | 9.70 | 8.40 | 10.6 |
| Specific Conductance | µS/cm | - | - | 287 | 171 | 165 | 166 | 118 | 166 | 164 | 177 |
| Field Conductance | µS/cm | - | - | 230 | 127 | 122 | - | - | - | - | 159 |
| Laboratory Conductance | µS/cm | - | - | 273 | 169 | 161 | 160 | 160 | 162 | 158 | 178 |
| Dissolved Oxygen | mg/L | > 6.5 | - | 8.11 | 9.04 | 8.85 | 9.44 | 7.67 | 8.17 | 8.71 | 8.57 |
| Dissolved Oxygen | % | - | - | 80.4 | 83.1 | 80.7 | 85.1 | 67.9 | 71.4 | 74.3 | 77.6 |
| Field pH | pH units | 6.5 - 9.0 | 6.0 - 9.0 | 7.85 | 7.26 | 7.13 | 8.28 | 7.98 | 6.50 | 7.59 | 7.51 |
| Laboratory pH | pH units | - | - | 8.07 | 7.76 | 7.75 | 7.66 | 7.90 | 7.95 | 7.68 | 7.82 |
| Cation - Anion Balance | % | - | - | 0.30 | -0.50 | -0.80 | -0.40 | 0.70 | -0.30 | 0.80 | <0.44 |
| Anion Sum | meq/L | - | - | 2.83 | 1.80 | 1.75 | 1.69 | 1.73 | 1.78 | 1.69 | 1.90 |
| Cation Sum | meq/L | - | - | 2.85 | 1.78 | 1.72 | 1.68 | 1.76 | 1.77 | 1.71 | 1.90 |
| Ions, Nutrients and Solids | | | | | | | | | | | |
| Hardness (as CaCO ₃) | mg/L | - | - | 119 | 78.6 | 77.0 | 74.9 | 78.2 | 79.3 | 76.3 | 83.3 |
| Alkalinity, Total (as CaCO ₃) | mg/L | - | - | 95.0 | 76.2 | 75.7 | 73.4 | 75.5 | 77.8 | 72.9 | 78.1 |
| Alkalinity, Bicarbonate (as CaCO ₃) | mg/L | - | - | 95.0 | 76.2 | 75.7 | 73.4 | 75.5 | 77.8 | 72.9 | 78.1 |
| Alkalinity, Carbonate (as CaCO ₃) | mg/L | - | - | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1 |
| Alkalinity, Hydroxide (as CaCO ₃) | mg/L | - | - | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1 |
| Sulfate (SO ₄) | mg/L | 309 ^b | - | 11.1 | 10.4 | 10.6 | 10.6 | 10.9 | 10.9 | 11.1 | 10.8 |
| Chloride (Cl) | mg/L | 120 | - | 23.8 | 1.92 | 0.69 | <0.50 | <0.50 | <0.50 | <0.50 | <4.06 |
| Total Ammonia (as N) | mg/L | 0.20 to 26.6 | 0.25 | 0.049 | 0.40 | 0.38 | 0.23 | 0.39 | 0.41 | 0.41 | 0.33 |
| Nitrite (as N) | mg/L | 0.060 | 0.060 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.001 |
| Nitrate (as N) | mg/L | 3.00 | 9.10 | 0.40 | 0.028 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | 0.0068 | <0.065 |
| Nitrate and Nitrite (as N) | mg/L | - | - | 0.40 | 0.028 | <0.0051 | <0.0051 | <0.0051 | <0.0051 | 0.0068 | <0.065 |
| Total Suspended Solids | mg/L | narrative ^d | - | <3.0 | 3.30 | 4.00 | <3.0 | <3.0 | <3.0 | <3.0 | <3.19 |
| Total Dissolved Solids | mg/L | - | - | 148 | 91.0 | 88.3 | 85.4 | 88.3 | 89.9 | 86.1 | 96.7 |
| Total Metals | | | | | | | | | | | |
| Aluminum (Al) | mg/L | 0.10 ^e | - | 0.081 | 0.054 | 0.047 | 0.091 | 0.070 | 0.059 | 0.062 | 0.066 |
| Antimony (Sb) | mg/L | 0.0090 | - | <0.00010 | 0.00010 | 0.00012 | 0.00015 | 0.00011 | <0.00010 | 0.00011 | 0.00011 |
| Arsenic (As) | mg/L | 0.0050 | - | 0.00052 | 0.00087 | 0.00085 | 0.00083 | 0.00091 | 0.00074 | 0.00063 | 0.00076 |
| Barium (Ba) | mg/L | - | - | 0.045 | 0.041 | 0.041 | 0.043 | 0.043 | 0.042 | 0.043 | 0.042 |
| Beryllium (Be) | mg/L | - | - | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.00002 |
| Bismuth (Bi) | mg/L | - | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.00005 |
| Boron (B) | mg/L | 1.50 | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.01 |
| Cadmium (Cd) | mg/L | 0.00016 ^b | - | 0.0000086 | 0.000011 | 0.000013 | 0.0000078 | 0.0000056 | 0.0000076 | 0.0000051 | 0.0000084 |
| Calcium (Ca) | mg/L | - | - | 36.2 | 22.8 | 21.6 | 20.6 | 20.3 | 21.8 | 21.1 | 23.5 |
| Chromium (Cr) | mg/L | 0.0010 / 0.0090 ^f | - | 0.00022 | 0.00027 | 0.00032 | 0.00038 | 0.00030 | 0.00024 | 0.00023 | 0.00028 |
| Cobalt (Co) | mg/L | 0.0040 | - | 0.00016 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00011 |
| Copper (Cu) | mg/L | 0.0024 ^b | - | 0.0028 | 0.0020 | 0.0022 | 0.0019 | 0.0019 | 0.0018 | 0.0019 | 0.0021 |
| Iron (Fe) | mg/L | 0.30 | - | 0.15 | 0.12 | 0.12 | 0.15 | 0.14 | 0.10 | 0.11 | 0.13 |
| Lead (Pb) | mg/L | 0.0032 ^b | - | 0.00020 | 0.00013 | 0.00011 | 0.00019 | 0.000089 | 0.00011 | 0.000067 | 0.00013 |
| Lithium (Li) | mg/L | - | - | <0.0010 | <0.0010 | <0.0010 | 0.0011 | <0.0010 | <0.0010 | 0.0011 | <0.0010 |
| Magnesium (Mg) | mg/L | - | - | 6.99 | 5.92 | 5.75 | 5.63 | 5.75 | 5.85 | 5.97 | 5.98 |
| Manganese (Mn) | mg/L | 1.00 | - | 0.0073 | 0.0059 | 0.0061 | 0.0075 | 0.0070 | 0.0059 | 0.0071 | 0.0067 |
| Mercury (Hg) | mg/L | 0.000026 | - | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.000005 |
| Molybdenum (Mo) | mg/L | 0.073 | - | 0.0019 | 0.0013 | 0.0013 | 0.0013 | 0.0012 | 0.0014 | 0.0014 | 0.0014 |
| Nickel (Ni) | mg/L | 0.096 ^b | - | 0.00074 | 0.00074 | 0.00065 | 0.0010 | 0.00069 | 0.00070 | 0.00057 | 0.00073 |
| Phosphorus (P) | mg/L | - | - | <0.050 | 0.11 | 0.10 | 0.054 | 0.082 | 0.067 | 0.060 | 0.074 |
| Potassium (K) | mg/L | - | - | 1.92 | 0.98 | 0.89 | 0.86 | 0.82 | 0.75 | 0.82 | 1.01 |
| Selenium (Se) | mg/L | 0.0010 | - | 0.00015 | 0.00014 | 0.00011 | 0.00012 | 0.00013 | 0.00018 | 0.00020 | 0.00015 |
| Silicon (Si) | mg/L | - | - | 4.41 | 3.88 | 3.50 | 3.70 | 3.75 | 3.79 | 3.51 | 3.79 |
| Silver (Ag) | mg/L | 0.00025 | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.00001 |
| Sodium (Na) | mg/L | - | - | 9.56 | 3.59 | 2.97 | 3.42 | 3.28 | 3.21 | 3.14 | 4.17 |
| Strontium (Sr) | mg/L | - | - | 0.23 | 0.14 | 0.14 | 0.14 | 0.14 | 0.14 | 0.13 | 0.15 |
| Sulphur (S) | mg/L | - | - | 4.01 | 3.90 | 3.65 | 3.45 | 3.93 | 4.06 | 4.48 | 3.93 |
| Thallium (Tl) | mg/L | 0.00080 | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.00001 |
| Tin (Sn) | mg/L | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0001 |
| Titanium (Ti) | mg/L | - | - | 0.0024 | 0.0017 | 0.0015 | 0.0033 | 0.0028 | 0.0020 | 0.0023 | 0.0023 |
| Uranium (U) | mg/L | 0.015 | - | 0.0014 | 0.0011 | 0.0010 | 0.0012 | 0.0010 | 0.0012 | 0.0011 | 0.0011 |
| Vanadium (V) | mg/L | - | - | 0.00070 | 0.00075 | 0.00071 | 0.00093 | 0.00084 | 0.00069 | 0.00069 | 0.00076 |
| Zinc (Zn) | mg/L | 0.030 | - | 0.009 | 0.010 | 0.0077 | 0.0061 | 0.0044 | <0.0030 | <0.0030 | 0.0061 |
| Zirconium (Zr) | mg/L | - | - | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.00030 | <0.0003 |
| Dissolved Metals | | | | | | | | | | | |
| Aluminum (Al) | mg/L | - | 0.10 | 0.017 | 0.013 | 0.011 | 0.015 | 0.016 | 0.013 | 0.014 | 0.014 |
| Antimony (Sb) | mg/L | - | - | <0.00010 | <0.00010 | <0.00010 | 0.00010 | <0.00010 | 0.00010 | <0.00010 | <0.0001 |
| Arsenic (As) | mg/L | - | 0.0050 | 0.00045 | 0.00066 | 0.00064 | 0.00057 | 0.00066 | 0.00061 | 0.00057 | 0.00059 |
| Barium (Ba) | mg/L | - | - | 0.044 | 0.038 | 0.040 | 0.039 | 0.043 | 0.043 | 0.043 | 0.041 |
| Beryllium (Be) | mg/L | - | - | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.000020 | <0.00002 |
| Bismuth (Bi) | mg/L | - | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.00005 |
| Boron (B) | mg/L | - | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.01 |
| Cadmium (Cd) | mg/L | - | 0.00021 | <0.0000050 | 0.0000073 | 0.0000083 | 0.0000056 | 0.0000056 | <0.0000050 | <0.0000050 | 0.0000060 |
| Calcium (Ca) | mg/L | - | - | 36.4 | 22.1 | 21.5 | 20.7 | 21.4 | 21.8 | 20.8 | 23.5 |
| Chromium (Cr) | mg/L | - | 0.0010 | <0.00010 | 0.00015 | 0.00015 | 0.00013 | 0.00015 | 0.00014 | 0.00013 | 0.00014 |
| Cobalt (Co) | mg/L | - | - | 0.00013 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Copper (Cu) | mg/L | - | 0.013 / 0.02 ^h | 0.0014 | 0.0014 | 0.0013 | 0.0014 | 0.0014 | 0.0012 | 0.0011 | 0.0013 |
| Iron (Fe) | mg/L | - | 1.10 | 0.027 | 0.031 | 0.026 | 0.030 | 0.036 | 0.027 | 0.029 | 0.029 |
| Lead (Pb) | mg/L | - | 0.0040 | 0.000062 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000052 |
| Lithium (Li) | mg/L | - | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0010 | <0.001 |
| Magnesium (Mg) | mg/L | - | - | 6.84 | 5.70 | 5.69 | 5.61 | 6.00 | 6.05 | 5.91 | 5.97 |
| Manganese (Mn) | mg/L | - | - | 0.0031 | 0.0013 | 0.00083 | 0.0012 | 0.0024 | 0.0022 | 0.0035 | 0.0021 |
| Mercury (Hg) | mg/L | - | - | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| Molybdenum (Mo) | mg/L | - | 0.073 | 0.0018 | 0.0012 | 0.0012 | 0.0012 | 0.0014 | 0.0012 | 0.0013 | 0.0013 |
| Nickel (Ni) | mg/L | - | 0.11 | 0.00059 | 0.00060 | 0.00051 | 0.00070 | 0.00059 | 0.00056 | <0.00050 | 0.00058 |
| Phosphorus (P) | mg/L | - | <0.050 | 0.068 | 0.055 | 0.055 | <0.050 | 0.066 | <0.050 | 0.050 | 0.056 |
| Potassium (K) | mg/L | - | - | 1.85 | 0.93 | 0.84 | 0.86 | 0.80 | 0.83 | 0.83 | 0.99 |
| Selenium (Se) | mg/L | - | 0.0020 | 0.00016 | 0.00014 | 0.00013 | 0.00011 | 0.00011 | 0.00012 | 0.00017 | 0.00013 |
| Silicon (Si) | mg/L | - | - | 4.37 | 3.73 | 3.45 | 3.49 | 3.89 | 3.67 | 3.32 | 3.70 |
| Silver (Ag) | mg/L | - | 0.00010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.00001 |
| Sodium (Na) | mg/L | - | - | 9.49 | 3.49 | 3.08 | 3.17 | 3.33 | 3.05 | 3.11 | 4.10 |
| Strontium (Sr) | mg/L | - | - | 0.22 | 0.14 | 0.13 | 0.14 | 0.15 | 0.14 | 0.13 | 0.15 |
| Sulphur (S) | mg/L | - | - | 3.95 | 3.61 | 3.61 | 3.48 | 3.83 | 3.97 | 3.75 | 3.74 |
| Thallium (Tl) | mg/L | - | | | | | | | | | |

APPENDIX D
BENTHIC INVERTEBRATE COMMUNITY DATA

Methods and QC Report 2016

Project ID: Minto Mine EEM Monitoring 2016 (157202-0087); PO: 223066

Client: Minnow Environmental c/o Minto Explorations Ltd.



Cordillera
Consulting

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Sample Reception

On October 8, 2016, Cordillera Consulting received 15 benthic samples from Minnow Environmental on behalf of Minto Mines, Minto Explorations Ltd. When samples arrived to Cordillera Consulting, exterior packaging was initially inspected for damage or wet spots that would have indicated damage to the interior containers.

Next, samples were logged into a proprietary software database (INSTAR1) where the clients assigned sample name was recorded along with a Cordillera Consulting (CC) number for cross-reference. Each sample was checked to ensure that all sites and replicates recorded on field sheets or packing lists were delivered intact and with adequate preservative. Any missing, mislabelled or extra samples were reported to the client immediately to confirm the total numbers and correct names on the sample jars. The client representative was notified of the arrival of the shipment and provided a sample inventory once intake was completed.

See table below for sample inventory:

Table 1: Summary of sample information including Cordillera Consulting (CC) number

| Sample | CC# | Date | Size | # of Jars |
|--------|----------|-----------|-------|-----------|
| UMC-1 | CC171138 | 9/25/2016 | 500µM | 1 |
| UMC-2 | CC171139 | 9/22/2016 | 500µM | 1 |
| UMC-3 | CC171140 | 9/22/2016 | 500µM | 1 |
| UMC-4 | CC171141 | 9/25/2016 | 500µM | 1 |
| UMC-5 | CC171142 | 9/22/2016 | 500µM | 1 |
| REF-1 | CC171143 | 9/25/2016 | 500µM | 1 |
| REF-2 | CC171144 | 9/24/2016 | 500µM | 1 |
| REF-3 | CC171145 | 9/24/2016 | 500µM | 2 |
| REF-4 | CC171146 | 9/24/2016 | 500µM | 1 |
| REF-5 | CC171147 | 9/23/2016 | 500µM | 1 |
| REF-6 | CC171148 | 9/24/2016 | 500µM | 1 |
| REF-7 | CC171149 | 9/24/2016 | 500µM | 1 |
| REF-8 | CC171150 | 9/25/2016 | 500µM | 1 |

| | | | | |
|--------|----------|-----------|-------|---|
| REF-9 | CC171151 | 9/23/2016 | 500µM | 1 |
| REF-10 | CC171152 | 9/23/2016 | 500µM | 1 |

Sample Sorting

- Using a gridded Petri dish, fine forceps and a low power stereo-microscope (Olympus, Nikon, Leica) the sorting technicians removed the invertebrates and sorted them into family/orders.
- The sorting technician kept a running tally of total numbers excluding organisms from Porifera, Nemata, Platyhelminthes, Ostracoda, Copepoda, Cladocera and terrestrial drop-ins such as aphids. These organisms were marked for their presence (value of 1) and left in the sample. They were not included towards the 300-organism subsample count.
- Where specimens are broken or damaged, only heads were counted.
- Subsampling was conducted with the use of a Marchant Box.
- Cells were extracted at the same time in the order indicated by a random number table.
- If the 300th organism was found part way into sorting a cell then the balance of that cell was sorted. If the organism count had not reached 300 by the 50th cell then the entire sample was sorted.
- The total number of cells sorted and the number of organisms removed were recorded manually on a bench sheet and then recorded into INSTAR1
- Organisms were stored in vials containing 80% ethanol and an interior label indicating the site names, date of sampling, site code numbers and portion subsampled. This information was also recorded on the laboratory bench sheet and on INSTAR1.
- The sorted portion of the debris was preserved and labeled separately from the unsorted portion and was tested for sorting efficiency (Sorting Quality Control – Sorting Efficiency). The unsorted portion was also labeled and preserved in separate jars.

Percent sub-sampled and total countable invertebrates pulled from the samples were summarized in the table below.

Table 2: Percent sub-sample and invertebrate count for each sample

| Sample | Date | CC# | 500 micron fraction | |
|--------|-----------|----------|---------------------|-----------------|
| | | | % Sampled | # Invertebrates |
| UMC-1 | 25-Sep-16 | CC171138 | 100% | 301 |
| UMC-2 | 22-Sep-16 | CC171139 | 100% | 180 |
| UMC-3 | 22-Sep-16 | CC171140 | 100% | 264 |
| UMC-4 | 25-Sep-16 | CC171141 | 100% | 435 |
| UMC-5 | 22-Sep-16 | CC171142 | 100% | 267 |
| REF-1 | 25-Sep-16 | CC171143 | 75% | 370 |
| REF-2 | 24-Sep-16 | CC171144 | 25% | 332 |
| REF-3 | 24-Sep-16 | CC171145 | 50% | 351 |
| REF-4 | 24-Sep-16 | CC171146 | 100% | 145 |

| | | | | |
|--------|-----------|----------|------|-----|
| REF-5 | 23-Sep-16 | CC171147 | 50% | 381 |
| REF-6 | 24-Sep-16 | CC171148 | 100% | 354 |
| REF-7 | 24-Sep-16 | CC171149 | 100% | 357 |
| REF-8 | 25-Sep-16 | CC171150 | 50% | 328 |
| REF-9 | 23-Sep-16 | CC171151 | 6% | 324 |
| REF-10 | 23-Sep-16 | CC171152 | 25% | 597 |

Sorting Quality Control - Sorting Efficiency

As a part of Cordillera's laboratory policy, all projects undergo sorting efficiency checks.

- As sorting progresses, 10% of samples were randomly chosen by senior members of the sorting team for resorting.
- All sorters working on a project had at least 1 sample resorted by another sorter.
- An efficiency of 90 % was expected (95% for CABIN samples).
- If 90/95% efficiency was not met, samples from that sorter were resorted.
- To calculate sorting efficiency the following formula was used:

$$\frac{\#OrganismsMissed}{TotalOrganismsFound} * 100 = \% OM$$

Table 3: Summary of sorting efficiency

| CC # | Number of Organisms Recovered (initial sort) | Number of Organisms in Re-sort | Percent Recovery |
|------------------|--|--------------------------------|------------------|
| CC171139 | 180 | 4 | 98% |
| CC171140 | 264 | 6 | 98% |
| Average Recovery | | | 98% |

Sorting Quality Control - Sub-Sampling QC

Certain Provincial and Mining projects require additional sorting checks in the form of sub-sampling QC, (Environmental Effects Monitoring (EEM) protocol). This ensured that any fraction of the total sample that was examined was actually an accurate representation of the number of total organisms. Organisms from the additional sub-samples were not identified; rather total organism count only was compared.

Sub-Sampling efficiency was measured on 10% of the number of sub-sampled samples in the project. Ex. In a project where 50 of 100 total samples were processed through subsampling using a Marchant box, then 10% of 50; or 5 samples were used for sub sampling efficiency.

Sub-Sampling efficiency was performed by fractioning the entire sample into sub-sample percentages. On each sub-sampled portion, a total organism count was recorded and

compared to the rest of the sub-samples. In order to pass, all fractions were required to be within 20% of total organism count.

Example: If 300 organisms are found in 10% of the sample, the sorter will continue to sample in 10% fractions until the entire sample is separated. They will then count the total number of organisms in each of the 10 fractions of 10% and compare the organism count.

When divergence is >20% the sorting manager examines for the source of the problem and takes steps to correct it. With the Marchant box, the problem typically rested with how the box is flipped back to the upright position. For this reason subsampling was performed by experienced employees only. Another common source of error would be the type of debris in the sample. Samples with algae or heavy with periphyton have a higher incident of failure due to clumping than clear samples.

NOTE: A single member of our staff sorted this entire project. This experienced staff member upon conducting sub-sampling QC failed the first 2 QC samples that were examined. We recognized a problem with the sub-sampling device, and repeated all of the sub-sampled samples from this project. The results below are from the repeated QAQC after fixing our equipment.

Taxonomic Effort

The next procedure was the identification to genus-species level where possible of all the organisms in the sample.

- Identifications were made at the genus/species level for all insect organisms found including Chironomidae (Based on CABIN protocol).
- Non-insect organisms (except those not included in CABIN count) were identified to genus/species where possible and to a minimum of family level with intact and mature specimens.
- The Standard Taxonomic Effort lists compiled by the CABIN manual¹, SAFIT², and PNAMP³ were used as a guide line for what level of identification to achieve where the condition and maturity of the organism enabled.
- Organisms from the same families/order were kept in separate vials with 80% ethanol and an interior label of printed laser paper.
- Chironomidae was identified to genus/species level where possible and was aided by slide mounts. CMC-10 was used to clear and mount the slide.
- Oligochaetes was identified to family/genus level with the aid of slide mounts. CMC-10 was used to clear and mount the slide.
- Other Annelida (leeches, polychaetes) were identified to the family/genus/species level with undamaged, mature specimens.
- Mollusca was identified to family and genus/species where possible
- Decapoda, Amphipoda and Isopoda were identified at family/genus/species level where possible.
- Bryozoans and Nemata remained at the phylum level
- Hydrachnidae and Cnidaria were identified at the family/genus level where possible.
- When requested, reference collections were made containing at least one individual from each taxa listed. Organisms represented will have been identified to the lowest practical level.
- Reference collection specimens were stored in 55 mm glass vials with screw-cap lids with polyseal inserts (museum quality). They were labeled with taxa name, site code, date identified and taxonomist name. The same information was applied to labels on the slide mounts.

Taxonomy Staff

The taxonomists for this project were certified by the Society of Freshwater Science (SFS) Taxonomic Certification Program at level 2 which is the required certification for CABIN projects:

Sue Salter: Group 1 General Arthropods (West); Group 2 EPT (East/West); Group 3 Chironomidae (East/West); Group 4 Oligochaeta

Scott Finlayson: Group 1 General Arthropods (East/West); Group 2 EPT (East/West); Group 3 Chironomidae (East/West); Group 4 Oligochaeta

Adam Bliss: Group 1 General Arthropods (East/West); Group 2 EPT (East/West);
Group 3 Chironomidae
Rita Avery: Group 1 General Arthropods (East/West); Group 2 EPT (East/West)
Qi Liu: Group 3 Chironomid (East/West)

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² Southwest Association of Freshwater Invertebrate Taxonomists. (2015). www.safit.org

³ Pacific Northwest Aquatic Monitoring Partnership (Accessed 2015). www.pnamp.org

Taxonomic Keys

Below is a reference list of taxonomic keys utilized by taxonomists at Cordillera Consulting. Cordillera taxonomists routinely seek out new literature to ensure the most accurate identification keys are being utilized. This is not reflective of the exhaustive list of resources that we use for identification. A more complete list of taxonomic resources can be found at Southwest Association of Freshwater Invertebrate Taxonomists. (2015). http://www.safit.org/Docs/SAFIT_Taxonomic_Literature_Database_1_March_2011.enl

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| | Site: UMC | UMC | UMC | UMC | UMC | REF | REF | REF | REF | REF | REF | REF | REF | REF | |
|---------------------------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | Sample: UMC-1 | UMC-2 | UMC-3 | UMC-4 | UMC-5 | REF-1 | REF-2 | REF-3 | REF-4 | REF-5 | REF-6 | REF-7 | REF-8 | REF-9 | REF-10 |
| Sample Collection Date: | 25-Sep-16 | 22-Sep-16 | 22-Sep-16 | 25-Sep-16 | 22-Sep-16 | 25-Sep-16 | 24-Sep-16 | 24-Sep-16 | 24-Sep-16 | 23-Sep-16 | 24-Sep-16 | 24-Sep-16 | 25-Sep-16 | 23-Sep-16 | 23-Sep-16 |
| CC#: | CC171138 | CC171139 | CC171140 | CC171141 | CC171142 | CC171143 | CC171144 | CC171145 | CC171146 | CC171147 | CC171148 | CC171149 | CC171150 | CC171151 | CC171152 |
| Phylum: Arthropoda | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Collembola | 2 | 0 | 3 | 14 | 0 | 1 | 4 | 2 | 1 | 0 | 2 | 0 | 0 | 0 | 12 |
| Family: Onychiuridae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 |
| Subphylum: Hexapoda | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Insecta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Ephemeroptera | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Ameletidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Ameletus</i> | 16 | 10 | 5 | 21 | 7 | 101 | 12 | 0 | 0 | 32 | 184 | 13 | 20 | 0 | 96 |
| Family: Baetidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Baetis</i> | 3 | 2 | 2 | 6 | 5 | 1 | 0 | 0 | 1 | 16 | 2 | 3 | 0 | 133 | 16 |
| <i>Baetis tricaudatus group</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Baetis bicaudatus</i> | 16 | 5 | 12 | 10 | 9 | 1 | 0 | 0 | 0 | 0 | 6 | 32 | 0 | 867 | 204 |
| Family: Ephemerellidae | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 117 | 0 |
| <i>Drunella</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Drunella grandis group</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| <i>Drunella doddsii</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Family: Heptageniidae | 1 | 0 | 0 | 1 | 0 | 0 | 68 | 0 | 0 | 0 | 1 | 1 | 44 | 0 | 0 |
| <i>Cinygmula</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Order: Plecoptera | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Capniidae | 11 | 7 | 13 | 14 | 8 | 23 | 28 | 90 | 1 | 24 | 4 | 8 | 22 | 33 | 48 |
| Family: Chloroperlidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 8 |
| <i>Haploperla</i> | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 5 | 0 | 0 | 12 |
| <i>Sweltsa</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Family: Leuctridae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| Family: Nemouridae | 11 | 3 | 5 | 3 | 10 | 128 | 284 | 40 | 71 | 0 | 12 | 13 | 12 | 67 | 0 |
| <i>Nemoura</i> | 4 | 5 | 9 | 8 | 4 | 0 | 76 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Ostrocerca</i> | 0 | 0 | 0 | 0 | 0 | 5 | 200 | 0 | 2 | 0 | 3 | 0 | 2 | 0 | 0 |
| <i>Podmosta</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 2 | 0 | 0 | 0 | 2 | 0 | 0 |
| <i>Zapada</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 0 | 3 | 0 | 317 | 56 |
| <i>Zapada oregonensis group</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 74 | 0 | 16 | 0 | 17 | 0 |
| <i>Zapada cinctipes</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 67 | 64 |
| <i>Zapada columbiana</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 104 |
| Family: Perlodidae | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| <i>Skwala</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 4 | 0 | 0 |
| Family: Taeniopterygidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 4 | 0 | 67 | 0 |
| Order: Trichoptera | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Hydropsychidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 0 |
| Family: Limnephilidae | 0 | 0 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Chyrandra centralis</i> | 8 | 1 | 2 | 2 | 1 | 35 | 0 | 0 | 0 | 12 | 3 | 0 | 6 | 0 | 0 |
| <i>Clostoeca disjuncta</i> | 0 | 2 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Ecclisomyia</i> | 6 | 6 | 8 | 11 | 9 | 0 | 0 | 0 | 0 | 64 | 1 | 0 | 4 | 0 | 12 |
| Family: Rhyacophilidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Rhyacophila</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| <i>Rhyacophila vofixa group</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Family: Uenoidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Neothremma</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |

| Site: | UMC | UMC | UMC | UMC | UMC | REF | REF | REF | REF | REF | REF | REF | REF | REF | REF |
|-------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Sample: | UMC-1 | UMC-2 | UMC-3 | UMC-4 | UMC-5 | REF-1 | REF-2 | REF-3 | REF-4 | REF-5 | REF-6 | REF-7 | REF-8 | REF-9 | REF-10 |
| Sample Collection Date: | 25-Sep-16 | 22-Sep-16 | 22-Sep-16 | 25-Sep-16 | 22-Sep-16 | 25-Sep-16 | 24-Sep-16 | 24-Sep-16 | 24-Sep-16 | 23-Sep-16 | 24-Sep-16 | 24-Sep-16 | 25-Sep-16 | 23-Sep-16 | 23-Sep-16 |
| CC#: | CC171138 | CC171139 | CC171140 | CC171141 | CC171142 | CC171143 | CC171144 | CC171145 | CC171146 | CC171147 | CC171148 | CC171149 | CC171150 | CC171151 | CC171152 |
| Order: Coleoptera | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Carabidae | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Hydraenidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Hydraena</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Family: Staphylinidae | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Diptera | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Family: Chironomidae | 3 | 5 | 0 | 6 | 0 | 0 | 0 | 2 | 0 | 14 | 1 | 0 | 12 | 50 | 0 |
| Subfamily: Chironominae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tribe: Chironomini | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Stictochironomus</i> | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tribe: Tanytarsini | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Micropsectra</i> | 39 | 8 | 41 | 31 | 20 | 11 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 83 | 0 |
| <i>Paratanytarsus</i> | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Rheotanytarsus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Subfamily: Diamesinae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Pseudokiefferiella</i> | 0 | 0 | 0 | 0 | 0 | 0 | 32 | 26 | 1 | 0 | 0 | 0 | 12 | 0 | 0 |
| Tribe: Diamesini | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Diamesa</i> | 0 | 0 | 3 | 3 | 4 | 3 | 0 | 38 | 0 | 202 | 1 | 6 | 224 | 50 | 172 |
| <i>Paqastia</i> | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 3 | 46 | 117 | 1028 |
| <i>Pseudodiamesa</i> | 14 | 2 | 10 | 15 | 12 | 25 | 60 | 4 | 1 | 32 | 42 | 5 | 52 | 33 | 8 |
| Subfamily: Orthoclaadiinae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Brillia</i> | 4 | 1 | 10 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Chaetocladius</i> | 0 | 0 | 0 | 0 | 0 | 0 | 44 | 106 | 1 | 0 | 1 | 0 | 6 | 0 | 0 |
| <i>Corynoneura</i> | 2 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Diplocladius cultriger</i> | 7 | 1 | 3 | 22 | 2 | 4 | 0 | 0 | 6 | 2 | 1 | 0 | 0 | 33 | 0 |
| <i>Eukiefferiella</i> | 22 | 33 | 24 | 58 | 21 | 16 | 228 | 288 | 5 | 2 | 21 | 177 | 50 | 50 | 60 |
| <i>Hydrobaenus</i> | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Krenosmittia</i> | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Limnophyes</i> | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 |
| <i>Metriocnemus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Orthocladus complex</i> | 39 | 60 | 36 | 101 | 40 | 37 | 112 | 16 | 4 | 4 | 0 | 0 | 4 | 600 | 0 |
| <i>Orthocladus lignicola</i> | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Paraphaenocladus</i> | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Parorthocladus</i> | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 |
| <i>Psectrocladius</i> | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Rheocricotopus</i> | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 | 0 |
| <i>Tvetenia</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 2167 | 36 |
| Subfamily: Podonominae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Trichotanypus</i> | 1 | 1 | 5 | 0 | 2 | 12 | 100 | 2 | 9 | 6 | 2 | 0 | 0 | 0 | 0 |
| Family: Empididae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Chelifera/Metachela</i> | 13 | 1 | 2 | 6 | 2 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 117 | 0 |
| <i>Clinocera</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| <i>Clinocerinae Unknown Genus A</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 |
| <i>Neoplasta</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 67 | 0 |
| <i>Oreogeton</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |
| Family: Muscidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Limnophora</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Psychodidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Pericoma/Telmatoscopus</i> | 3 | 5 | 10 | 26 | 14 | 1 | 0 | 0 | 0 | 18 | 33 | 8 | 10 | 183 | 44 |
| Family: Simuliidae | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 2 | 0 | 4 | 0 | 17 | 0 |
| <i>Gymnopsis</i> | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Prosimulium</i> | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 174 | 1 | 3 | 2 | 0 | 260 |
| <i>Simulium</i> | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 4 |
| Family: Syrphidae | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Tipulidae | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Dicranota</i> | 14 | 6 | 16 | 14 | 13 | 29 | 16 | 28 | 24 | 18 | 12 | 5 | 8 | 50 | 8 |

| Site: | UMC | UMC | UMC | UMC | UMC | REF | REF | REF | REF | REF | REF | REF | REF | REF | REF |
|-------------------------|------------|------------|------------|------------|------------|------------|-------------|------------|------------|------------|------------|------------|------------|-------------|-------------|
| Sample: | UMC-1 | UMC-2 | UMC-3 | UMC-4 | UMC-5 | REF-1 | REF-2 | REF-3 | REF-4 | REF-5 | REF-6 | REF-7 | REF-8 | REF-9 | REF-10 |
| Sample Collection Date: | 25-Sep-16 | 22-Sep-16 | 22-Sep-16 | 25-Sep-16 | 22-Sep-16 | 25-Sep-16 | 24-Sep-16 | 24-Sep-16 | 24-Sep-16 | 23-Sep-16 | 24-Sep-16 | 24-Sep-16 | 25-Sep-16 | 23-Sep-16 | 23-Sep-16 |
| CC#: | CC171138 | CC171139 | CC171140 | CC171141 | CC171142 | CC171143 | CC171144 | CC171145 | CC171146 | CC171147 | CC171148 | CC171149 | CC171150 | CC171151 | CC171152 |
| Order: Lepidoptera | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Subphylum: Chelicerata | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Arachnida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Trombidiformes | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Lebertiidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Lebertia</i> | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| Family: Sperchontidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Sperchon</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 52 |
| Order: Sarcoptiformes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Oribatida | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Malacostraca | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Amphipoda | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Corophiidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Americorophium</i> | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Phylum: Annelida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subphylum: Clitellata | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Oligochaeta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Lumbriculida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Lumbriculidae | 53 | 11 | 27 | 38 | 77 | 28 | 28 | 16 | 2 | 2 | 13 | 3 | 114 | 33 | 4 |
| <i>Rhynchelmis</i> | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Order: Tubificida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Naididae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Tubifex</i> | 0 | 3 | 2 | 1 | 0 | 0 | 0 | 10 | 2 | 10 | 0 | 10 | 0 | 0 | 0 |
| Subfamily: Tubificinae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Spirosperma</i> | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals: | 299 | 178 | 262 | 432 | 266 | 487 | 1324 | 698 | 145 | 758 | 352 | 356 | 656 | 5385 | 2384 |

Taxa present but not included:

| | | | | | | | | | | | | | | | |
|-------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|
| <i>Terrestrials</i> | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Phylum: Arthropoda | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subphylum: Crustacea | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Ostracoda | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Class: Maxillipoda | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Copepoda | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Phylum: Nemata | 0 | 0 | 0 | 1 | 0 | 1 | 4 | 2 | 0 | 2 | 0 | 0 | 0 | 17 | 0 |
| Phylum: Platyhelminthes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Turbellaria | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 1 | 1 | 0 | 0 | 4 |
| Totals: | 2 | 2 | 2 | 3 | 1 | 2 | 4 | 4 | 0 | 4 | 2 | 1 | 0 | 17 | 4 |

Table D.1: Benthic Invertebrate Community (Organisms/m²) at the Lowest Practical Level of Taxonomic Resolution, Minto Mine, Phase 4, 2016

| Invertebrates | UMC-1 | UMC-2 | UMC-3 | UMC-4 | UMC-5 | REF-1 | REF-2 | REF-3 | REF-4 | REF-5 | REF-6 | REF-7 | REF-8 | REF-9 | REF-10 |
|---------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Phylum: Arthropoda | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Collembola | 7.2 | 0 | 11 | 50 | 0 | 3.6 | 14 | 7.2 | 3.6 | 0 | 7.2 | 0 | 0 | 0 | 43 |
| Family: Onychiuridae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 0 |
| Subphylum: Hexapoda | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Insecta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Ephemeroptera | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Ameletidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Ameletus</i> | 57 | 36 | 18 | 75 | 25 | 362 | 43 | 0 | 0 | 115 | 660 | 47 | 72 | 0 | 344 |
| Family: Baetidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Baetis</i> | 11 | 7.2 | 7.2 | 22 | 18 | 3.6 | 0 | 0 | 3.6 | 57 | 7.2 | 11 | 0 | 477 | 57 |
| <i>Baetis tricaudatus</i> group | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Baetis bicaudatus</i> | 57 | 18 | 43 | 36 | 32 | 3.6 | 0 | 0 | 0 | 0 | 22 | 115 | 0 | 3,111 | 732 |
| Family: Ephemerellidae | 0 | 0 | 3.6 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 420 | 0 |
| <i>Drunella grandis</i> group | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| <i>Drunella doddsii</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 |
| Family: Heptageniidae | 3.6 | 0 | 0 | 3.6 | 0 | 0 | 244 | 0 | 0 | 0 | 3.6 | 3.6 | 158 | 0 | 0 |
| <i>Cinygmula</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 |
| Order: Plecoptera | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Capniidae | 39 | 25 | 47 | 50 | 29 | 83 | 100 | 323 | 3.6 | 86 | 14 | 29 | 79 | 118 | 172 |
| Family: Chloroperlidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 29 |
| <i>Haploperla</i> | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 0 | 18 | 0 | 0 | 43 |
| <i>Sweltsa</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| Family: Leuctridae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 3.6 | 0 | 0 | 0 |
| Family: Nemouridae | 39 | 11 | 18 | 11 | 36 | 459 | 1,019 | 144 | 255 | 0 | 43 | 47 | 43 | 240 | 0 |
| <i>Nemoura</i> | 14 | 18 | 32 | 29 | 14 | 0 | 273 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Ostrocerca</i> | 0 | 0 | 0 | 0 | 0 | 18 | 718 | 0 | 7.2 | 0 | 11 | 0 | 7.2 | 0 | 0 |
| <i>Podmosta</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57 | 7.2 | 0 | 0 | 0 | 7.2 | 0 | 0 |
| <i>Zapada</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57 | 0 | 11 | 0 | 1,137 | 201 |
| <i>Zapada oregonensis</i> group | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 266 | 0 | 57 | 0 | 61 | 0 |
| <i>Zapada cinctipes</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 240 | 230 |
| <i>Zapada columbiana</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 373 |
| Family: Perlodidae | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 |
| <i>Skwala</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 14 | 0 | 0 |
| Family: Taeniopterygidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 14 | 0 | 240 | 0 |
| Order: Trichoptera | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Hydropsychidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 61 | 0 |
| Family: Limnephilidae | 0 | 0 | 0 | 0 | 0 | 61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Chyrandra centralis</i> | 29 | 3.6 | 7.2 | 7.2 | 3.6 | 126 | 0 | 0 | 0 | 43 | 11 | 0 | 22 | 0 | 0 |
| <i>Clostoeca disjuncta</i> | 0 | 7.2 | 11 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Ecclisomyia</i> | 22 | 22 | 29 | 39 | 32 | 0 | 0 | 0 | 0 | 230 | 3.6 | 0 | 14 | 0 | 43 |
| Family: Rhyacophilidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Rhyacophila</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| <i>Rhyacophila vofixa</i> group | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43 |
| Family: Uenoidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Neothremma</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 |

Notes: Samples processed in the lab using a 500 µm sieve. The numbers provided at higher levels of taxonomy (order, class, sub-phylum, or phylum) do not represent totals for that level of taxonomy. Rather, if a number other than zero is provided at a higher level of taxonomy, it represents any organism(s) within that taxonomic group that could not be assigned to a lower level of taxonomy.

Table D.1: Benthic Invertebrate Community (Organisms/m²) at the Lowest Practical Level of Taxonomic Resolution, Minto Mine, Phase 4, 2016

| Invertebrates | UMC-1 | UMC-2 | UMC-3 | UMC-4 | UMC-5 | REF-1 | REF-2 | REF-3 | REF-4 | REF-5 | REF-6 | REF-7 | REF-8 | REF-9 | REF-10 |
|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Order: Coleoptera | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Carabidae | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Hydraenidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hydraena | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 |
| Family: Staphylinidae | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Diptera | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 |
| Family: Chironomidae | 11 | 18 | 0 | 22 | 0 | 0 | 0 | 7.2 | 0 | 50 | 3.6 | 0 | 43 | 179 | 0 |
| Subfamily: Chironominae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tribe: Chironomini | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stictochironomus | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tribe: Tanytarsini | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Micropsectra | 140 | 29 | 147 | 111 | 72 | 39 | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 298 | 0 |
| Paratanytarsus | 3.6 | 0 | 0 | 3.6 | 7.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rheotanytarsus | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 |
| Subfamily: Diamesinae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pseudokiefferiella | 0 | 0 | 0 | 0 | 0 | 0 | 115 | 93 | 3.6 | 0 | 0 | 0 | 43 | 0 | 0 |
| Tribe: Diamesini | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Diamesa | 0 | 0 | 11 | 11 | 14 | 11 | 0 | 136 | 0 | 725 | 3.6 | 22 | 804 | 179 | 617 |
| Pagastia | 0 | 0 | 0 | 7.2 | 3.6 | 0 | 0 | 0 | 0 | 7.2 | 0 | 11 | 165 | 420 | 3,688 |
| Pseudodiamesa | 50 | 7.2 | 36 | 54 | 43 | 90 | 215 | 14 | 3.6 | 115 | 151 | 18 | 187 | 118 | 29 |
| Subfamily: Orthoclaadiinae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Brillia | 14 | 3.6 | 36 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chaetocladius | 0 | 0 | 0 | 0 | 0 | 0 | 158 | 380 | 3.6 | 0 | 3.6 | 0 | 22 | 0 | 0 |
| Corynoneura | 7.2 | 0 | 3.6 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Diplocladius cultriger | 25 | 3.6 | 11 | 79 | 7.2 | 14 | 0 | 0 | 22 | 7.2 | 3.6 | 0 | 0 | 118 | 0 |
| Eukiefferiella | 79 | 118 | 86 | 208 | 75 | 57 | 818 | 1,033 | 18 | 7.2 | 75 | 635 | 179 | 179 | 215 |
| Hydrobaenus | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Krenosmittia | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 |
| Limnophyes | 0 | 0 | 3.6 | 0 | 0 | 3.6 | 0 | 0 | 3.6 | 0 | 0 | 7.2 | 0 | 0 | 0 |
| Metriocnemus | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 | 7.2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Orthocladus complex | 140 | 215 | 129 | 362 | 144 | 133 | 402 | 57 | 14 | 14 | 0 | 0 | 14 | 2,153 | 0 |
| Orthocladus lignicola | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 |
| Paraphaenocladus | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Parorthocladus | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 3.6 | 0 | 0 | 0 |
| Psectrocladius | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rheocricotopus | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 118 | 0 |
| Tvetenia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 3.6 | 0 | 7,775 | 129 |
| Subfamily: Podonominae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Trichotanypus | 3.6 | 3.6 | 18 | 0 | 7.2 | 43 | 359 | 7.2 | 32 | 22 | 7.2 | 0 | 0 | 0 | 0 |
| Family: Empididae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chelifera/ Metachela | 47 | 3.6 | 7.2 | 22 | 7.2 | 0 | 0 | 0 | 0 | 36 | 0 | 0 | 0 | 420 | 0 |
| Clinocera | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| Clinocerinae Unknown Genus A | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43 | 0 | 0 | 0 |
| Neoplasta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 240 | 0 |
| Oreogeton | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |

Notes: Samples processed in the lab using a 500 µm sieve. The numbers provided at higher levels of taxonomy (order, class, sub-phylum, or phylum) do not represent totals for that level of taxonomy. Rather, if a number other than zero is provided at a higher level of taxonomy, it represents any organism(s) within that taxonomic group that could not be assigned to a lower level of taxonomy.

Table D.1: Benthic Invertebrate Community (Organisms/m²) at the Lowest Practical Level of Taxonomic Resolution, Minto Mine, Phase 4, 2016

| Invertebrates | UMC-1 | UMC-2 | UMC-3 | UMC-4 | UMC-5 | REF-1 | REF-2 | REF-3 | REF-4 | REF-5 | REF-6 | REF-7 | REF-8 | REF-9 | REF-10 |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Family: Muscidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Limnophora</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Psychodidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Pericoma/Telmatoscopus</i> | 11 | 18 | 36 | 93 | 50 | 3.6 | 0 | 0 | 0 | 65 | 118 | 29 | 36 | 657 | 158 |
| Family: Simuliidae | 0 | 0 | 0 | 0 | 0 | 0 | 43 | 0 | 0 | 7.2 | 0 | 14 | 0 | 61 | 0 |
| <i>Gymnopais</i> | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Prosimulium</i> | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 3.6 | 624 | 3.6 | 11 | 7.2 | 0 | 933 |
| <i>Simulium</i> | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 7.2 | 0 | 0 | 0 | 7.2 | 0 | 0 | 14 |
| Family: Syrphidae | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Tipulidae | 3.6 | 0 | 3.6 | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Dicranota</i> | 50 | 22 | 57 | 50 | 47 | 104 | 57 | 100 | 86 | 65 | 43 | 18 | 29 | 179 | 29 |
| Order: Lepidoptera | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 |
| Subphylum: Chelicerata | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Arachnida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Trombidiformes | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Lebertiidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Lebertia</i> | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 72 |
| Family: Sperchontidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Sperchon</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 | 187 |
| Order: Oribatida | 0 | 0 | 3.6 | 0 | 3.6 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Malacostraca | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Amphipoda | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Corophiidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Americorophium</i> | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Phylum: Annelida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subphylum: Clitellata | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Oligochaeta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Lumbriculida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Lumbriculidae | 190 | 39 | 97 | 136 | 276 | 100 | 100 | 57 | 7.2 | 7.2 | 47 | 11 | 409 | 118 | 14 |
| <i>Rhynchelmis</i> | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 7.2 | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 |
| Order: Tubificida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Naididae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Tubifex</i> | 0 | 11 | 7.2 | 3.6 | 0 | 0 | 0 | 36 | 7.2 | 36 | 0 | 36 | 0 | 0 | 0 |
| Subfamily: Tubificinae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Spirosperma</i> | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Notes: Samples processed in the lab using a 500 µm sieve. The numbers provided at higher levels of taxonomy (order, class, sub-phylum, or phylum) do not represent totals for that level of taxonomy. Rather, if a number other than zero is provided at a higher level of taxonomy, it represents any organism(s) within that taxonomic group that could not be assigned to a lower level of taxonomy.

Table D.2: Benthic Invertebrate Community (Organisms/m²) at the Family Level of Taxonomic Resolution, Minto Mine, Phase 4, 2016

| Invertebrates | UMC-1 | UMC-2 | UMC-3 | UMC-4 | UMC-5 | REF-1 | REF-2 | REF-3 | REF-4 | REF-5 | REF-6 | REF-7 | REF-8 | REF-9 | REF-10 |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|
| Phylum: Arthropoda | | | | | | | | | | | | | | | |
| Order: Collembola | 7.2 | 0 | 11 | 50 | 0 | 3.6 | 14 | 7.2 | 3.6 | 0 | 7.2 | 22 | 0 | 0 | 43 |
| Family: Onychiuridae | | | | | | | | | | | | | | | |
| Subphylum: Hexapoda | | | | | | | | | | | | | | | |
| Class: Insecta | | | | | | | | | | | | | | | |
| Order: Ephemeroptera | | | | | | | | | | | | | | | |
| Family Ameletidae | 57 | 36 | 18 | 75 | 25 | 362 | 43 | 0 | 0 | 115 | 660 | 47 | 72 | 0 | 344 |
| Family Baetidae | 68 | 25 | 50 | 57 | 50 | 7.2 | 0 | 0 | 7.2 | 57 | 29 | 126 | 0 | 3,588 | 789 |
| Family Ephemerellidae | 0 | 0 | 3.6 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 420 | 14 |
| Family Heptageniidae | 3.6 | 0 | 0 | 3.6 | 0 | 0 | 244 | 0 | 0 | 7.2 | 3.6 | 3.6 | 158 | 0 | 0 |
| Order: Plecoptera | | | | | | | | | | | | | | | |
| Family Capniidae | 39 | 25 | 47 | 50 | 29 | 83 | 100 | 323 | 3.6 | 86 | 14 | 29 | 79 | 118 | 172 |
| Family Chloroperlidae | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 36 | 0 | 18 | 0 | 0 | 86 |
| Family Leuctridae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 3.6 | 0 | 0 | 0 |
| Family Nemouridae | 54 | 29 | 50 | 39 | 50 | 477 | 2,009 | 201 | 276 | 323 | 54 | 115 | 57 | 1,679 | 804 |
| Family Perlodidae | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 0 | 0 | 7.2 | 0 | 22 | 14 | 0 | 0 |
| Family Taeniopterygidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 14 | 0 | 240 | 0 |
| Order: Trichoptera | | | | | | | | | | | | | | | |
| Family Hydropsychidae | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family Limnephilidae | 50 | 32 | 47 | 50 | 36 | 187 | 0 | 0 | 0 | 273 | 14 | 0 | 36 | 0 | 43 |
| Family Rhyacophilidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57 |
| Family Uenoidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 |
| Order: Coleoptera | | | | | | | | | | | | | | | |
| Family Carabidae | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family Hydraenidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 |
| Family Staphylinidae | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Diptera | | | | | | | | | | | | | | | |
| Family Chironomidae | 477 | 398 | 492 | 911 | 373 | 395 | 2,081 | 1,737 | 122 | 947 | 258 | 703 | 1,457 | 11,539 | 4,679 |
| Family Empididae | 47 | 3.6 | 7.2 | 22 | 7.2 | 0 | 0 | 0 | 0 | 43 | 0 | 43 | 0 | 660 | 115 |
| Family Muscidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family Psychodidae | 11 | 18 | 36 | 93 | 50 | 3.6 | 0 | 0 | 0 | 65 | 118 | 29 | 36 | 657 | 158 |
| Family Simuliidae | 0 | 0 | 0 | 0 | 0 | 22 | 43 | 7.2 | 3.6 | 631 | 3.6 | 32 | 7.2 | 61 | 947 |
| Family Syrphidae | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family Tipulidae | 54 | 22 | 61 | 50 | 47 | 108 | 57 | 100 | 86 | 65 | 43 | 18 | 29 | 179 | 29 |
| Order: Lepidoptera | | | | | | | | | | | | | | | |
| Subphylum: Chelicerata | | | | | | | | | | | | | | | |
| Class: Arachnida | | | | | | | | | | | | | | | |
| Order: Trombidiformes | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family Lebertiidae | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 72 |
| Family Spermontidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.6 | 0 | 0 | 0 | 187 |
| Order: Oribatida | 0 | 0 | 3.6 | 0 | 3.6 | 0 | 0 | 7.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Malacostraca | | | | | | | | | | | | | | | |
| Order: Amphipoda | | | | | | | | | | | | | | | |
| Family Corophiidae | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Phylum: Annelida | | | | | | | | | | | | | | | |
| Subphylum: Clitellata | | | | | | | | | | | | | | | |
| Class: Oligochaeta | | | | | | | | | | | | | | | |
| Order: Lumbriculida | | | | | | | | | | | | | | | |
| Family Lumbriculidae | 190 | 39 | 97 | 136 | 276 | 100 | 115 | 65 | 7.2 | 7.2 | 50 | 11 | 409 | 118 | 14 |
| Order: Tubificida | | | | | | | | | | | | | | | |
| Family Naididae | 3.6 | 11 | 7.2 | 3.6 | 0 | 0 | 0 | 36 | 7.2 | 36 | 0 | 36 | 0 | 0 | 0 |

Table D.3: Benthic Endpoints from Reference and Exposed Stations, Minto Mine, Phase 4, 2016

| Area | Station ID | Density / Abundance | Lowest Practical Level | | | Family Level | | | EPT | | Ephemeroptera | | Plecoptera | | Trichoptera | | Chironomidae | | Diptera (excluding Chironomidae) | | Oligocheata | |
|-----------|------------|---------------------|------------------------|----------------------|----------------------|--------------|----------------------|----------------------|-------------|-----------------------|---------------|-----------------------|------------|-----------------------|-------------|-----------------------|--------------|-----------------------|----------------------------------|-----------------------|-------------|-----------------------|
| | | | Richness | Evenness (Simpson's) | Bray Curtis Distance | Richness | Evenness (Simpson's) | Bray Curtis Distance | (%) | (org/m ²) | (%) | (org/m ²) | (%) | (org/m ²) | (%) | (org/m ²) | (%) | (org/m ²) | (%) | (org/m ²) | (%) | (org/m ²) |
| Reference | REF-1 | 1,747 | 22 | 0.32 | 0.43 | 11 | 0.48 | 0.45 | 64 | 1,116 | 21 | 370 | 32 | 560 | 11 | 187 | 23 | 395 | 7.6 | 133 | 5.7 | 100 |
| | REF-2 | 4,750 | 18 | 0.39 | 0.69 | 11 | 0.24 | 0.46 | 51 | 2,440 | 6.0 | 287 | 45 | 2,138 | 0.30 | 14 | 44 | 2,081 | 2.1 | 100 | 2.4 | 115 |
| | REF-3 | 2,504 | 18 | 0.25 | 0.60 | 11 | 0.18 | 0.26 | 21 | 524 | 0 | 0 | 21 | 524 | 0 | 0 | 69 | 1,737 | 4.9 | 122 | 4.0 | 100 |
| | REF-4 | 520 | 24 | 0.32 | 0.47 | 10 | 0.27 | 0.59 | 56 | 291 | 1.4 | 7.2 | 54 | 283 | 0 | 0 | 23 | 122 | 17 | 90 | 2.8 | 14 |
| | REF-5 | 2,720 | 26 | 0.25 | 0.57 | 18 | 0.27 | 0.32 | 34 | 919 | 6.6 | 179 | 17 | 459 | 10 | 280 | 35 | 947 | 30 | 804 | 1.6 | 43 |
| | REF-6 | 1,263 | 21 | 0.16 | 0.59 | 14 | 0.22 | 0.65 | 62 | 779 | 55 | 696 | 5.4 | 68 | 1.1 | 14 | 20 | 258 | 13 | 165 | 4.0 | 50 |
| | REF-7 | 1,277 | 26 | 0.14 | 0.55 | 18 | 0.17 | 0.36 | 29 | 377 | 14 | 176 | 16 | 201 | 0 | 0 | 55 | 703 | 9.8 | 126 | 3.7 | 47 |
| | REF-8 | 2,354 | 19 | 0.30 | 0.58 | 11 | 0.22 | 0.27 | 18 | 416 | 9.8 | 230 | 6.4 | 151 | 1.5 | 36 | 62 | 1,457 | 3.0 | 72 | 17 | 409 |
| | REF-9 | 19,321 | 22 | 0.21 | 0.90 | 12 | 0.21 | 0.83 | 32 | 6,107 | 21 | 4,008 | 11 | 2,038 | 0.32 | 61 | 60 | 11,539 | 8.1 | 1,557 | 0.61 | 118 |
| | REF-10 | 8,554 | 26 | 0.17 | 0.82 | 17 | 0.18 | 0.66 | 27 | 2,311 | 13 | 1,148 | 12 | 1,062 | 1.2 | 100 | 55 | 4,679 | 15 | 1,249 | 0.17 | 14 |
| | | Mean | 4,501 | 22 | 0.25 | 0.62 | 13 | 0.24 | 0.49 | 39 | 1,528 | 15 | 710 | 22 | 748 | 2.5 | 69 | 45 | 2,392 | 11 | 442 | 4.2 |
| | SD | 5,698 | 3.2 | 0.081 | 0.15 | 3.2 | 0.091 | 0.19 | 17 | 1,783 | 16 | 1,209 | 17 | 760 | 4.2 | 95 | 18 | 3,479 | 8.2 | 556 | 4.9 | 115 |
| Exposed | UMC-1 | 1,073 | 25 | 0.44 | 0.57 | 15 | 0.27 | 0.47 | 25 | 273 | 12 | 129 | 8.7 | 93 | 4.7 | 50 | 44 | 477 | 10 | 111 | 18 | 194 |
| | UMC-2 | 639 | 19 | 0.31 | 0.60 | 11 | 0.22 | 0.53 | 23 | 147 | 9.6 | 61 | 8.4 | 54 | 5.1 | 32 | 62 | 398 | 6.7 | 43 | 7.9 | 50 |
| | UMC-3 | 940 | 30 | 0.41 | 0.55 | 16 | 0.21 | 0.44 | 23 | 219 | 7.6 | 72 | 11 | 100 | 5.0 | 47 | 52 | 492 | 11 | 104 | 11 | 104 |
| | UMC-4 | 1,550 | 28 | 0.35 | 0.55 | 15 | 0.18 | 0.28 | 18 | 276 | 8.8 | 136 | 5.8 | 90 | 3.2 | 50 | 59 | 911 | 11 | 165 | 9.0 | 140 |
| | UMC-5 | 954 | 22 | 0.34 | 0.58 | 13 | 0.31 | 0.55 | 20 | 194 | 8.3 | 79 | 8.3 | 79 | 3.8 | 36 | 39 | 373 | 11 | 108 | 29 | 276 |

Table D.4: Summary Statistics for Benthic Invertebrate Community Endpoints for Reference (n = 10) and Exposed (n = 5) Sites, 2016

| Site | Endpoint | Units | N | Mean | Standard Deviation | Standard Error | Minimum | Median | Maximum | |
|-----------|----------------------|----------------------------------|--------------------|--------|--------------------|----------------|---------|--------|---------|--------|
| Reference | Density | org/m ² | 10 | 4,501 | 5,698 | 1,802 | 520 | 2,429 | 19,321 | |
| | LPL | Richness | # taxa | 10 | 22 | 3.2 | 1.0 | 18 | 22 | 26 |
| | | Evenness (Simpson's) | - | 10 | 0.25 | 0.081 | 0.026 | 0.14 | 0.25 | 0.39 |
| | | Bray-Curtis Distance | - | 10 | 0.62 | 0.15 | 0.047 | 0.43 | 0.58 | 0.90 |
| | | Family | Richness | # taxa | 10 | 13 | 3.2 | 1.0 | 10 | 12 |
| | Evenness (Simpson's) | | - | 10 | 0.24 | 0.091 | 0.029 | 0.17 | 0.22 | 0.48 |
| | BC Distance | | - | 10 | 0.49 | 0.19 | 0.061 | 0.26 | 0.45 | 0.83 |
| | Relative Density | EPT | % | 10 | 39 | 17 | 5.4 | 18 | 33 | 64 |
| | | Ephemeroptera | % | 10 | 15 | 16 | 5.0 | 0 | 12 | 55 |
| | | Plecoptera | % | 10 | 22 | 17 | 5.3 | 5.4 | 16 | 54 |
| | | Trichoptera | % | 10 | 2.5 | 4.2 | 1.3 | 0 | 0.73 | 11 |
| | | Chironomidae | % | 10 | 45 | 18 | 5.7 | 20 | 49 | 69 |
| | | Diptera (excluding Chironomidae) | % | 10 | 11 | 8.2 | 2.6 | 2.1 | 8.9 | 30 |
| | | Oligochaeta | % | 10 | 4.2 | 4.9 | 1.6 | 0.17 | 3.2 | 17 |
| | Density | EPT | org/m ² | 10 | 1,528 | 1,783 | 564 | 291 | 849 | 6,107 |
| | | Ephemeroptera | org/m ² | 10 | 710 | 1,209 | 382 | 0 | 258 | 4,008 |
| | | Plecoptera | org/m ² | 10 | 748 | 760 | 240 | 68 | 492 | 2,138 |
| | | Trichoptera | org/m ² | 10 | 69 | 95 | 30 | 0 | 25 | 280 |
| | | Chironomidae | org/m ² | 10 | 2,392 | 3,479 | 1,100 | 122 | 1,202 | 11,539 |
| | | Diptera (excluding Chironomidae) | org/m ² | 10 | 442 | 556 | 176 | 72 | 129 | 1,557 |
| | | Oligochaeta | org/m ² | 10 | 101 | 115 | 36 | 14 | 75 | 409 |
| Exposed | Density | org/m ² | 5 | 1,031 | 331 | 148 | 639 | 954 | 1,550 | |
| | LPL | Richness | # taxa | 5 | 25 | 4.4 | 2.0 | 19 | 25 | 30 |
| | | Evenness (Simpson's) | - | 5 | 0.37 | 0.054 | 0.024 | 0.31 | 0.35 | 0.44 |
| | | Bray-Curtis Distance | - | 5 | 0.57 | 0.021 | 0.010 | 0.55 | 0.57 | 0.60 |
| | | Family | Richness | # taxa | 5 | 14 | 2.0 | 0.89 | 11 | 15 |
| | Evenness (Simpson's) | | - | 5 | 0.24 | 0.050 | 0.022 | 0.18 | 0.22 | 0.31 |
| | BC Distance | | - | 5 | 0.45 | 0.11 | 0.048 | 0.28 | 0.47 | 0.55 |
| | Relative Density | EPT | % | 5 | 22 | 2.9 | 1.3 | 18 | 23 | 25 |
| | | Ephemeroptera | % | 5 | 9.3 | 1.7 | 0.76 | 7.6 | 8.8 | 12 |
| | | Plecoptera | % | 5 | 8.4 | 1.7 | 0.78 | 5.8 | 8.4 | 11 |
| | | Trichoptera | % | 5 | 4.3 | 0.80 | 0.36 | 3.2 | 4.7 | 5.1 |
| | | Chironomidae | % | 5 | 51 | 10 | 4.3 | 39 | 52 | 62 |
| | | Diptera (excluding Chironomidae) | % | 5 | 10 | 1.9 | 0.84 | 6.7 | 11 | 11 |
| | | Oligochaeta | % | 5 | 15 | 8.7 | 3.9 | 7.9 | 11 | 29 |
| | Density | EPT | org/m ² | 5 | 222 | 55 | 24 | 147 | 219 | 276 |
| | | Ephemeroptera | org/m ² | 5 | 95 | 35 | 16 | 61 | 79 | 136 |
| | | Plecoptera | org/m ² | 5 | 83 | 18 | 8.1 | 54 | 90 | 100 |
| | | Trichoptera | org/m ² | 5 | 43 | 8.4 | 3.8 | 32 | 47 | 50 |
| | | Chironomidae | org/m ² | 5 | 530 | 219 | 98 | 373 | 477 | 911 |
| | | Diptera (excluding Chironomidae) | org/m ² | 5 | 106 | 43 | 19 | 43 | 108 | 165 |
| | | Oligochaeta | org/m ² | 5 | 153 | 87 | 39 | 50 | 140 | 276 |

Table D.5: Upper Minto Creek Compared to the Upper and Lower 90% Confidence Limits on the 2.5th and 97.5th Percentiles of the Reference Area Distribution

| Endpoint | | Transformation | 97.5 th Percentile | | | 50 th Percentile | | | 2.5 th Percentile | | | Minto Creek | | | | |
|----------------------------------|-----------------------|----------------|-------------------------------|--------|--------------|-----------------------------|-------|--------------|------------------------------|----------------|----------------|-------------|-------|-------|-------|-------|
| | | | 90% Upper CL | Value | 90% Lower CL | 90% Upper CL | Value | 90% Lower CL | 90% Upper CL | Value | 90% Lower CL | UMC-1 | UMC-2 | UMC-3 | UMC-4 | UMC-5 |
| Density | | Log | 59,720 | 21,679 | 11,445 | 3.6 | 3.4 | 3.2 | 623 | 329 | 119 | 1,073 | 639 | 940 | 1,550 | 954 |
| Lowest Practical Level | Richness | Fourth Root | 34 | 29 | 27 | 2.2 | 2.2 | 2.1 | 18 | 16 | 14 | 25 | 19 | 30 | 28 | 22 |
| | Simpson's Evenness | Log (x+1) | 0.51 | 0.42 | 0.37 | 0.28 | 0.25 | 0.21 | 0.14 | 0.094 | 0.027 | 0.44 | 0.31 | 0.41 | 0.35 | 0.34 |
| | Bray Curtis Distance | Log | 1.2 | 0.96 | 0.84 | 0.67 | 0.61 | 0.55 | 0.44 | 0.38 | 0.30 | 0.57 | 0.60 | 0.55 | 0.55 | 0.58 |
| Family Level | Richness | Log | 26 | 21 | 18 | 14 | 13 | 12 | 9.4 | 8.1 | 6.5 | 15 | 11 | 16 | 15 | 13 |
| | Simpson's Evenness | Log | 0.58 | 0.43 | 0.36 | 0.27 | 0.23 | 0.20 | 0.15 | 0.12 | 0.092 | 0.27 | 0.22 | 0.21 | 0.18 | 0.31 |
| | Bray-Curtis Distance | Fourth Root | 1.3 | 0.97 | 0.78 | 0.55 | 0.46 | 0.38 | 0.25 | 0.18 | 0.11 | 0.47 | 0.53 | 0.44 | 0.28 | 0.55 |
| EPT | (%) | Log | 142 | 91 | 68 | 44 | 36 | 29 | 19 | 14 | 9.1 | 25 | 23 | 23 | 18 | 20 |
| | (org/m ²) | Log | 17,894 | 6,890 | 3,775 | 1,466 | 959 | 627 | 243 | 133 | 51 | 273 | 147 | 219 | 276 | 194 |
| Ephemeroptera | (%) | Square Root | 89 | 56 | 38 | 18 | 11 | 5.9 | 0.21 | 0 ^a | 0 ^a | 12 | 9.6 | 7.6 | 8.8 | 8.3 |
| | (org/m ²) | Fourth Root | 12,386 | 5,030 | 2,513 | 611 | 262 | 90 | 0.88 | 0 ^a | 0 ^a | 129 | 61 | 72 | 136 | 79 |
| Plecoptera | (%) | Log | 173 | 81 | 50 | 24 | 17 | 12 | 5.7 | 3.5 | 1.7 | 8.7 | 8.4 | 11 | 5.8 | 8.3 |
| | (org/m ²) | Log | 12,918 | 4,332 | 2,176 | 737 | 453 | 279 | 94 | 47 | 16 | 93 | 54 | 100 | 90 | 79 |
| Tricoptera | (%) | Fourth Root | 67 | 23 | 10 | 1.6 | 0.47 | 0.080 | 0.00026 | 0 ^a | 0 ^a | 4.7 | 5.1 | 5.0 | 3.2 | 3.8 |
| | (org/m ²) | Square Root | 570 | 328 | 209 | 77 | 38 | 13 | 4.4 | 1.0 | 1.0 | 50 | 32 | 47 | 50 | 36 |
| Chironomidae | (%) | None | 99 | 81 | 70 | 53 | 45 | 37 | 19 | 7.8 | 0 ^a | 44 | 62 | 52 | 59 | 39 |
| | (org/m ²) | Log | 64,428 | 17,032 | 7,362 | 1,970 | 1,089 | 602 | 161 | 70 | 18 | 477 | 398 | 492 | 911 | 373 |
| Diptera (excluding Chironomidae) | (%) | Fourth Root | 58 | 35 | 24 | 13 | 9.1 | 6.3 | 2.5 | 1.2 | 0.25 | 10 | 6.7 | 11 | 11 | 11 |
| | (org/m ²) | Log | 7,501 | 2,392 | 1,164 | 375 | 225 | 136 | 44 | 21 | 6.8 | 111 | 43 | 104 | 165 | 108 |
| Oligochaeta | (%) | Log (x+1) | 39 | 18 | 11 | 4.5 | 2.9 | 1.8 | 0.34 | 0 ^a | 0 ^a | 18 | 7.9 | 11 | 9.0 | 29 |
| | (org/m ²) | Log (x+1) | 1,323 | 496 | 267 | 101 | 65 | 41 | 15 | 7.7 | 2.3 | 194 | 50 | 104 | 140 | 276 |

Value less than the lower 90% confidence limit on the 2.5th percentile or greater than the upper 90% confidence limit on the 97.5th percentile (i.e., out of reference condition).

Value greater than the upper 90% confidence limit on the 2.5th percentile or less than the lower 90% confidence limit on the 97.5th percentile (i.e., within reference condition).

Value within the 90% confidence limits on the 2.5th percentile or within the 90% confidence limits on the 97.5th percentile (i.e., inconclusive).

^a Value was negative and truncated to zero.

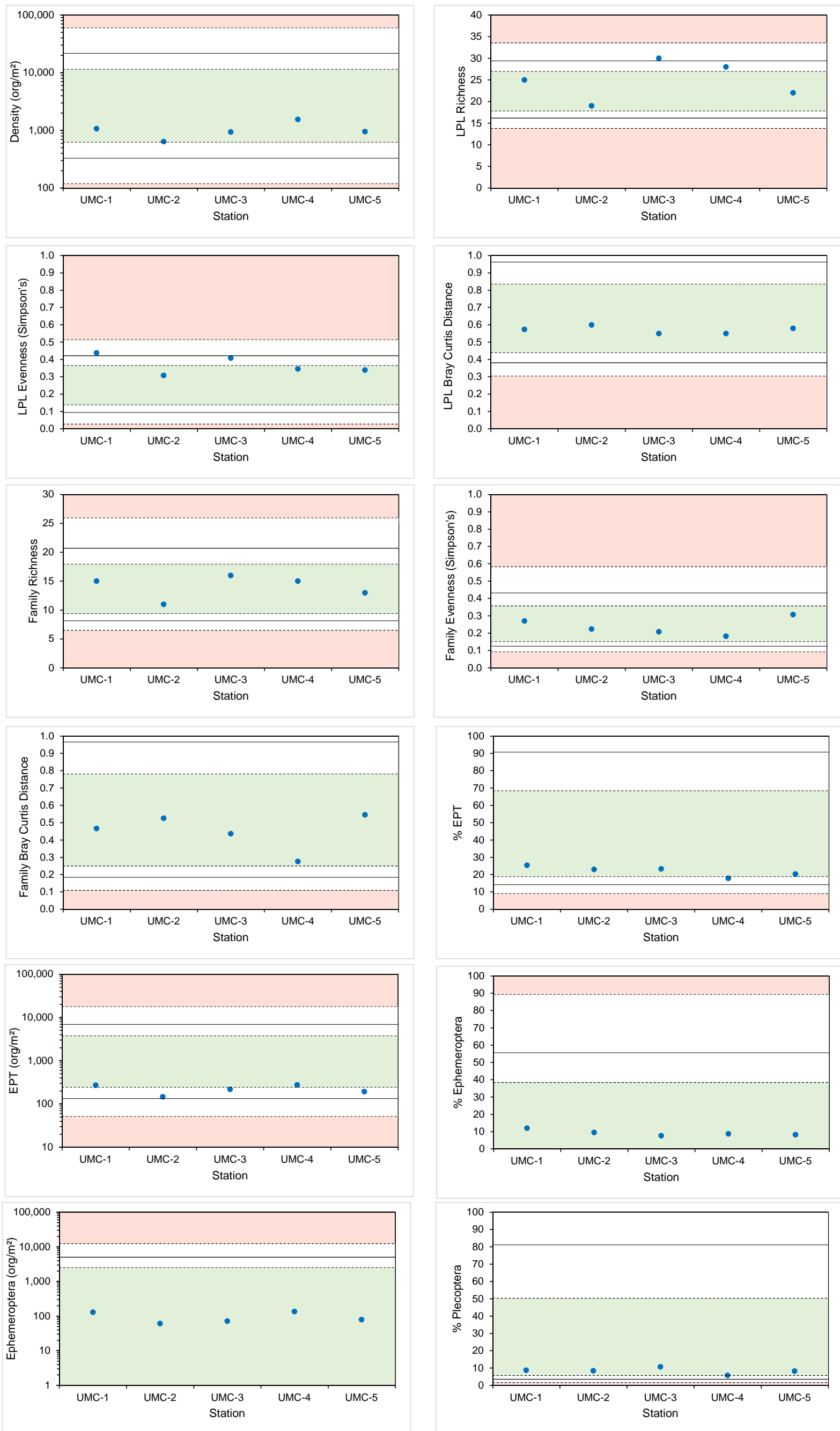


Figure D.1: Individual Value Plot of Benthic Invertebrate Community Endpoints for Exposed Sites (n = 5), Relative to the Reference Condition (n = 10), 2017

Notes: solid lines = 2.5th and 97.5th percentiles, dashed lines = 90% confidence limits on the percentiles.

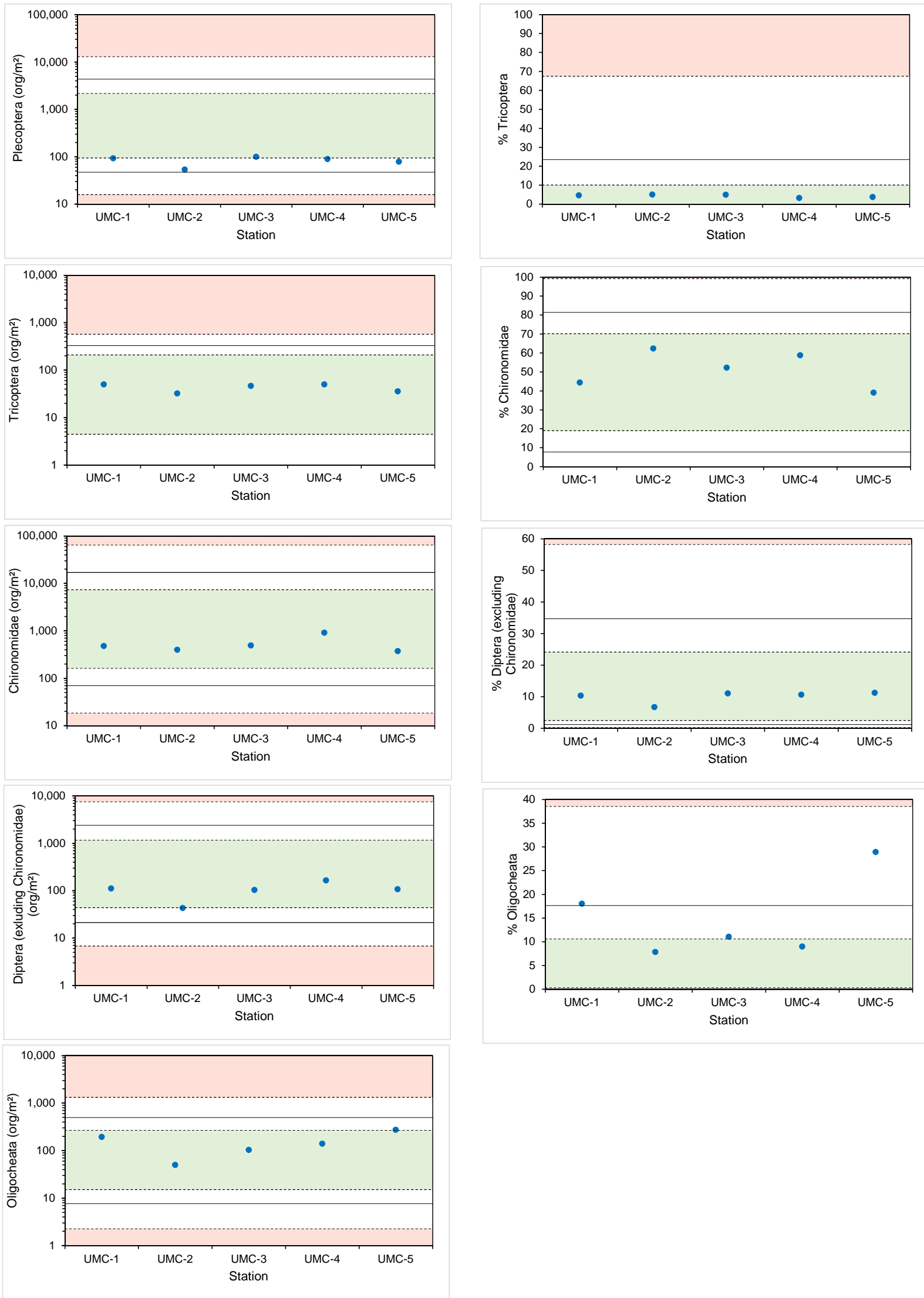



Figure D.1: Individual Value Plot of Benthic Invertebrate Community Endpoints for Exposed Sites (n = 5), Relative to the Reference Condition (n = 10), 2017

Notes: solid lines = 2.5th and 97.5th percentiles, dashed lines = 90% confidence limits on the percentiles.

Table D.6: Summary of Statistical Comparisons of Benthic Invertebrate Community Endpoints Between Reference (n = 10) and Exposed (n = 5) Sites, 2016

| Endpoint | | Data Transformation | Test | Test P-value | Mean or Median ^a | | Observed ES ^b (Exposed - Reference)/SD |
|------------------------|------------------------------------|---------------------|----------|--------------|-----------------------------|---------|--|
| | | | | | Reference | Exposed | |
| Density | | log | T | 0.059 | 2,671 | 990 | -1.2 |
| Lowest Practical Level | Richness | none | T | 0.215 | 22 | 25 | 0.74 |
| | Evenness (Simpson's) | fourth root | T | 0.016 | 0.24 | 0.37 | 1.6 |
| | Bray-Curtis Distance | log | T | 0.577 | 0.61 | 0.57 | -0.32 |
| Family Level | Richness | log | T | 0.567 | 13 | 14 | 0.33 |
| | Evenness (Simpson's) | log | T | 0.955 | 0.23 | 0.23 | 0.033 |
| | BC Distance | square root | T | 0.795 | 0.47 | 0.44 | -0.15 |
| Relative Density | % EPT | fourth root | Tunequal | 0.009 | 37 | 22 | -1.3 |
| | % Ephemeroptera | log(X+1) | T | 0.942 | 9.8 | 10 | 0.042 |
| | % Plecoptera | log | Tunequal | 0.018 | 17 | 8.2 | -1.2 |
| | % Trichoptera | fourth root | Tunequal | 0.019 | 0.47 | 4.3 | 1.1 |
| | % Chironomidae | none | T | 0.451 | 45 | 51 | 0.44 |
| | % Diptera (excluding Chironomidae) | fourth root | Tunequal | 0.746 | 9.1 | 9.9 | 0.14 |
| | % Oligochaeta | fourth root | T | 0.006 | 2.8 | 14 | 1.9 |
| Density | EPT | log | T | 0.006 | 959 | 3 | -1.9 |
| | Ephemeroptera | rank | MW | 0.066 | 258 | 219 | - |
| | Plecoptera | log | Tunequal | <0.001 | 453 | 81 | -1.9 |
| | Trichoptera | square root | Tunequal | 0.854 | 38 | 43 | 0.075 |
| | Chironomidae | log | Tunequal | 0.117 | 1,089 | 502 | -0.70 |
| | Diptera (excluding Chironomidae) | log | T | 0.153 | 225 | 98 | -0.86 |
| | Oligochaeta | log | T | 0.178 | 64 | 131 | 0.81 |

 P-value < 0.1.

^a For transformed data, the mean was calculated on the transformed scale, and back-transformed to original data units; the median is reported for the Mann-Whitney test.

^b The observed effect size is calculated on the transformed scale when the data were transformed for analysis. An effect size is not reported when the data were analyzed using the Mann-Whitney test.

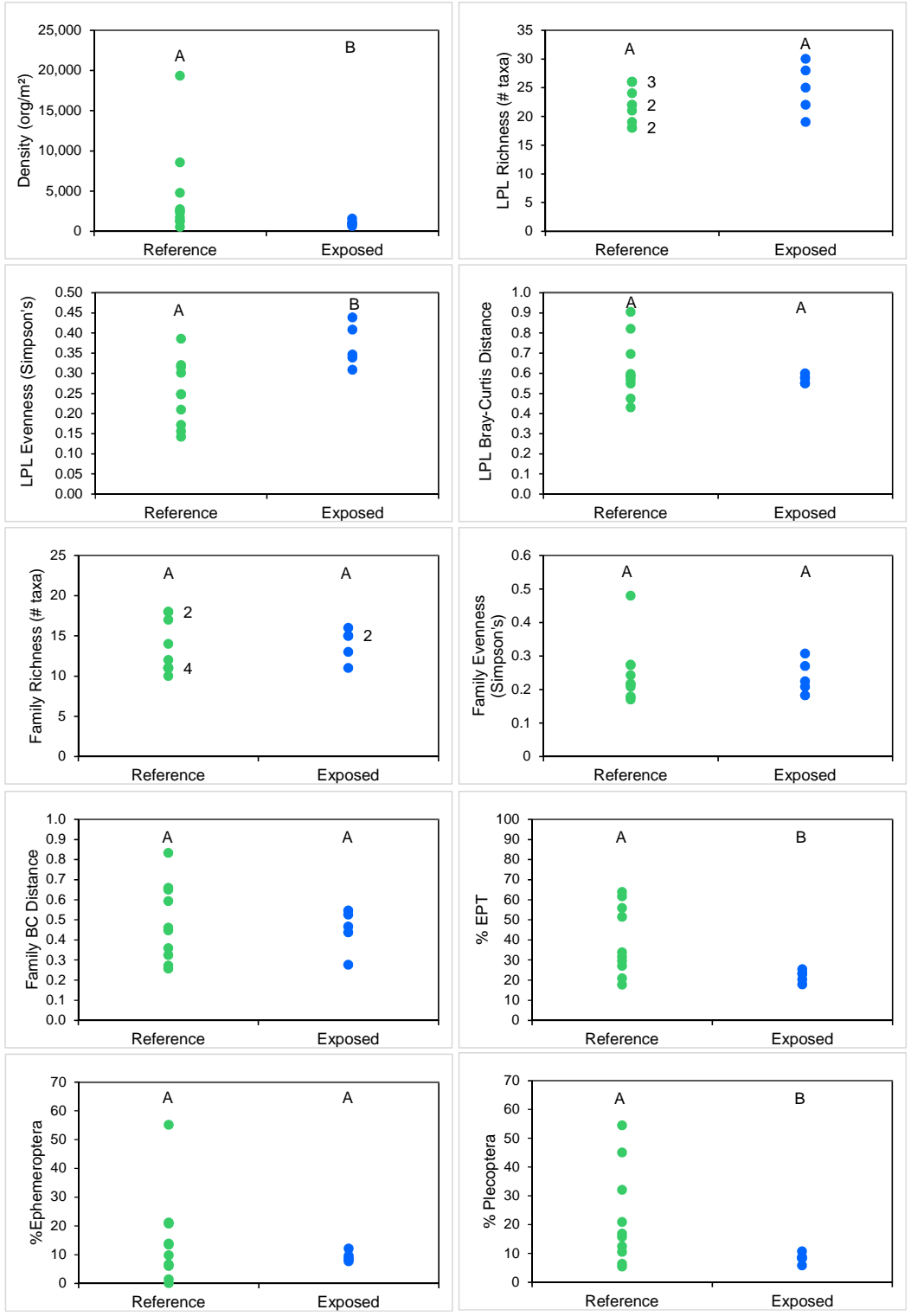


Figure D.2: Individual Value Plot of Benthic Invertebrate Community Taxon Proportions for Reference (n = 10) and Exposed (n = 5) Sites, 2017

Notes: The letter B above the exposed group indicates a significant difference relative to reference (A) $\alpha = 0.1$. The letter A above the exposed group indicates no significant difference relative to reference (A) $\alpha = 0.1$. Numbers next to individual points represent the number of overlapping points at that value.

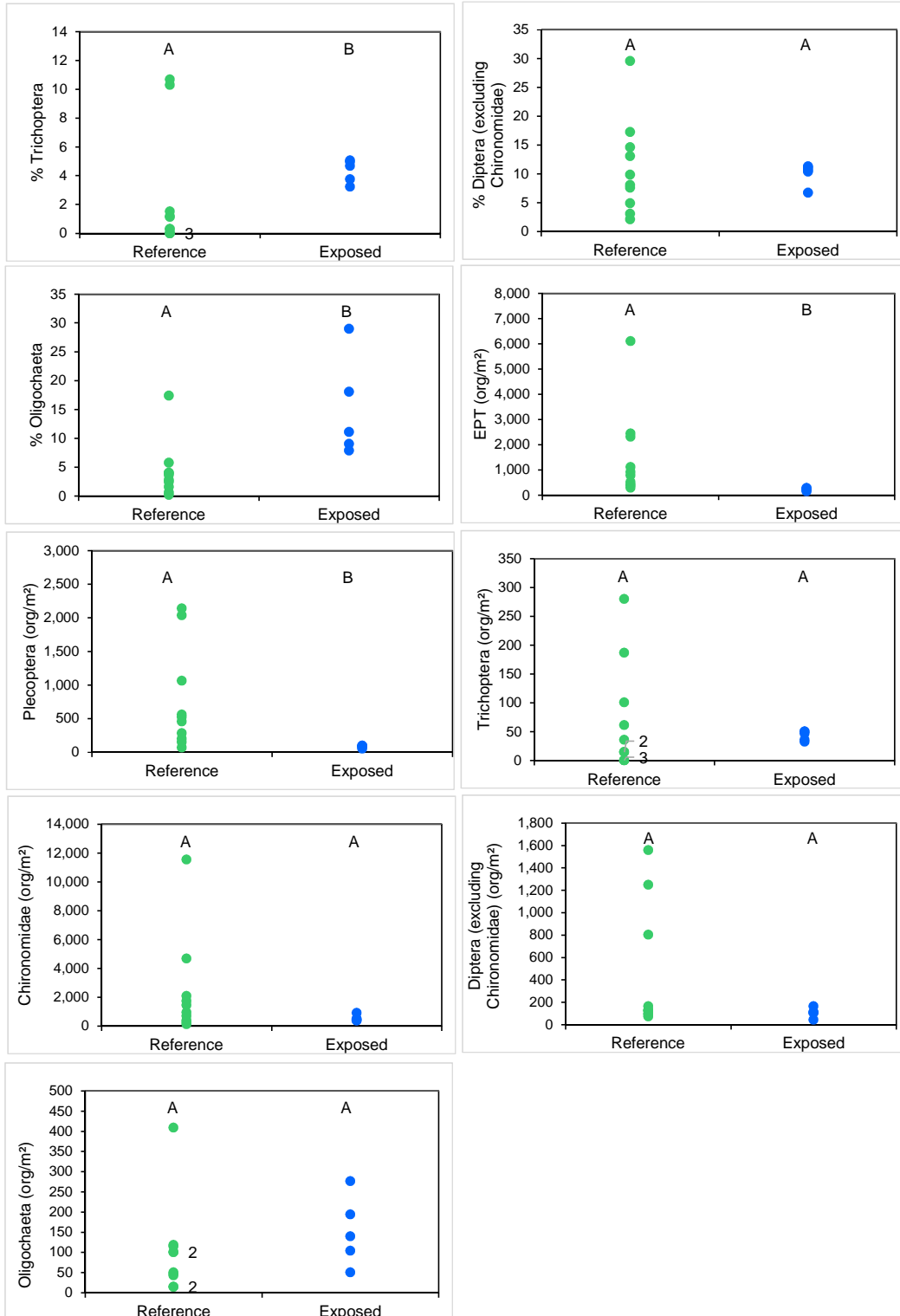


Figure D.2: Individual Value Plot of Benthic Invertebrate Community Taxon Proportions for Reference (n = 10) and Exposed (n = 5) Sites, 2017

Notes: The letter B above the exposed group indicates a significant difference relative to reference (A) $\alpha = 0.1$. The letter A above the exposed group indicates no significant difference relative to reference (A) $\alpha = 0.1$. Numbers next to individual points represent the number of overlapping points at that value.

Table D.7: Symmetric Component Coefficients for Each Taxa and Each Area for the First Two Components (C-1 and C-2) of a Correspondance Analysis for the Relative Abundance of 19 Taxa for Reference (n = 10) and Mine-exposed (n = 5) Areas, 2016

| Taxa | Symmetric Component Coefficients | |
|------------------|----------------------------------|----------------|
| | C-1 (27.8%) | C-2 (23.3%) |
| Collembola | 0.0105 | 0.2057 |
| Ameletidae | 1.7519 | -0.1901 |
| Baetidae | -0.2057 | 0.4646 |
| Ephemerellidae | -0.1535 | 0.6471 |
| Heptageniidae | -0.3724 | -0.1611 |
| Capniidae | -0.1379 | 0.1818 |
| Chloroperlidae | -0.3451 | 0.0938 |
| Nemouridae | -0.2715 | -1.0555 |
| Perlodidae | -0.4424 | 0.0406 |
| Taeniopterygidae | -0.4968 | 0.4901 |
| Limnephilidae | 0.2030 | -0.0389 |
| Chironomidae | -0.1790 | 0.2193 |
| Empididae | -0.2718 | 0.5172 |
| Psychodidae | 0.6612 | 0.3922 |
| Simuliidae | -0.2731 | -0.2828 |
| Tipulidae | -0.0391 | -0.5681 |
| Oribatida | -0.2579 | 0.6262 |
| Lumbriculidae | 0.0542 | 0.5117 |
| Naididae | -0.3775 | -0.0745 |

| Area | Symmetric Component Coefficients | |
|--------|----------------------------------|----------------|
| | C-1 (27.8%) | C-2 (23.3%) |
| UMC-1 | -0.0156 | 0.3336 |
| UMC-2 | -0.0305 | 0.2659 |
| UMC-3 | -0.1194 | 0.2703 |
| UMC-4 | 0.0109 | 0.3741 |
| UMC-5 | -0.0010 | 0.4265 |
| REF-1 | 0.5018 | -0.5845 |
| REF-2 | -0.3916 | -0.7394 |
| REF-3 | -0.3300 | 0.1723 |
| REF-4 | -0.3912 | -1.2416 |
| REF-5 | -0.1440 | -0.2193 |
| REF-6 | 1.7766 | -0.1002 |
| REF-7 | -0.2183 | 0.1950 |
| REF-8 | -0.1437 | 0.3892 |
| REF-9 | -0.3206 | 0.3664 |
| REF-10 | -0.1970 | 0.0962 |

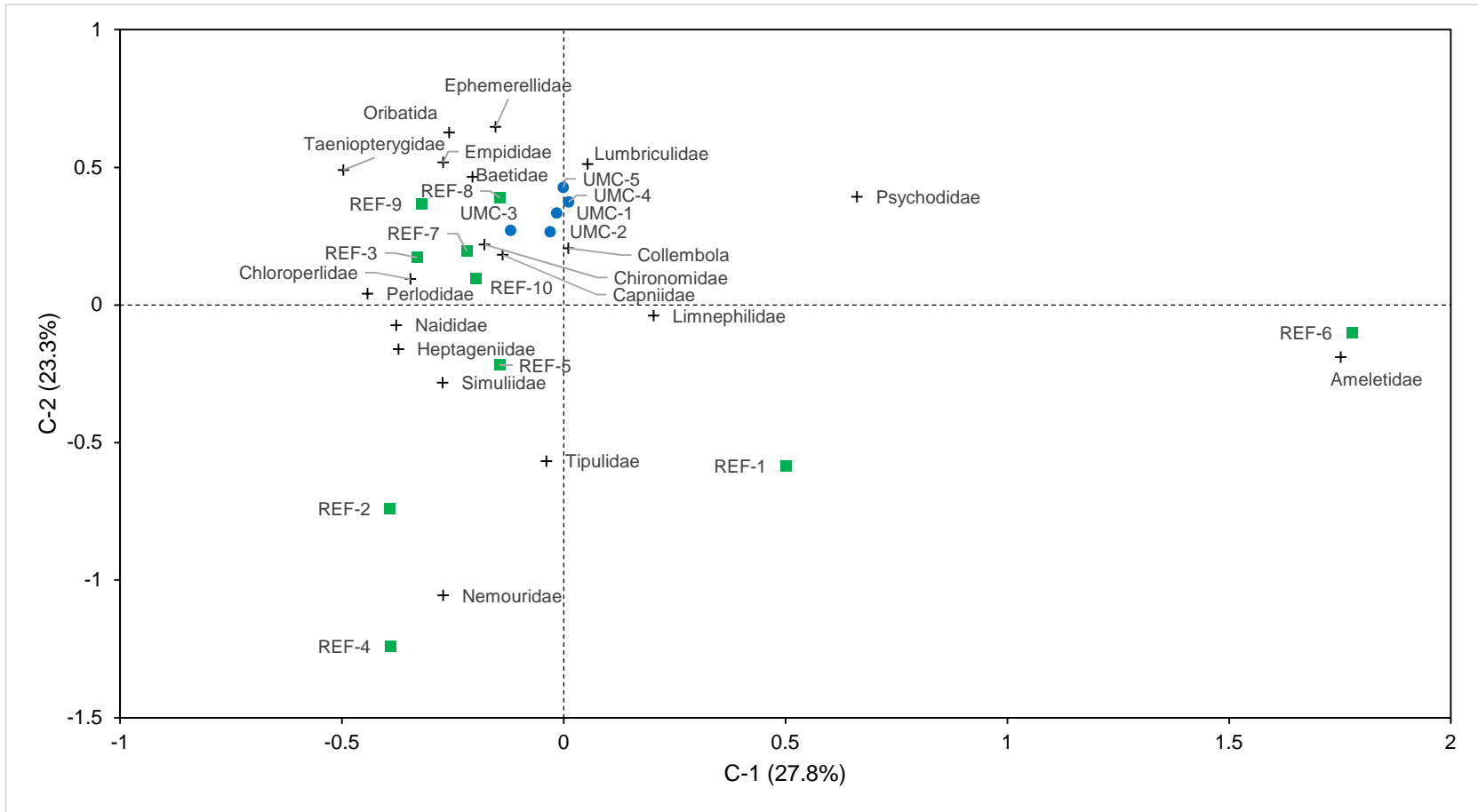


Figure D.3: Scatterplot of the Symmetric Representation of Component 2 (C-2) vs. C-1 from a Correspondence Analysis of Areas and Taxa

Table D.8: Coefficients for Water Quality Variables (Total Metals Only) for the First Two Principal Components (PC-1 and PC-2) and Spearman Rank Correlations for Water Quality Variables (Total Metals Only) with PC-1 and PC-2 for a Principal Component Analysis of Ranked Concentrations of Water Quality Variables for Reference (n = 10) and Mine-exposed (n = 3) Areas, 2016

| Variable | Principal Component Coefficients | | Spearman Rank Correlations | | | |
|--|----------------------------------|--------|----------------------------|---------|--------|---------|
| | PC-1 | PC-2 | PC-1 | | PC-2 | |
| | | | r | P-value | r | P-value |
| Hardness (as CaCO ₃) | -0.224 | 0.254 | -0.703 | 0.007 | 0.670 | 0.012 |
| Total Suspended Solids | 0.213 | 0.178 | 0.548 | 0.053 | 0.429 | 0.144 |
| Total Dissolved Solids | -0.187 | 0.295 | -0.580 | 0.038 | 0.801 | 0.001 |
| Total Alkalinity (as CaCO ₃) | -0.205 | 0.260 | -0.619 | 0.024 | 0.685 | 0.010 |
| Total Ammonia (as N) | 0.242 | 0.042 | 0.672 | 0.012 | -0.038 | 0.903 |
| Nitrate (as N) | -0.021 | 0.230 | -0.245 | 0.420 | 0.616 | 0.025 |
| Total Kjeldahl Nitrogen | 0.163 | 0.296 | 0.407 | 0.168 | 0.725 | 0.005 |
| Total Phosphorus (P) | 0.192 | 0.261 | 0.457 | 0.117 | 0.586 | 0.035 |
| Dissolved Organic Carbon | 0.088 | 0.006 | 0.371 | 0.212 | -0.085 | 0.782 |
| Total Aluminum | 0.233 | 0.125 | 0.610 | 0.027 | 0.330 | 0.271 |
| Total Arsenic | 0.087 | -0.002 | 0.144 | 0.639 | -0.038 | 0.903 |
| Total Barium | -0.013 | 0.113 | -0.163 | 0.596 | 0.320 | 0.287 |
| Total Cadmium | 0.122 | 0.109 | 0.141 | 0.646 | 0.294 | 0.329 |
| Total Calcium | -0.185 | 0.272 | -0.610 | 0.027 | 0.742 | 0.004 |
| Total Chromium | 0.258 | 0.019 | 0.463 | 0.111 | 0.077 | 0.802 |
| Total Cobalt | 0.258 | 0.019 | 0.463 | 0.111 | 0.077 | 0.802 |
| Total Copper | 0.147 | 0.272 | 0.346 | 0.247 | 0.681 | 0.010 |
| Total Iron | 0.280 | 0.027 | 0.846 | <0.001 | -0.011 | 0.972 |
| Total Lithium | -0.207 | -0.026 | -0.717 | 0.006 | -0.015 | 0.962 |
| Total Magnesium | -0.228 | 0.244 | -0.714 | 0.006 | 0.632 | 0.021 |
| Total Manganese | 0.165 | 0.117 | 0.380 | 0.201 | 0.201 | 0.511 |
| Total Molybdenum | -0.069 | 0.276 | -0.296 | 0.326 | 0.777 | 0.002 |
| Total Nickel | 0.112 | 0.157 | 0.266 | 0.379 | 0.407 | 0.168 |
| Total Potassium | -0.099 | 0.085 | -0.309 | 0.305 | 0.309 | 0.305 |
| Total Selenium | -0.148 | 0.192 | -0.544 | 0.055 | 0.473 | 0.103 |
| Total Sodium | 0.001 | 0.260 | 0.052 | 0.865 | 0.602 | 0.029 |
| Total Titanium | 0.240 | 0.156 | 0.472 | 0.104 | 0.376 | 0.206 |
| Total Uranium | -0.244 | 0.127 | -0.737 | 0.004 | 0.292 | 0.334 |
| Total Vanadium | 0.256 | 0.148 | 0.757 | 0.003 | 0.254 | 0.402 |



 P-value < 0.05.
 r > 0.6 or r < -0.6.

Table D.9: The First Two Principal Components (PC-1 and PC-2) for a Principal Component Analysis of Ranked Concentrations of Water Quality Variables (Total Metals Only) for Reference (n = 10) and Mine-exposed (n = 3) Areas, 2016

| Area | PC-1 (30.0%) | PC-2 (23.7%) |
|--------|-----------------|-----------------|
| REF-1 | 1.552 | -2.078 |
| REF-2 | 1.857 | -2.116 |
| REF-3 | 1.653 | 0.123 |
| REF-4 | 7.471 | 0.446 |
| REF-5 | -2.888 | -2.002 |
| REF-6 | -1.051 | 1.615 |
| REF-7 | -2.856 | 1.936 |
| REF-8 | -0.738 | -1.067 |
| REF-9 | -4.030 | -0.686 |
| REF-10 | 0.037 | -5.372 |
| UMC-1 | -1.064 | 2.543 |
| UMC-2 | 1.529 | 4.737 |
| UMC-3 | -1.472 | 1.920 |

Note: PCA conducted on the correlation matrix with ranked concentrations (equivalent to the Spearman rank correlation matrix).

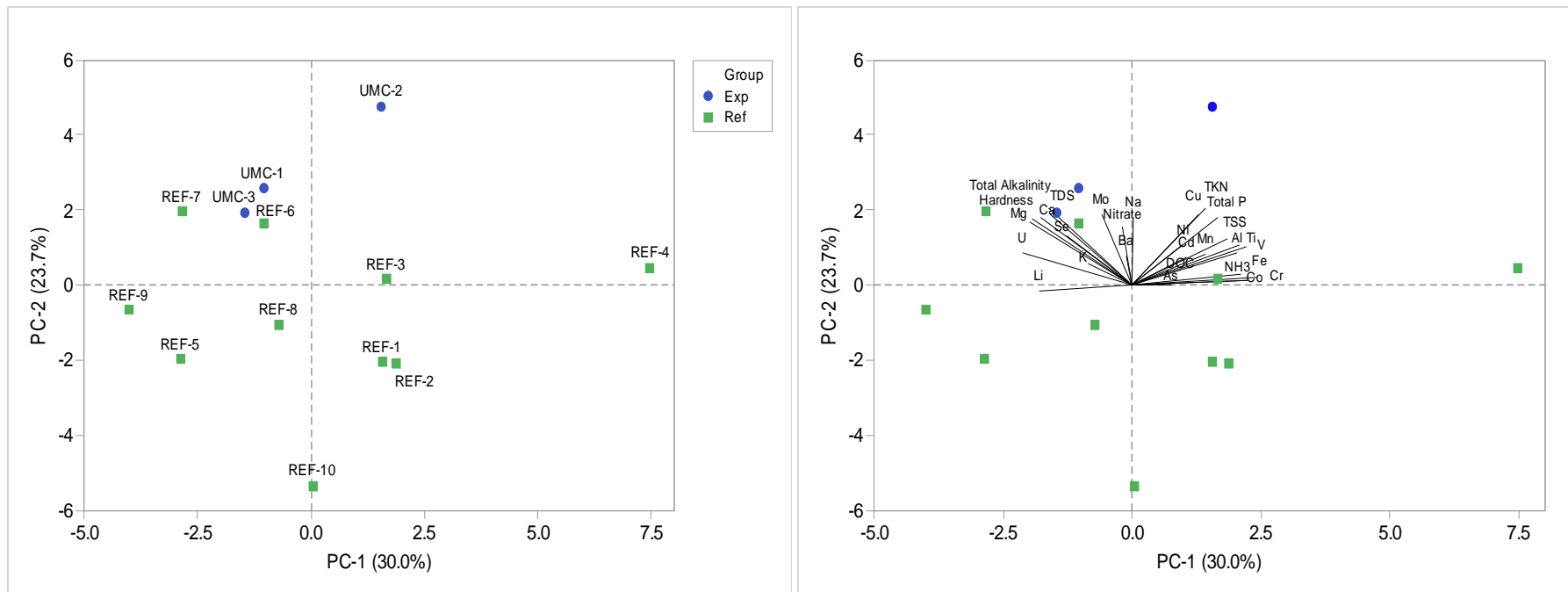


Figure D.4: Scatterplot of Principal Component 2 (PC-2) vs. PC-1 for Reference (n = 10) and Mine-exposed (n = 3) Areas from a Principal Component Analysis of Ranks of Water Quality Variables (left) and the Loadings (Scaled Coefficients) of Each Variable to each Principal Component are Plotted on the Scatterplot (right)

Note: Only total metals concentration data were included in the Principal Component Analysis; dissolved metals data were excluded.

Table D.10: Coefficients for Each Habitat Variable for the First Two Principal Components (PC-1 and PC-2) and Pearson Correlations for Each Habitat Variable with PC-1 and PC-2 for a Principal Component Analysis of Habitat Variables for Reference (n = 9) and Mine-exposed (n = 5) Areas, 2016

| Variable | Principal Component Coefficients | | Spearman Rank Correlations | | | |
|------------------|----------------------------------|--------|----------------------------|---------|--------|---------|
| | | | PC-1 | | PC-2 | |
| | PC-1 | PC-2 | r | P-value | r | P-value |
| Water Velocity | 0.534 | 0.053 | 0.948 | <0.001 | 0.074 | 0.802 |
| Average Depth | -0.511 | 0.032 | -0.906 | <0.001 | 0.045 | 0.879 |
| Median | 0.372 | -0.284 | 0.661 | 0.010 | -0.398 | 0.159 |
| Median | 0.200 | 0.169 | 0.355 | 0.214 | 0.237 | 0.415 |
| % cobble | -0.046 | -0.708 | -0.081 | 0.782 | -0.990 | <0.001 |
| % gravel | -0.393 | 0.368 | -0.697 | 0.006 | 0.515 | 0.059 |
| % sand and finer | 0.345 | 0.501 | 0.611 | 0.020 | 0.700 | 0.005 |



 P-value < 0.05.
 r > 0.6 or r < -0.6.

Table D.11: The First Two Principal Components (PC-1 and PC-2) for a Principal Component Analysis of Habitat Variables for Reference (n = 9) and Mine-exposed (n = 5) Areas, 2016

| Area | PC-1 (45.0%) | PC-2 (28.0%) |
|--------|-----------------|-----------------|
| Ref-2 | -0.327 | -1.675 |
| Ref-3 | 2.044 | -0.495 |
| Ref-4 | -3.392 | -0.466 |
| Ref-5 | 2.195 | 2.190 |
| Ref-6 | -4.073 | 1.330 |
| Ref-7 | 0.813 | 0.815 |
| Ref-8 | -0.407 | -1.828 |
| Ref-9 | 0.864 | -2.290 |
| Ref-10 | 0.319 | -1.364 |
| UMC-1 | 0.667 | 0.913 |
| UMC-2 | 0.682 | 1.070 |
| UMC-3 | -0.307 | 1.200 |
| UMC-4 | -0.095 | 0.971 |
| UMC-5 | 1.017 | -0.371 |

Notes: no particle size data for Ref-1 were collected so this area was omitted from the analysis. PCA conducted on the correlation matrix.

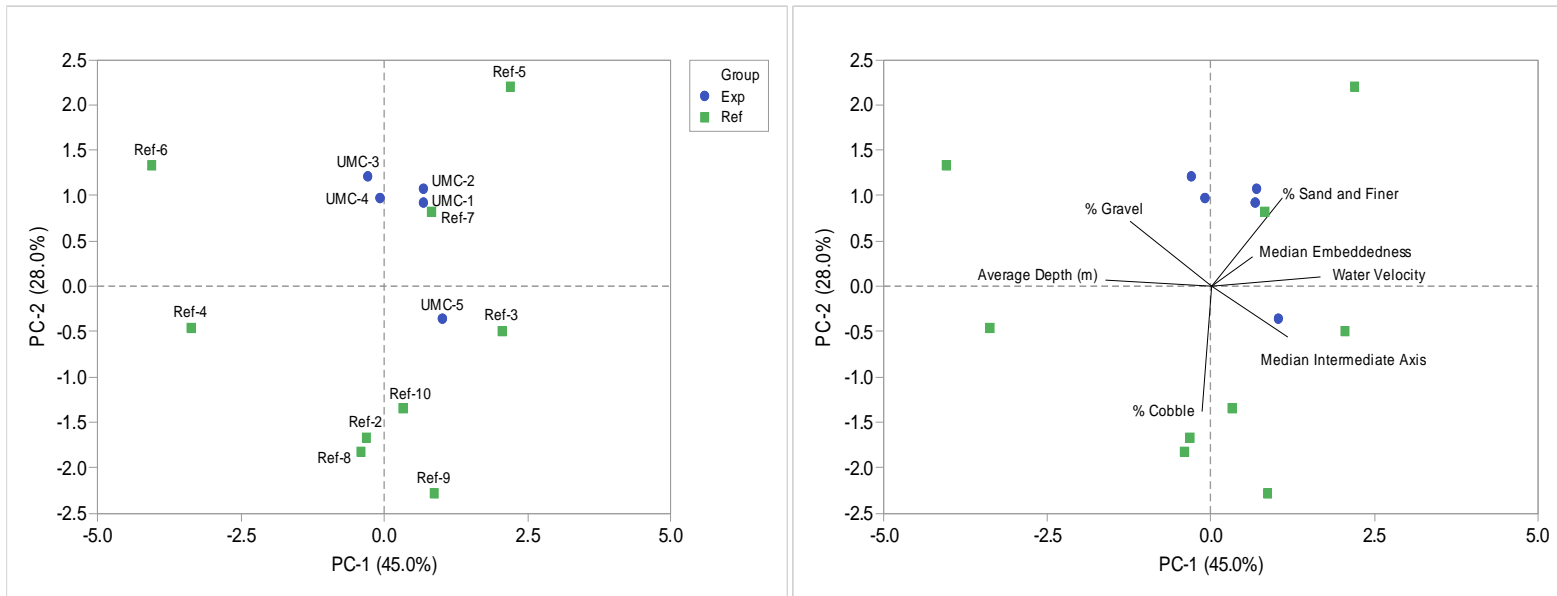


Figure D.5: Scatterplot of Principal Component 2 (PC-2) vs. PC-1 for Reference (n = 9) and Mine-exposed (n = 5) Areas from a Principal Component Analysis of Habitat Variables (left) and the Loading (Scaled Coefficients) of Each Variable to each Principal Component are Plotted on the Scatterplot (right)

Note: No particle size data for Ref-1 were collected so this area was omitted from the analysis.

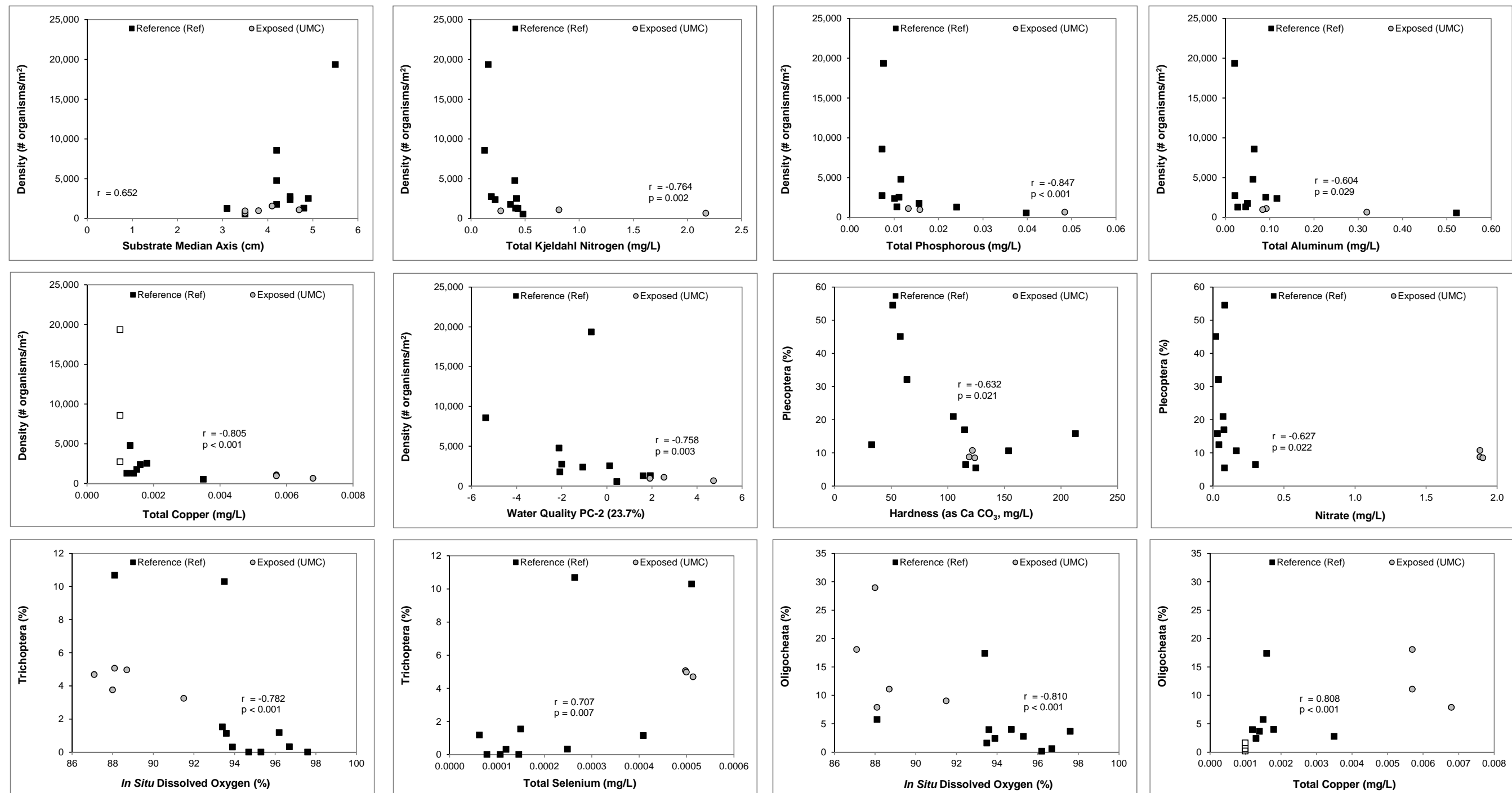


Figure D.6: Scatterplots of Significant Spearman's Rank Correlation Relationships between Benthic Invertebrate Community Metrics, and Water Quality, *In Situ*, and Principal Components Results, Minto Mine Cycle 4 EEM, 2016

Notes: Hollow symbols represent values below the Method Detection Limit (MDL). All correlations were calculated using data < MDL at the MDL value. N = 13 for all analyses of water quality (n = 10 for reference, n = 3 for exposed). N = 14 for all habitat analyses (n = 9 for reference due to exclusion of Ref-1, n = 5 for exposed). The Spearman's Rank Correlation coefficient is represented by "r" on the above plots.

Table D.12: Spearman Correlation of Benthic Invertebrate Endpoints vs. Principal Components Results, *In situ* Measures, and Water Quality Results, Minto Mine Phase 4 EEM, 2016

| Endpoint | | <i>In situ</i> Measures | | | | | | | | | | | | | | | Water Quality | | | | | | |
|------------------------|---------------------------------------|-------------------------|---------|------------------------------|---------|-------------------------|---------|----------------------|---------|---------------|---------|----------------------|---------|----------------|---------|---|---------------|--|---------|----------------------|---------|--------------------------------|---------|
| | | Temperature (°C) | | Specific Conductance (µs/cm) | | Dissolved Oxygen (mg/L) | | Dissolved Oxygen (%) | | pH (pH units) | | Water Velocity (m/s) | | Mean Depth (m) | | Substrate Median Intermediate Axis (cm) | | Hardness (as CaCO ₃ , mg/L) | | Nitrate (as N, mg/L) | | Total Kjeldahl Nitrogen (mg/L) | |
| | | n=15 | | n=15 | | n=15 | | n=15 | | n=15 | | n=15 | | n=15 | | n=15 | | n=13 | | n=13 | | n=13 | |
| | | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value |
| Density * | | -0.453 | 0.090 | -0.179 | 0.524 | 0.525 | 0.044 | 0.481 | 0.070 | 0.252 | 0.365 | 0.159 | 0.571 | -0.052 | 0.853 | 0.652 | 0.008 | -0.181 | 0.553 | -0.514 | 0.072 | -0.764 | 0.002 |
| Lowest Practical Level | Richness | 0.441 | 0.100 | 0.204 | 0.467 | -0.259 | 0.350 | -0.005 | 0.987 | -0.296 | 0.284 | 0.143 | 0.612 | -0.087 | 0.759 | -0.090 | 0.750 | 0.103 | 0.739 | 0.081 | 0.794 | -0.325 | 0.279 |
| | Evenness (Simpson's) | 0.428 | 0.112 | -0.075 | 0.791 | -0.679 | 0.005 | -0.685 | 0.005 | -0.277 | 0.318 | 0.030 | 0.914 | 0.083 | 0.769 | -0.272 | 0.327 | -0.330 | 0.271 | 0.371 | 0.212 | 0.297 | 0.325 |
| | Bray Curtis Distance | 0.054 | 0.849 | 0.021 | 0.940 | 0.236 | 0.398 | 0.234 | 0.401 | 0.263 | 0.344 | 0.254 | 0.361 | -0.038 | 0.893 | 0.176 | 0.529 | 0.038 | 0.901 | 0.055 | 0.858 | -0.242 | 0.426 |
| Family Level | Richness | 0.329 | 0.231 | 0.368 | 0.177 | -0.046 | 0.872 | 0.084 | 0.766 | 0.057 | 0.841 | 0.412 | 0.127 | -0.206 | 0.461 | 0.150 | 0.594 | 0.359 | 0.228 | -0.111 | 0.719 | -0.393 | 0.184 |
| | Evenness (Simpson's) | -0.007 | 0.980 | -0.286 | 0.302 | -0.493 | 0.062 | -0.593 | 0.020 | -0.352 | 0.198 | -0.134 | 0.634 | 0.215 | 0.442 | -0.347 | 0.204 | -0.363 | 0.223 | 0.107 | 0.727 | 0.313 | 0.297 |
| | Bray Curtis Distance | 0.267 | 0.336 | -0.021 | 0.940 | -0.111 | 0.694 | 0.155 | 0.580 | -0.109 | 0.699 | -0.254 | 0.361 | 0.137 | 0.626 | -0.299 | 0.279 | 0.027 | 0.929 | 0.151 | 0.622 | 0.011 | 0.972 |
| Relative Density | EPT (%) * | -0.397 | 0.142 | -0.314 | 0.254 | 0.143 | 0.612 | 0.304 | 0.271 | -0.118 | 0.675 | -0.478 | 0.072 | 0.300 | 0.278 | -0.122 | 0.664 | -0.170 | 0.578 | -0.492 | 0.087 | -0.011 | 0.972 |
| | Ephemeroptera (%) | -0.116 | 0.680 | 0.321 | 0.243 | 0.043 | 0.879 | 0.021 | 0.940 | 0.214 | 0.443 | -0.403 | 0.137 | -0.034 | 0.903 | 0.063 | 0.823 | 0.467 | 0.108 | -0.052 | 0.865 | -0.181 | 0.553 |
| | Plecoptera (%) * | -0.288 | 0.297 | -0.564 | 0.028 | 0.200 | 0.475 | 0.372 | 0.172 | -0.341 | 0.213 | 0.007 | 0.980 | -0.090 | 0.749 | 0.241 | 0.386 | -0.632 | 0.021 | -0.627 | 0.022 | -0.060 | 0.845 |
| | Trichoptera (%) * | 0.199 | 0.476 | 0.043 | 0.879 | -0.591 | 0.020 | -0.782 | <0.001 | -0.425 | 0.114 | 0.223 | 0.425 | -0.074 | 0.792 | -0.249 | 0.370 | 0.000 | 1.000 | 0.357 | 0.231 | -0.160 | 0.601 |
| | Chironomidae (%) | 0.174 | 0.536 | 0.339 | 0.216 | 0.125 | 0.657 | 0.168 | 0.549 | 0.270 | 0.331 | 0.347 | 0.205 | -0.350 | 0.201 | 0.452 | 0.091 | 0.247 | 0.415 | 0.272 | 0.368 | -0.060 | 0.845 |
| | Diptera (%) | 0.251 | 0.368 | -0.100 | 0.723 | -0.079 | 0.781 | 0.059 | 0.835 | -0.434 | 0.106 | 0.127 | 0.652 | 0.193 | 0.490 | -0.380 | 0.163 | -0.077 | 0.803 | 0.096 | 0.754 | -0.121 | 0.694 |
| | Oligocheata (%) * | 0.358 | 0.190 | 0.275 | 0.321 | -0.554 | 0.032 | -0.810 | <0.001 | -0.023 | 0.934 | 0.052 | 0.854 | -0.213 | 0.446 | -0.227 | 0.416 | 0.253 | 0.405 | 0.556 | 0.049 | 0.511 | 0.074 |
| Density | EPT (org/m ²) * | -0.650 | 0.009 | -0.368 | 0.177 | 0.600 | 0.018 | 0.599 | 0.018 | 0.159 | 0.571 | -0.225 | 0.419 | 0.168 | 0.550 | 0.437 | 0.103 | -0.275 | 0.364 | -0.641 | 0.018 | -0.654 | 0.015 |
| | Ephemeroptera (org/m ²) * | -0.392 | 0.148 | -0.043 | 0.879 | 0.357 | 0.191 | 0.309 | 0.262 | 0.259 | 0.351 | -0.324 | 0.239 | 0.217 | 0.438 | 0.207 | 0.459 | 0.055 | 0.859 | -0.322 | 0.284 | -0.632 | 0.021 |
| | Plecoptera (org/m ²) * | -0.440 | 0.100 | -0.482 | 0.069 | 0.454 | 0.089 | 0.577 | 0.024 | -0.055 | 0.845 | -0.048 | 0.864 | -0.078 | 0.783 | 0.560 | 0.030 | -0.500 | 0.082 | -0.680 | 0.011 | -0.615 | 0.025 |
| | Trichoptera (org/m ²) | 0.050 | 0.859 | -0.059 | 0.834 | -0.255 | 0.360 | -0.307 | 0.266 | -0.361 | 0.186 | 0.197 | 0.482 | -0.045 | 0.873 | 0.181 | 0.519 | -0.133 | 0.665 | 0.114 | 0.712 | -0.600 | 0.030 |
| | Chironomidae (org/m ²) | -0.165 | 0.557 | -0.025 | 0.930 | 0.429 | 0.111 | 0.477 | 0.072 | 0.265 | 0.341 | 0.306 | 0.268 | -0.146 | 0.603 | 0.675 | 0.006 | -0.077 | 0.803 | -0.272 | 0.368 | -0.687 | 0.010 |
| | Diptera (org/m ²) | -0.120 | 0.670 | 0.121 | 0.666 | 0.207 | 0.459 | 0.377 | 0.166 | 0.097 | 0.732 | 0.120 | 0.670 | -0.150 | 0.594 | 0.340 | 0.215 | 0.093 | 0.762 | -0.388 | 0.190 | -0.582 | 0.037 |
| | Oligocheata (org/m ²) | 0.223 | 0.425 | 0.344 | 0.210 | -0.383 | 0.159 | -0.516 | 0.049 | 0.385 | 0.156 | -0.024 | 0.932 | -0.169 | 0.547 | 0.197 | 0.482 | 0.279 | 0.357 | 0.318 | 0.290 | -0.033 | 0.915 |

■ P-value < 0.05.

■ $r > 0.6$ or $r < -0.6$.

* = benthic invertebrate community endpoint that was one or more of: 1) out of reference condition (no instances); 2) inconclusive with respect to the reference condition; and/or 3) statistically different from reference following the Control-Impact comparison.

Notes: All correlations were calculated using data < Method Detection Limit (MDL) at the MDL value. N = 13 for all analyses of water quality (n = 10 for reference, n = 3 for exposed). N = 14 for all habitat analyses (n = 9 for reference due to exclusion of REF-1 and n = 5 for the effluent-exposed area). The Spearman's Rank Correlation coefficient is represented by "r" in the above table.

Table D.12: Spearman Correlation of Benthic Invertebrate Endpoints vs. Principal Components Results, *In situ* Measures, and Water Quality Results, Minto Mine Phase 4 EEM, 2016

| Endpoint | | Water Quality | | | | | | | | | | | | Principal Components | | | | | | | | | |
|------------------------|-------------------------------------|-------------------------|---------|-----------------------|---------|----------------------|---------|---------------------|---------|-------------------|---------|-------------------------|---------|-----------------------|---------|----------------------------|---------|----------------------------|---------|----------------------|---------|----------------------|---------|
| | | Total Phosphorus (mg/L) | | Total Aluminum (mg/L) | | Total Arsenic (mg/L) | | Total Copper (mg/L) | | Total Iron (mg/L) | | Total Molybdenum (mg/L) | | Total Selenium (mg/L) | | Water Quality PC-1 (30.0%) | | Water Quality PC-2 (23.7%) | | Habitat PC-1 (45.0%) | | Habitat PC-2 (28.0%) | |
| | | n=13 | | n=13 | | n=13 | | n=13 | | n=13 | | n=13 | | n=13 | | n=13 | | n=13 | | n=14 | | n=14 | |
| | | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value | r | P-value |
| Density | | -0.847 | <0.001 | -0.604 | 0.029 | 0.025 | 0.935 | -0.805 | <0.001 | -0.401 | 0.174 | -0.599 | 0.031 | -0.357 | 0.231 | -0.220 | 0.471 | -0.758 | 0.003 | 0.279 | 0.334 | -0.495 | 0.072 |
| Lowest Practical Level | Richness | -0.217 | 0.477 | -0.216 | 0.478 | -0.267 | 0.377 | -0.117 | 0.703 | -0.325 | 0.279 | 0.396 | 0.181 | 0.291 | 0.334 | -0.560 | 0.046 | 0.117 | 0.705 | 0.051 | 0.863 | 0.443 | 0.113 |
| | Evenness (Simpson's) | 0.437 | 0.135 | 0.522 | 0.067 | -0.235 | 0.440 | 0.628 | 0.022 | 0.154 | 0.616 | 0.373 | 0.209 | 0.374 | 0.209 | 0.324 | 0.280 | 0.121 | 0.694 | -0.174 | 0.553 | 0.112 | 0.703 |
| | Bray Curtis Distance | -0.327 | 0.275 | -0.148 | 0.629 | 0.025 | 0.935 | -0.349 | 0.243 | -0.291 | 0.334 | -0.208 | 0.494 | -0.258 | 0.394 | -0.049 | 0.873 | -0.225 | 0.459 | 0.169 | 0.563 | -0.455 | 0.102 |
| Family Level | Richness | -0.512 | 0.074 | -0.560 | 0.046 | -0.442 | 0.130 | -0.413 | 0.160 | -0.600 | 0.030 | 0.312 | 0.300 | 0.325 | 0.278 | -0.778 | 0.002 | 0.065 | 0.833 | 0.312 | 0.278 | 0.483 | 0.080 |
| | Evenness (Simpson's) | 0.421 | 0.152 | 0.176 | 0.566 | 0.106 | 0.729 | 0.213 | 0.485 | 0.269 | 0.374 | -0.134 | 0.661 | 0.418 | 0.156 | 0.335 | 0.263 | -0.082 | 0.789 | -0.068 | 0.817 | 0.222 | 0.446 |
| | Bray Curtis Distance | 0.184 | 0.547 | -0.132 | 0.668 | 0.388 | 0.190 | -0.246 | 0.417 | 0.005 | 0.986 | -0.077 | 0.802 | -0.055 | 0.859 | -0.022 | 0.943 | 0.000 | 1.000 | -0.187 | 0.523 | -0.134 | 0.648 |
| Relative Density | EPT (%) | 0.168 | 0.584 | -0.495 | 0.086 | 0.442 | 0.131 | -0.451 | 0.122 | 0.264 | 0.384 | -0.424 | 0.149 | 0.011 | 0.972 | 0.110 | 0.721 | -0.313 | 0.297 | -0.244 | 0.401 | 0.130 | 0.659 |
| | Ephemeroptera (%) | -0.069 | 0.823 | -0.516 | 0.071 | 0.157 | 0.609 | -0.362 | 0.224 | -0.247 | 0.415 | -0.007 | 0.983 | 0.225 | 0.459 | -0.451 | 0.122 | 0.027 | 0.929 | -0.134 | 0.648 | -0.011 | 0.970 |
| | Plecoptera (%) | -0.050 | 0.872 | 0.011 | 0.972 | 0.147 | 0.631 | -0.089 | 0.774 | 0.544 | 0.055 | -0.326 | 0.277 | -0.456 | 0.117 | 0.495 | 0.086 | -0.434 | 0.138 | 0.200 | 0.493 | -0.244 | 0.401 |
| | Trichoptera (%) | 0.058 | 0.850 | -0.055 | 0.858 | -0.387 | 0.191 | 0.120 | 0.697 | -0.204 | 0.503 | 0.257 | 0.397 | 0.707 | 0.007 | -0.243 | 0.424 | -0.044 | 0.886 | 0.210 | 0.472 | 0.581 | 0.029 |
| | Chironomidae (%) | -0.264 | 0.383 | 0.291 | 0.334 | -0.207 | 0.498 | 0.246 | 0.417 | -0.143 | 0.642 | 0.242 | 0.426 | -0.247 | 0.415 | -0.093 | 0.762 | 0.214 | 0.482 | 0.319 | 0.267 | -0.385 | 0.175 |
| | Diptera (%) | -0.055 | 0.858 | -0.187 | 0.541 | 0.110 | 0.721 | -0.246 | 0.417 | -0.209 | 0.494 | 0.020 | 0.948 | 0.209 | 0.494 | -0.324 | 0.280 | 0.060 | 0.845 | -0.007 | 0.982 | 0.516 | 0.059 |
| | Oligocheata (%) | 0.501 | 0.081 | 0.544 | 0.055 | -0.269 | 0.373 | 0.808 | <0.001 | 0.027 | 0.929 | 0.575 | 0.040 | 0.484 | 0.094 | 0.071 | 0.817 | 0.571 | 0.041 | -0.068 | 0.817 | 0.226 | 0.436 |
| Density | EPT (org/m ²) | -0.605 | 0.028 | -0.681 | 0.010 | 0.304 | 0.313 | -0.871 | <0.001 | -0.176 | 0.566 | -0.773 | 0.002 | -0.379 | 0.201 | -0.044 | 0.887 | -0.830 | <0.001 | -0.002 | 0.994 | -0.451 | 0.106 |
| | Ephemeroptera (org/m ²) | -0.465 | 0.109 | -0.681 | 0.010 | 0.125 | 0.683 | -0.788 | 0.001 | -0.368 | 0.216 | -0.457 | 0.116 | -0.055 | 0.859 | -0.335 | 0.263 | -0.571 | 0.041 | -0.160 | 0.584 | -0.288 | 0.318 |
| | Plecoptera (org/m ²) | -0.575 | 0.040 | -0.401 | 0.174 | 0.216 | 0.478 | -0.617 | 0.025 | 0.055 | 0.859 | -0.632 | 0.020 | -0.571 | 0.041 | 0.165 | 0.590 | -0.819 | <0.001 | 0.169 | 0.563 | -0.626 | 0.017 |
| | Trichoptera (org/m ²) | -0.432 | 0.140 | -0.379 | 0.202 | -0.210 | 0.492 | -0.362 | 0.224 | -0.481 | 0.096 | -0.071 | 0.817 | 0.451 | 0.122 | -0.432 | 0.141 | -0.418 | 0.156 | 0.261 | 0.368 | 0.091 | 0.758 |
| | Chironomidae (org/m ²) | -0.809 | <0.001 | -0.335 | 0.263 | -0.175 | 0.567 | -0.523 | 0.067 | -0.451 | 0.122 | -0.272 | 0.368 | -0.379 | 0.201 | -0.253 | 0.405 | -0.516 | 0.071 | 0.301 | 0.296 | -0.591 | 0.026 |
| | Diptera (org/m ²) | -0.591 | 0.033 | -0.830 | <0.001 | 0.310 | 0.302 | -0.805 | <0.001 | -0.451 | 0.122 | -0.380 | 0.200 | -0.033 | 0.915 | -0.522 | 0.067 | -0.396 | 0.181 | 0.354 | 0.215 | 0.051 | 0.864 |
| | Oligocheata (org/m ²) | -0.037 | 0.904 | 0.047 | 0.879 | -0.075 | 0.806 | 0.233 | 0.443 | -0.408 | 0.166 | 0.160 | 0.601 | 0.301 | 0.318 | -0.163 | 0.595 | 0.074 | 0.809 | 0.000 | 1.000 | -0.271 | 0.349 |

■ P-value < 0.05.

■ r > 0.6 or r < -0.6.

* = benthic invertebrate community endpoint that was inconclusive with respect to the Reference Condition Approach and/or difference from reference following the Control-Impact comparison.

Notes: All correlations were calculated using data < Method Detection Limit (MDL) at the MDL value. N = 13 for all analyses of water quality (n = 10 for reference, n = 3 for exposed). N = 14 for all habitat analyses (n = 9 for reference due to exclusion of REF-1 and n = 5 for the effluent-exposed area). The Spearman's Rank Correlation coefficient is represented by "r" in the above table.

APPENDIX E
FISH SURVEY DATA

Table E.1: Meristic Data for Juvenile Chinook Salmon Collected from Lower Minto Creek and Lower Big Creek, June to September 2016

| Lower Big Creek | | |
|-----------------|-------------|------------|
| Month | Length (mm) | Weight (g) |
| June | 48 | 1.1 |
| | 48 | 1.9 |
| July | 63 | 3.9 |
| | 58 | 2.8 |
| | 58 | 3.5 |
| | 62 | 4.7 |
| | 55 | 2.6 |
| | 56 | 2.8 |
| | 62 | 3.4 |
| | 60 | 2.8 |
| | 56 | 2.8 |
| | 57 | 3.4 |
| | 48 | 2.1 |
| | 57 | 2.7 |
| | 53 | 2.1 |
| | 65 | 3.9 |
| | 54 | 2.4 |
| | 57 | 2.3 |
| 55 | 2.0 | |
| 52 | 2.8 | |
| 65 | 4.2 | |
| 62 | 3.5 | |
| 61 | 3.3 | |

| Lower Big Creek | | |
|-----------------|-------------|------------|
| Month | Length (mm) | Weight (g) |
| August | 73 | 5.01 |
| | 67 | 2.75 |
| | 77 | 5.52 |
| | 69 | 3.47 |
| | 68 | 3.83 |
| | 62 | 2.60 |
| | 81 | 6.21 |
| | 68 | 4.08 |
| | 75 | 4.60 |
| | 66 | 3.65 |
| | 58 | 2.34 |
| | 61 | 3.92 |
| | 66 | 3.59 |
| | 62 | 2.90 |
| | 64 | 3.40 |
| | 61 | 3.00 |
| September | 77 | 6.37 |
| | 78 | 5.89 |
| | 76 | 4.61 |
| | 58 | 3.22 |
| | 73 | 3.75 |
| | 72 | 4.44 |
| | 56 | 3.48 |
| | 63 | 3.32 |
| | 78 | 5.18 |
| | 62 | 2.90 |
| | 68 | 2.71 |
| 69 | 4.29 | |

| Lower Minto Creek | | |
|-------------------|-------------|------------|
| Month | Length (mm) | Weight (g) |
| September | 73 | 4.48 |
| | 87 | 7.20 |
| | 62 | 3.03 |
| | 64 | 3.36 |
| | 71 | 4.43 |
| | 80 | 5.90 |

Table E.2: Descriptive Summary Statistics of Juvenile Chinook Salmon Length and Weight Collected from Lower Minto Creek and Lower Big Creek, June to September 2016

| Month | Summary Statistic | Area | | | |
|-----------|--------------------|-----------------------------|------------|-----------------------------|------------|
| | | Reference (lower Big Creek) | | Exposed (lower Minto Creek) | |
| | | Fork Length (mm) | Weight (g) | Fork Length (mm) | Weight (g) |
| June | N | 2 | 2 | 0 | 0 |
| | Mean | 48 | 1.50 | - | - |
| | Median | 48 | 1.50 | - | - |
| | Minimum | 48 | 1.10 | - | - |
| | Maximum | 48 | 1.90 | - | - |
| | Standard Deviation | 0 | 0.57 | - | - |
| | Standard Error | 0 | 0.40 | - | - |
| July | N | 21 | 21 | 0 | 0 |
| | Mean | 57.9 | 3.0 | - | - |
| | Median | 57.0 | 2.8 | - | - |
| | Minimum | 48.0 | 2.0 | - | - |
| | Maximum | 65.0 | 4.7 | - | - |
| | Standard Deviation | 4.41 | 0.73 | - | - |
| | Standard Error | 0.96 | 0.16 | - | - |
| August | N | 16 | 16 | 0 | 0 |
| | Mean | 67.4 | 3.80 | - | - |
| | Median | 66.5 | 3.62 | - | - |
| | Minimum | 58.0 | 2.34 | - | - |
| | Maximum | 81.0 | 6.21 | - | - |
| | Standard Deviation | 6.4 | 1.08 | - | - |
| | Standard Error | 1.6 | 0.27 | - | - |
| September | N | 12 | 12 | 6 | 6 |
| | Mean | 69.2 | 4.18 | 72.8 | 4.73 |
| | Median | 70.5 | 4.02 | 72.0 | 4.46 |
| | Minimum | 56.0 | 2.71 | 62.0 | 3.03 |
| | Maximum | 78.0 | 6.37 | 87.0 | 7.20 |
| | Standard Deviation | 7.8 | 1.17 | 9.5 | 1.57 |
| | Standard Error | 2.3 | 0.34 | 3.9 | 0.64 |

Table E.3: Raw Meristic Data of Kokanee at Day 0 (Pre-Exposed) of Control, E6, and E3 Treatments for the Minto Mine Fish Hatchery Exposure, August 2016

| Date | Fish # | Control | | | E6 | | | E3 | | |
|------------|--------|-------------------|------------------|------------|-------------------|------------------|------------|-------------------|------------------|------------|
| | | Total length (mm) | Fork length (mm) | Weight (g) | Total length (mm) | Fork length (mm) | Weight (g) | Total length (mm) | Fork length (mm) | Weight (g) |
| 4-Aug-2016 | 1 | 76.29 | 70.98 | 3.43 | 68.50 | 64.70 | 2.39 | 75.61 | 72.00 | 3.22 |
| 4-Aug-2016 | 2 | 79.66 | 73.13 | 3.92 | 75.50 | 71.80 | 3.39 | 81.51 | 76.81 | 4.16 |
| 4-Aug-2016 | 3 | 68.84 | 64.47 | 2.50 | 77.60 | 72.10 | 3.48 | 81.20 | 78.13 | 4.54 |
| 4-Aug-2016 | 4 | 62.99 | 59.59 | 1.74 | 79.00 | 74.30 | 3.81 | 74.13 | 71.29 | 3.14 |
| 4-Aug-2016 | 5 | 71.99 | 66.43 | 2.94 | 78.80 | 72.90 | 3.75 | 71.24 | 67.42 | 2.53 |
| 4-Aug-2016 | 6 | 79.26 | 74.10 | 4.30 | 80.40 | 75.20 | 4.14 | 79.30 | 75.00 | 3.95 |
| 4-Aug-2016 | 7 | 78.20 | 73.80 | 3.30 | 70.00 | 65.80 | 2.55 | 77.30 | 72.60 | 3.63 |
| 4-Aug-2016 | 8 | 72.29 | 67.88 | 3.00 | 74.60 | 70.10 | 3.15 | 70.20 | 67.20 | 2.39 |
| 4-Aug-2016 | 9 | 79.01 | 73.50 | 3.85 | 78.10 | 72.90 | 3.71 | 76.30 | 71.70 | 3.35 |
| 4-Aug-2016 | 10 | 66.11 | 61.48 | 2.14 | 77.70 | 72.90 | 3.62 | 72.20 | 68.00 | 2.83 |
| 4-Aug-2016 | 11 | 81.11 | 77.67 | 4.22 | 79.50 | 75.30 | 3.93 | 85.00 | 79.50 | 5.39 |
| 4-Aug-2016 | 12 | 74.72 | 71.39 | 3.35 | 75.30 | 71.30 | 3.17 | 74.70 | 69.20 | 3.05 |
| 4-Aug-2016 | 13 | 86.16 | 80.56 | 4.90 | 82.70 | 76.80 | 4.48 | 72.10 | 68.90 | 2.80 |
| 4-Aug-2016 | 14 | 81.69 | 75.87 | 4.11 | 83.60 | 79.80 | 4.81 | 72.30 | 68.30 | 3.01 |
| 4-Aug-2016 | 15 | 77.94 | 73.15 | 3.68 | 81.70 | 77.80 | 4.04 | 78.00 | 73.40 | 3.60 |
| 4-Aug-2016 | 16 | 80.18 | 75.48 | 4.02 | 82.80 | 77.90 | 4.50 | 79.10 | 76.10 | 3.82 |
| 4-Aug-2016 | 17 | 82.46 | 77.59 | 4.29 | 79.30 | 75.40 | 3.94 | 79.20 | 73.00 | 3.68 |
| 4-Aug-2016 | 18 | 77.73 | 73.37 | 3.52 | 75.00 | 70.20 | 3.20 | 68.90 | 63.70 | 2.42 |
| 4-Aug-2016 | 19 | 84.52 | 81.79 | 4.65 | 83.80 | 78.20 | 4.55 | 69.10 | 64.20 | 2.33 |
| 4-Aug-2016 | 20 | 72.23 | 67.39 | 2.80 | 81.40 | 77.50 | 4.31 | 83.00 | 78.50 | 4.46 |
| 4-Aug-2016 | 21 | 73.71 | 69.69 | 3.01 | 77.00 | 72.40 | 3.49 | 84.00 | 78.50 | 4.72 |
| 4-Aug-2016 | 22 | 85.57 | 80.44 | 5.29 | 76.80 | 72.10 | 3.27 | 77.30 | 71.80 | 3.51 |
| 4-Aug-2016 | 23 | 70.65 | 66.60 | 2.80 | 66.80 | 63.00 | 2.24 | 78.10 | 72.00 | 3.81 |
| 4-Aug-2016 | 24 | 80.19 | 75.82 | 4.02 | 71.20 | 67.20 | 2.70 | 75.80 | 70.20 | 3.48 |
| 4-Aug-2016 | 25 | 76.81 | 73.14 | 3.47 | 66.10 | 62.30 | 2.11 | 78.20 | 72.90 | 3.65 |
| 4-Aug-2016 | 26 | 77.10 | 71.20 | 3.36 | 63.50 | 60.20 | 1.85 | 75.10 | 70.10 | 2.98 |
| 4-Aug-2016 | 27 | 63.50 | 60.00 | 1.90 | 68.40 | 65.50 | 2.33 | 79.50 | 74.00 | 3.51 |
| 4-Aug-2016 | 28 | 68.50 | 65.30 | 2.32 | 77.60 | 72.20 | 3.45 | 69.60 | 65.50 | 2.42 |
| 4-Aug-2016 | 29 | 79.20 | 74.70 | 3.85 | 78.40 | 74.30 | 3.74 | 79.40 | 74.10 | 3.62 |
| 4-Aug-2016 | 30 | 76.20 | 71.20 | 3.20 | 73.20 | 70.00 | 2.95 | 66.80 | 62.10 | 2.10 |
| 4-Aug-2016 | 31 | 71.20 | 67.10 | 2.65 | 80.50 | 76.10 | 3.93 | 77.20 | 72.30 | 3.33 |
| 4-Aug-2016 | 32 | 79.30 | 73.80 | 4.07 | 73.00 | 68.30 | 2.93 | 79.70 | 75.10 | 3.88 |
| 4-Aug-2016 | 33 | 78.80 | 73.50 | 3.48 | 64.00 | 60.00 | 1.97 | 77.00 | 71.90 | 3.50 |
| 4-Aug-2016 | 34 | 80.90 | 76.20 | 4.26 | 80.20 | 74.30 | 4.24 | 78.00 | 72.60 | 3.55 |
| 4-Aug-2016 | 35 | 72.30 | 67.10 | 2.73 | 80.20 | 77.10 | 3.89 | 79.10 | 76.10 | 3.54 |
| 4-Aug-2016 | 36 | 71.10 | 67.30 | 2.80 | 75.00 | 70.70 | 3.20 | 85.50 | 80.40 | 5.01 |
| 4-Aug-2016 | 37 | 80.50 | 76.90 | 4.16 | 80.80 | 76.20 | 3.94 | 81.10 | 76.50 | 3.83 |
| 4-Aug-2016 | 38 | 80.30 | 76.20 | 4.28 | 72.90 | 68.30 | 2.95 | 83.90 | 79.50 | 4.79 |
| 4-Aug-2016 | 39 | 75.40 | 70.00 | 3.18 | 80.60 | 76.40 | 4.04 | 66.90 | 62.00 | 2.36 |
| 4-Aug-2016 | 40 | 76.90 | 72.70 | 3.58 | 79.20 | 73.90 | 3.92 | 78.10 | 73.60 | 3.56 |
| 4-Aug-2016 | 41 | 64.30 | 60.50 | 1.83 | 83.80 | 78.10 | 4.54 | 69.50 | 65.00 | 2.46 |
| 4-Aug-2016 | 42 | 76.50 | 72.00 | 3.12 | 78.00 | 73.20 | 3.71 | 81.70 | 77.50 | 3.94 |
| 4-Aug-2016 | 43 | 69.60 | 66.10 | 2.66 | 78.10 | 72.80 | 3.49 | 77.20 | 70.30 | 3.38 |
| 4-Aug-2016 | 44 | 75.30 | 71.20 | 3.16 | 83.60 | 77.70 | 4.27 | 74.10 | 69.90 | 3.07 |
| 4-Aug-2016 | 45 | 80.60 | 77.20 | 4.08 | 74.00 | 69.80 | 3.00 | 83.80 | 78.50 | 4.83 |
| 4-Aug-2016 | 46 | 80.80 | 76.40 | 4.24 | 78.10 | 74.00 | 3.71 | 76.20 | 72.50 | 3.64 |
| 4-Aug-2016 | 47 | 75.30 | 70.30 | 3.33 | 75.30 | 70.90 | 3.10 | 72.90 | 68.00 | 2.55 |
| 4-Aug-2016 | 48 | 74.10 | 69.80 | 3.00 | 80.80 | 75.50 | 3.92 | 72.30 | 67.90 | 2.88 |
| 4-Aug-2016 | 49 | 80.60 | 76.10 | 4.01 | 76.60 | 71.10 | 3.18 | 74.10 | 70.40 | 3.25 |
| 4-Aug-2016 | 50 | 71.60 | 68.70 | 2.61 | 75.50 | 71.30 | 3.15 | 73.90 | 69.50 | 3.02 |
| 4-Aug-2016 | 51 | 77.20 | 71.50 | 3.54 | 82.70 | 77.10 | 4.80 | 84.70 | 79.30 | 4.46 |
| 4-Aug-2016 | 52 | 78.40 | 75.10 | 3.74 | 74.20 | 70.90 | 3.08 | 79.30 | 75.10 | 3.89 |
| 4-Aug-2016 | 53 | 81.10 | 76.70 | 4.03 | 64.70 | 60.50 | 2.00 | 82.20 | 76.40 | 4.31 |
| 4-Aug-2016 | 54 | 65.10 | 62.20 | 2.04 | 80.50 | 76.30 | 3.92 | 63.50 | 59.20 | 1.84 |
| 4-Aug-2016 | 55 | 74.60 | 70.30 | 3.00 | 76.20 | 70.90 | 3.35 | 83.10 | 78.10 | 4.49 |
| 4-Aug-2016 | 56 | 72.80 | 68.80 | 2.80 | 77.80 | 73.70 | 3.69 | 79.70 | 74.90 | 3.69 |
| 4-Aug-2016 | 57 | 72.00 | 67.90 | 2.65 | 73.90 | 70.00 | 3.22 | 84.20 | 79.00 | 4.43 |
| 4-Aug-2016 | 58 | 71.20 | 66.00 | 2.62 | 76.50 | 72.20 | 3.29 | 82.80 | 78.20 | 4.62 |
| 4-Aug-2016 | 59 | 72.50 | 68.30 | 3.00 | 78.70 | 72.50 | 3.76 | 82.20 | 76.30 | 3.91 |
| 4-Aug-2016 | 60 | 78.70 | 74.10 | 4.06 | 72.60 | 68.70 | 2.87 | 76.90 | 72.30 | 3.43 |
| 4-Aug-2016 | 61 | 85.00 | 79.30 | 4.78 | 75.00 | 70.40 | 3.38 | 83.00 | 79.10 | 4.62 |
| 4-Aug-2016 | 62 | 71.20 | 67.80 | 2.79 | 78.80 | 73.90 | 3.84 | 72.90 | 68.70 | 2.92 |
| 4-Aug-2016 | 63 | 75.00 | 70.70 | 3.04 | 76.10 | 71.40 | 3.58 | 83.00 | 76.90 | 4.48 |
| 4-Aug-2016 | 64 | 76.20 | 72.80 | 3.41 | 82.20 | 77.50 | 4.27 | 82.20 | 77.70 | 4.45 |
| 4-Aug-2016 | 65 | 78.10 | 73.90 | 3.64 | 75.30 | 71.70 | 3.30 | 83.10 | 77.30 | 4.55 |
| 4-Aug-2016 | 66 | 77.80 | 73.40 | 3.69 | 75.40 | 71.30 | 3.28 | 64.00 | 60.50 | 1.97 |
| 4-Aug-2016 | 67 | 76.90 | 72.10 | 3.22 | 68.60 | 64.50 | 2.36 | 84.20 | 78.20 | 4.75 |
| 4-Aug-2016 | 68 | 81.80 | 76.50 | 4.35 | 75.40 | 70.60 | 3.23 | 78.00 | 71.30 | 3.66 |
| 4-Aug-2016 | 69 | 79.80 | 74.50 | 3.75 | 79.70 | 74.10 | 3.76 | 64.90 | 60.30 | 1.92 |
| 4-Aug-2016 | 70 | 78.90 | 73.90 | 3.76 | 84.80 | 78.90 | 5.08 | 72.80 | 67.60 | 2.74 |
| 4-Aug-2016 | 71 | 84.10 | 80.20 | 4.83 | 82.10 | 76.70 | 4.59 | 82.20 | 77.00 | 4.08 |
| 4-Aug-2016 | 72 | 77.20 | 72.00 | 3.55 | 83.10 | 78.10 | 4.64 | 76.10 | 70.30 | 3.10 |
| 4-Aug-2016 | 73 | 79.20 | 73.70 | 3.45 | 73.90 | 69.00 | 3.29 | 73.30 | 68.90 | 3.08 |
| 4-Aug-2016 | 74 | 72.00 | 67.70 | 2.75 | 82.30 | 77.20 | 4.32 | 80.20 | 75.50 | 3.70 |
| 4-Aug-2016 | 75 | 74.00 | 71.30 | 3.04 | 79.40 | 75.60 | 3.90 | 77.40 | 73.00 | 3.79 |
| 4-Aug-2016 | 76 | 63.10 | 59.80 | 1.81 | 77.50 | 73.20 | 3.25 | 76.10 | 74.20 | 3.47 |
| 4-Aug-2016 | 77 | 62.20 | 58.90 | 1.73 | 84.50 | 80.00 | 4.32 | 75.30 | 69.80 | 3.06 |
| 4-Aug-2016 | 78 | 74.70 | 68.90 | 3.04 | 74.80 | 69.20 | 3.14 | 69.10 | 63.90 | 2.33 |
| 4-Aug-2016 | 79 | 75.20 | 70.00 | 3.23 | 72.20 | 67.30 | 2.95 | 69.90 | 65.50 | 2.55 |
| 4-Aug-2016 | 80 | 75.10 | 70.30 | 3.27 | 81.10 | 76.00 | 4.31 | 73.60 | 69.60 | 3.20 |
| 4-Aug-2016 | 81 | 85.80 | 80.60 | 4.94 | 74.50 | 71.60 | 2.88 | 78.10 | 73.50 | 3.52 |
| 4-Aug-2016 | 82 | 81.30 | 77.00 | 3.98 | 75.50 | 70.80 | 3.37 | 79.60 | 74.50 | 3.91 |
| 4-Aug-2016 | 83 | 76.80 | 72.70 | 3.61 | 79.60 | 74.00 | 3.91 | 72.20 | 67.90 | 2.70 |
| 4-Aug-2016 | 84 | 83.30 | 78.10 | 4.31 | 79.10 | 74.70 | 3.60 | 75.40 | 71.00 | 3.23 |
| 4-Aug-2016 | 85 | 77.90 | 72.60 | 3.87 | 77.20 | 73.10 | 3.71 | 83.70 | 78.20 | 4.43 |
| 4-Aug-2016 | 86 | 80.40 | 75.40 | 3.94 | 80.00 | 74.80 | 4.01 | 77.90 | 72.80 | 3.53 |
| 4-Aug-2016 | 87 | 74.70 | 70.70 | 3.09 | 71.90 | 67.30 | 2.68 | 72.90 | 68.70 | 3.00 |
| 4-Aug-2016 | 88 | 74.90 | 70.00 | 2.90 | 78.10 | 72.60 | 3.71 | 78.50 | 73.10 | 4.04 |
| 4-Aug-2016 | 89 | 73.20 | 69.00 | 2.95 | 78.00 | 73.30 | 3.79 | 66.50 | 62.70 | 2.16 |
| 4-Aug-2016 | 90 | 77.30 | 72.30 | 3.78 | 67.70 | 63.10 | 2.20 | 65.50 | 60.80 | 2.26 |
| 4-Aug-2016 | 91 | 63.70 | 59.60 | 1.97 | 73.10 | 68.20 | 2.90 | 78.80 | 74.80 | 3.71 |
| 4-Aug-2016 | 92 | 79.50 | 75.00 | 3.60 | 77.60 | 73.50 | 3.35 | 79.00 | 74.50 | 3.76 |
| 4-Aug-2016 | 93 | 86.80 | 83.20 | 5.14 | 82.00 | 76.80 | 3.91 | 76.50 | 71.30 | 3.24 |
| 4-Aug-2016 | 94 | 76.20 | 72.00 | 3.15 | 79.70 | 76.60 | 3.94 | 73.20 | 68.90 | 2.94 |
| 4-Aug-2016 | 95 | 75.80 | 70.70 | 3.24 | 75.80 | 70.50 | 3.42 | 76.70 | 72.00 | 3.68 |
| 4-Aug-2016 | 96 | 77.70 | 73.30 | 3.56 | 80.20 | 74.20 | 3.80 | 77.40 | 72.90 | 3.38 |
| 4-Aug-2016 | 97 | 80.40 | 75.10 | 3.98 | 69.80 | 66.70 | 2.85 | 77.00 | 72.10 | 3.37 |
| 4-Aug-2016 | 98 | 76.00 | 71.50 | 3.31 | 68.90 | 64.40 | 2.44 | 75.30 | 70.10 | 3.09 |

Table E.3: Raw Meristic Data of Kokanee at Day 0 (Pre-Exposed) of Control, E6, and E3 Treatments for the Minto Mine Fish Hatchery Exposure, August 2016

| Date | Fish # | Control | | | E6 | | | E3 | | |
|------------|--------|-------------------|------------------|------------|-------------------|------------------|------------|-------------------|------------------|------------|
| | | Total length (mm) | Fork length (mm) | Weight (g) | Total length (mm) | Fork length (mm) | Weight (g) | Total length (mm) | Fork length (mm) | Weight (g) |
| 4-Aug-2016 | 99 | 82.10 | 76.90 | 4.25 | 63.60 | 59.20 | 1.92 | 72.30 | 68.50 | 2.75 |
| 4-Aug-2016 | 100 | 78.40 | 74.60 | 3.87 | 82.80 | 78.10 | 4.15 | 71.90 | 67.10 | 2.59 |
| 4-Aug-2016 | 101 | 80.80 | 75.30 | 4.25 | 75.50 | 70.50 | 3.13 | 78.20 | 73.70 | 3.74 |
| 4-Aug-2016 | 102 | 78.20 | 74.50 | 3.83 | 74.00 | 69.20 | 2.90 | 83.00 | 78.50 | 4.55 |
| 4-Aug-2016 | 103 | 73.30 | 69.80 | 3.18 | 81.90 | 77.20 | 4.21 | 86.20 | 80.40 | 4.74 |
| 4-Aug-2016 | 104 | 78.20 | 74.70 | 3.68 | 78.00 | 72.90 | 3.68 | 82.30 | 77.30 | 4.31 |
| 4-Aug-2016 | 105 | 79.00 | 72.90 | 3.67 | 80.00 | 75.40 | 3.95 | 82.90 | 77.80 | 4.53 |
| 4-Aug-2016 | 106 | 80.20 | 75.30 | 3.91 | 78.30 | 74.10 | 3.39 | 77.60 | 73.00 | 3.37 |
| 4-Aug-2016 | 107 | 76.80 | 71.90 | 3.18 | 79.80 | 75.30 | 3.96 | 80.00 | 75.10 | 3.72 |
| 4-Aug-2016 | 108 | 78.60 | 74.10 | 3.76 | 79.90 | 74.90 | 3.86 | 75.20 | 71.20 | 3.03 |
| 4-Aug-2016 | 109 | 78.70 | 74.20 | 3.80 | 83.30 | 77.20 | 4.59 | 80.60 | 75.20 | 4.20 |
| 4-Aug-2016 | 110 | 75.60 | 71.00 | 3.09 | 76.70 | 71.40 | 4.46 | 80.30 | 76.30 | 3.89 |
| 4-Aug-2016 | 111 | 85.70 | 81.20 | 4.61 | 86.40 | 81.00 | 5.43 | 76.20 | 71.20 | 3.07 |
| 4-Aug-2016 | 112 | 80.30 | 76.20 | 3.94 | 79.90 | 75.70 | 4.05 | 82.40 | 77.20 | 4.31 |
| 4-Aug-2016 | 113 | 85.60 | 79.80 | 4.73 | 77.80 | 73.00 | 3.76 | 70.10 | 66.00 | 2.71 |
| 4-Aug-2016 | 114 | 84.80 | 79.90 | 4.91 | 79.20 | 75.30 | 3.93 | 75.70 | 70.40 | 3.22 |
| 4-Aug-2016 | 115 | 79.60 | 75.10 | 3.82 | 77.40 | 73.70 | 3.64 | 73.00 | 69.10 | 2.72 |
| 4-Aug-2016 | 116 | 64.30 | 60.50 | 1.96 | 77.20 | 73.50 | 3.67 | 77.30 | 72.90 | 3.47 |
| 4-Aug-2016 | 117 | 79.70 | 75.20 | 3.49 | 82.50 | 77.30 | 4.63 | 76.30 | 72.00 | 3.35 |
| 4-Aug-2016 | 118 | 75.10 | 69.20 | 3.11 | 77.10 | 70.80 | 3.41 | 78.50 | 74.40 | 3.93 |
| 4-Aug-2016 | 119 | 71.70 | 68.60 | 2.68 | 79.10 | 75.20 | 3.76 | 74.90 | 71.00 | 3.29 |
| 4-Aug-2016 | 120 | 75.40 | 71.50 | 3.53 | 76.10 | 71.30 | 3.35 | 73.80 | 69.50 | 3.09 |
| 4-Aug-2016 | 121 | 82.90 | 78.40 | 4.25 | 75.50 | 71.90 | 3.17 | 77.20 | 72.60 | 3.29 |
| 4-Aug-2016 | 122 | 72.00 | 67.40 | 2.69 | 77.90 | 73.20 | 3.63 | 77.90 | 73.20 | 3.73 |
| 4-Aug-2016 | 123 | 77.10 | 72.10 | 3.60 | 78.00 | 72.20 | 3.67 | 73.90 | 71.00 | 3.10 |
| 4-Aug-2016 | 124 | 71.60 | 68.90 | 2.74 | 78.00 | 73.80 | 3.49 | 78.70 | 74.90 | 3.56 |
| 4-Aug-2016 | 125 | 84.60 | 79.40 | 4.88 | 75.30 | 71.40 | 3.62 | 77.10 | 72.20 | 3.44 |
| 4-Aug-2016 | 126 | 77.00 | 73.60 | 3.60 | 82.20 | 77.20 | 4.42 | 75.10 | 70.50 | 3.30 |
| 4-Aug-2016 | 127 | 80.10 | 75.20 | 3.89 | 74.90 | 71.00 | 3.01 | 77.90 | 74.50 | 3.83 |
| 4-Aug-2016 | 128 | 68.80 | 64.50 | 2.36 | 79.20 | 74.30 | 4.03 | 74.20 | 69.70 | 2.90 |
| 4-Aug-2016 | 129 | 82.20 | 77.70 | 4.11 | 79.20 | 74.00 | 3.59 | 73.20 | 68.20 | 2.84 |
| 4-Aug-2016 | 130 | 67.90 | 64.10 | 2.29 | 80.30 | 76.30 | 4.06 | 75.20 | 70.90 | 3.22 |
| 4-Aug-2016 | 131 | 80.30 | 74.90 | 3.91 | 90.00 | 85.90 | 5.80 | 77.90 | 73.00 | 3.68 |
| 4-Aug-2016 | 132 | 83.10 | 77.30 | 4.22 | 79.90 | 75.70 | 3.92 | 77.40 | 72.70 | 3.27 |
| 4-Aug-2016 | 133 | 68.10 | 63.80 | 2.32 | 73.60 | 69.80 | 2.85 | 85.00 | 81.20 | 4.91 |
| 4-Aug-2016 | 134 | 76.30 | 71.10 | 3.26 | 84.60 | 79.00 | 4.42 | 77.20 | 72.90 | 3.48 |
| 4-Aug-2016 | 135 | 76.10 | 71.50 | 3.43 | 79.20 | 74.50 | 3.77 | 73.00 | 69.30 | 2.92 |
| 4-Aug-2016 | 136 | 75.40 | 72.10 | 3.01 | 76.70 | 72.60 | 3.86 | 75.80 | 72.00 | 3.42 |
| 4-Aug-2016 | 137 | 74.90 | 71.00 | 3.11 | 73.30 | 70.00 | 2.97 | 80.00 | 75.40 | 4.23 |
| 4-Aug-2016 | 138 | 75.80 | 71.90 | 3.34 | 76.00 | 72.20 | 3.41 | 77.80 | 74.10 | 3.56 |
| 4-Aug-2016 | 139 | 78.50 | 73.30 | 3.60 | 66.50 | 62.30 | 2.12 | 73.70 | 69.90 | 2.95 |
| 4-Aug-2016 | 140 | 76.20 | 70.50 | 3.42 | 79.00 | 74.20 | 3.53 | 73.20 | 69.60 | 3.04 |
| 4-Aug-2016 | 141 | 79.10 | 75.20 | 3.71 | 83.80 | 78.10 | 4.43 | 77.60 | 74.10 | 3.93 |
| 4-Aug-2016 | 142 | 75.40 | 72.00 | 3.20 | 79.30 | 74.10 | 3.80 | 67.40 | 64.20 | 2.20 |
| 4-Aug-2016 | 143 | 80.30 | 75.60 | 4.23 | 79.20 | 75.00 | 3.91 | 81.80 | 76.90 | 3.96 |
| 4-Aug-2016 | 144 | 77.20 | 73.20 | 3.53 | 74.90 | 70.60 | 3.17 | 76.30 | 72.50 | 3.36 |
| 4-Aug-2016 | 145 | 82.10 | 77.90 | 4.33 | 83.40 | 78.20 | 4.43 | 82.10 | 77.70 | 4.32 |
| 4-Aug-2016 | 146 | 78.50 | 74.40 | 3.91 | 78.50 | 73.10 | 3.48 | 78.50 | 74.00 | 3.84 |
| 4-Aug-2016 | 147 | 78.60 | 74.20 | 3.90 | 73.80 | 70.00 | 2.87 | 73.70 | 68.20 | 2.86 |
| 4-Aug-2016 | 148 | 82.70 | 77.40 | 4.73 | 79.40 | 74.50 | 3.84 | 80.10 | 76.40 | 4.17 |
| 4-Aug-2016 | 149 | 78.90 | 73.30 | 3.40 | 77.30 | 73.00 | 3.21 | 76.20 | 71.90 | 3.26 |
| 4-Aug-2016 | 150 | 78.80 | 72.80 | 3.74 | 78.90 | 74.80 | 3.78 | 75.90 | 71.30 | 3.46 |
| 4-Aug-2016 | 151 | 83.00 | 78.10 | 4.51 | 83.00 | 78.40 | 4.30 | 82.00 | 77.40 | 4.02 |
| 4-Aug-2016 | 152 | 79.30 | 75.10 | 3.85 | 83.20 | 78.10 | 4.29 | 73.30 | 69.70 | 3.11 |
| 4-Aug-2016 | 153 | 77.60 | 74.10 | 3.90 | 77.20 | 73.20 | 3.50 | 73.10 | 68.30 | 3.02 |
| 4-Aug-2016 | 154 | 76.20 | 70.50 | 3.33 | 91.00 | 86.20 | 5.74 | 75.70 | 72.80 | 3.10 |
| 4-Aug-2016 | 155 | 79.20 | 76.00 | 4.05 | 83.50 | 79.20 | 4.47 | 84.70 | 79.80 | 4.75 |
| 4-Aug-2016 | 156 | 78.70 | 73.60 | 3.52 | 78.00 | 73.50 | 3.82 | 76.30 | 72.90 | 3.66 |
| 4-Aug-2016 | 157 | 85.10 | 81.80 | 4.72 | 76.70 | 71.40 | 3.52 | 81.40 | 77.10 | 4.31 |
| 4-Aug-2016 | 158 | 76.10 | 71.30 | 3.23 | 74.30 | 70.30 | 3.32 | 81.20 | 75.80 | 4.49 |
| 4-Aug-2016 | 159 | 72.90 | 68.90 | 2.86 | 74.30 | 69.90 | 3.20 | 73.50 | 70.20 | 3.11 |
| 4-Aug-2016 | 160 | 80.20 | 76.50 | 3.93 | 70.40 | 65.10 | 2.77 | 76.30 | 72.20 | 3.23 |

Table E.4: Raw Meristic Data of Kokanee at Day 26 of Control, E6, and E3 Treatments for the Minto Mine Fish Hatchery Exposure, September 2016

| Date | Fish # | Control | | | E6 | | | E3 | | |
|------------|--------|-------------------|------------------|------------|-------------------|------------------|------------|-------------------|------------------|------------|
| | | Total length (mm) | Fork length (mm) | Weight (g) | Total length (mm) | Fork length (mm) | Weight (g) | Total length (mm) | Fork length (mm) | Weight (g) |
| 1-Sep-2016 | 1 | 87.82 | 82.30 | 5.31 | 87.17 | 81.53 | 5.75 | 88.65 | 82.72 | 5.25 |
| 1-Sep-2016 | 2 | 90.45 | 84.55 | 5.99 | 92.97 | 86.14 | 6.78 | 92.63 | 85.20 | 6.39 |
| 1-Sep-2016 | 3 | 90.07 | 83.78 | 6.20 | 93.33 | 86.67 | 6.26 | 94.14 | 87.37 | 6.59 |
| 1-Sep-2016 | 4 | 93.76 | 87.02 | 6.29 | 95.78 | 88.21 | 6.25 | 92.90 | 86.53 | 6.82 |
| 1-Sep-2016 | 5 | 88.51 | 83.23 | 5.54 | 84.27 | 79.07 | 4.67 | 96.75 | 89.56 | 6.99 |
| 1-Sep-2016 | 6 | 88.64 | 84.72 | 5.11 | 93.28 | 86.00 | 6.45 | 88.27 | 81.55 | 5.41 |
| 1-Sep-2016 | 7 | 81.59 | 75.74 | 4.61 | 87.15 | 81.05 | 5.33 | 90.20 | 84.04 | 5.73 |
| 1-Sep-2016 | 8 | 90.57 | 85.67 | 5.50 | 94.34 | 86.41 | 6.08 | 89.45 | 82.68 | 4.96 |
| 1-Sep-2016 | 9 | 95.52 | 89.68 | 6.81 | 97.58 | 90.66 | 7.37 | 86.02 | 79.82 | 4.92 |
| 1-Sep-2016 | 10 | 88.12 | 81.74 | 5.33 | 83.74 | 78.65 | 4.97 | 97.00 | 88.77 | 7.45 |
| 1-Sep-2016 | 11 | 85.98 | 79.25 | 4.85 | 90.23 | 84.62 | 5.61 | 94.37 | 88.33 | 6.19 |
| 1-Sep-2016 | 12 | 94.80 | 90.00 | 6.87 | 91.71 | 84.56 | 6.15 | 89.74 | 82.70 | 6.05 |
| 1-Sep-2016 | 13 | 89.67 | 82.90 | 5.48 | 94.94 | 88.28 | 7.55 | 91.44 | 85.13 | 6.16 |
| 1-Sep-2016 | 14 | 91.42 | 85.65 | 5.99 | 86.45 | 80.72 | 5.13 | 93.76 | 86.55 | 6.90 |
| 1-Sep-2016 | 15 | 85.44 | 78.88 | 4.99 | 90.05 | 83.57 | 6.24 | 97.31 | 90.85 | 7.21 |
| 1-Sep-2016 | 16 | 92.24 | 85.82 | 5.98 | 96.95 | 90.65 | 7.85 | 86.92 | 82.00 | 5.12 |
| 1-Sep-2016 | 17 | 90.34 | 82.62 | 5.47 | 90.37 | 84.17 | 5.49 | 90.84 | 85.66 | 6.00 |
| 1-Sep-2016 | 18 | 94.33 | 86.99 | 6.87 | 96.32 | 89.88 | 6.68 | 83.09 | 78.08 | 4.32 |
| 1-Sep-2016 | 19 | 84.70 | 78.75 | 4.78 | 87.99 | 82.90 | 5.29 | 90.01 | 83.65 | 5.92 |
| 1-Sep-2016 | 20 | 91.53 | 84.68 | 6.06 | 92.26 | 85.21 | 6.56 | 95.83 | 88.43 | 6.94 |
| 1-Sep-2016 | 21 | 87.73 | 80.84 | 4.98 | 94.19 | 88.78 | 6.88 | 92.79 | 87.73 | 6.29 |
| 1-Sep-2016 | 22 | 91.85 | 85.02 | 5.81 | 93.51 | 86.15 | 6.19 | 91.34 | 85.29 | 6.85 |
| 1-Sep-2016 | 23 | 89.81 | 84.54 | 6.17 | 92.74 | 86.24 | 5.88 | 89.17 | 83.87 | 5.61 |
| 1-Sep-2016 | 24 | 85.55 | 79.83 | 4.55 | 95.51 | 88.32 | 6.53 | 90.40 | 85.74 | 6.25 |
| 1-Sep-2016 | 25 | 86.17 | 79.17 | 4.80 | 96.76 | 89.42 | 6.56 | 90.26 | 84.71 | 5.99 |
| 1-Sep-2016 | 26 | 96.02 | 89.55 | 6.67 | 84.15 | 79.20 | 4.11 | 97.45 | 90.55 | 7.21 |
| 1-Sep-2016 | 27 | 91.06 | 84.96 | 5.83 | 88.92 | 81.52 | 5.36 | 88.95 | 82.00 | 5.58 |
| 1-Sep-2016 | 28 | 90.95 | 84.74 | 5.97 | 93.19 | 86.44 | 6.32 | 87.11 | 81.55 | 5.00 |
| 1-Sep-2016 | 29 | 87.54 | 80.94 | 5.11 | 87.34 | 81.16 | 5.28 | 91.32 | 84.40 | 5.96 |
| 1-Sep-2016 | 30 | 91.63 | 85.88 | 5.93 | 89.98 | 82.57 | 5.27 | 93.55 | 86.62 | 6.60 |
| 1-Sep-2016 | 31 | 88.45 | 83.26 | 5.37 | 92.71 | 87.29 | 6.29 | 92.26 | 85.34 | 5.89 |
| 1-Sep-2016 | 32 | 89.52 | 82.78 | 5.73 | 87.10 | 80.23 | 5.42 | 92.04 | 85.16 | 5.99 |
| 1-Sep-2016 | 33 | 85.65 | 80.83 | 4.90 | 96.63 | 88.69 | 6.79 | 89.75 | 82.98 | 5.54 |
| 1-Sep-2016 | 34 | 84.61 | 77.66 | 4.51 | 95.68 | 88.59 | 6.89 | 96.38 | 90.08 | 7.58 |
| 1-Sep-2016 | 35 | 85.24 | 79.10 | 4.71 | 90.21 | 84.55 | 6.18 | 93.50 | 86.84 | 6.23 |
| 1-Sep-2016 | 36 | 91.09 | 84.44 | 5.74 | 91.53 | 85.69 | 5.96 | 91.61 | 86.18 | 6.77 |
| 1-Sep-2016 | 37 | 92.29 | 84.82 | 6.36 | 92.69 | 86.44 | 6.17 | 94.89 | 87.33 | 6.42 |
| 1-Sep-2016 | 38 | 92.67 | 86.15 | 6.18 | 85.72 | 80.08 | 4.91 | 88.41 | 82.42 | 5.71 |
| 1-Sep-2016 | 39 | 85.21 | 79.73 | 4.73 | 92.76 | 87.40 | 6.18 | 87.36 | 80.11 | 5.29 |
| 1-Sep-2016 | 40 | 92.26 | 87.13 | 6.02 | 78.96 | 74.09 | 3.83 | 97.59 | 89.98 | 7.21 |
| 1-Sep-2016 | 41 | 90.46 | 85.73 | 5.91 | 91.12 | 85.63 | 6.37 | 93.38 | 87.28 | 6.45 |
| 1-Sep-2016 | 42 | 87.43 | 80.79 | 5.02 | 89.15 | 82.75 | 5.58 | 97.21 | 91.20 | 7.29 |
| 1-Sep-2016 | 43 | 91.35 | 85.19 | 5.85 | 92.75 | 85.69 | 6.58 | 90.74 | 83.61 | 5.60 |
| 1-Sep-2016 | 44 | 86.61 | 79.82 | 5.28 | 93.27 | 87.52 | 6.25 | 89.85 | 83.54 | 5.69 |
| 1-Sep-2016 | 45 | 90.22 | 82.86 | 5.70 | 96.26 | 90.11 | 7.28 | 90.21 | 83.69 | 5.41 |
| 1-Sep-2016 | 46 | 92.29 | 85.40 | 5.82 | 92.14 | 86.00 | 6.31 | 91.87 | 84.07 | 6.03 |
| 1-Sep-2016 | 47 | 90.14 | 83.84 | 5.52 | 90.22 | 82.70 | 5.89 | 83.47 | 79.19 | 4.52 |
| 1-Sep-2016 | 48 | 95.59 | 91.54 | 6.91 | 94.02 | 87.28 | 6.50 | 88.84 | 82.87 | 5.45 |
| 1-Sep-2016 | 49 | 92.80 | 86.78 | 6.04 | 85.82 | 80.42 | 5.03 | 90.96 | 84.83 | 5.72 |
| 1-Sep-2016 | 50 | 87.57 | 83.26 | 5.37 | 97.72 | 91.27 | 7.38 | 95.03 | 88.82 | 7.04 |

Table E.5: Raw Meristic Data of Kokanee at Day 47 of Control, E6, and E3 Treatments for the Minto Mine Fish Hatchery Exposure, September 2016

| Date | Fish # | Control | | | E6 | | | E3 | | |
|-------------|--------|-------------------|------------------|------------|-------------------|------------------|------------|-------------------|------------------|------------|
| | | Total length (mm) | Fork length (mm) | Weight (g) | Total length (mm) | Fork length (mm) | Weight (g) | Total length (mm) | Fork length (mm) | Weight (g) |
| 22-Sep-2016 | 1 | 99.65 | 91.97 | 7.53 | 100.50 | 93.02 | 7.88 | 107.68 | 100.26 | 9.69 |
| 22-Sep-2016 | 2 | 104.14 | 96.29 | 8.75 | 99.22 | 93.22 | 7.97 | 105.67 | 98.12 | 8.91 |
| 22-Sep-2016 | 3 | 109.43 | 100.48 | 10.54 | 100.26 | 92.70 | 7.44 | 92.33 | 86.75 | 5.85 |
| 22-Sep-2016 | 4 | 100.86 | 93.22 | 8.23 | 106.92 | 100.19 | 9.37 | 106.65 | 98.38 | 9.27 |
| 22-Sep-2016 | 5 | 101.76 | 94.21 | 7.58 | 106.32 | 98.08 | 8.52 | 104.84 | 96.66 | 9.02 |
| 22-Sep-2016 | 6 | 103.48 | 96.50 | 8.16 | 105.07 | 97.74 | 8.34 | 113.97 | 106.19 | 12.14 |
| 22-Sep-2016 | 7 | 99.14 | 91.36 | 7.72 | 108.06 | 100.44 | 9.14 | 104.45 | 98.66 | 9.69 |
| 22-Sep-2016 | 8 | 112.92 | 104.85 | 11.45 | 105.06 | 98.49 | 9.00 | 101.90 | 95.87 | 8.14 |
| 22-Sep-2016 | 9 | 111.08 | 103.43 | 10.69 | 105.51 | 98.08 | 8.83 | 100.45 | 93.82 | 8.58 |
| 22-Sep-2016 | 10 | 108.00 | 101.29 | 9.70 | 101.39 | 93.48 | 7.05 | 101.43 | 95.10 | 8.91 |
| 22-Sep-2016 | 11 | 99.04 | 91.82 | 7.74 | 103.46 | 96.38 | 8.67 | 102.89 | 95.45 | 8.56 |
| 22-Sep-2016 | 12 | 87.43 | 80.72 | 4.96 | 108.14 | 100.00 | 8.97 | 108.37 | 99.17 | 9.18 |
| 22-Sep-2016 | 13 | 99.94 | 91.50 | 7.56 | 98.02 | 91.57 | 6.93 | 103.84 | 98.04 | 8.93 |
| 22-Sep-2016 | 14 | 109.42 | 102.14 | 10.04 | 109.84 | 102.37 | 10.60 | 104.67 | 98.28 | 9.63 |
| 22-Sep-2016 | 15 | 97.35 | 90.66 | 6.80 | 105.26 | 98.10 | 9.06 | 98.24 | 91.33 | 6.84 |
| 22-Sep-2016 | 16 | 92.72 | 85.48 | 6.30 | 107.32 | 100.19 | 10.23 | 112.27 | 104.13 | 11.16 |
| 22-Sep-2016 | 17 | 86.71 | 79.96 | 5.06 | 96.06 | 88.65 | 7.51 | 100.36 | 93.04 | 8.10 |
| 22-Sep-2016 | 18 | 99.67 | 92.87 | 8.09 | 108.66 | 100.19 | 9.63 | 98.65 | 91.89 | 7.37 |
| 22-Sep-2016 | 19 | 99.96 | 92.70 | 7.42 | 99.83 | 94.73 | 7.39 | 97.01 | 90.42 | 7.81 |
| 22-Sep-2016 | 20 | 101.16 | 94.81 | 8.19 | 108.12 | 101.13 | 10.20 | 100.31 | 92.68 | 7.68 |
| 22-Sep-2016 | 21 | 104.63 | 97.09 | 9.43 | 97.76 | 91.34 | 7.42 | 109.72 | 102.07 | 10.28 |
| 22-Sep-2016 | 22 | 104.67 | 97.21 | 8.76 | 98.07 | 95.52 | 7.44 | 103.16 | 95.80 | 8.23 |
| 22-Sep-2016 | 23 | 101.88 | 95.06 | 8.23 | 105.55 | 97.55 | 8.66 | 106.86 | 100.95 | 10.53 |
| 22-Sep-2016 | 24 | 103.02 | 96.29 | 8.53 | 107.77 | 100.87 | 9.46 | 102.88 | 96.29 | 8.61 |
| 22-Sep-2016 | 25 | 101.54 | 94.07 | 7.64 | 108.08 | 101.80 | 9.47 | 112.90 | 106.10 | 11.72 |
| 22-Sep-2016 | 26 | 109.44 | 101.51 | 10.83 | 102.15 | 94.92 | 8.12 | 106.10 | 99.44 | 9.52 |
| 22-Sep-2016 | 27 | 104.81 | 98.25 | 9.10 | 105.13 | 97.75 | 8.29 | 105.18 | 99.06 | 9.53 |
| 22-Sep-2016 | 28 | 105.95 | 96.92 | 9.18 | 106.34 | 97.57 | 8.90 | 106.14 | 99.14 | 9.91 |
| 22-Sep-2016 | 29 | 111.38 | 103.41 | 10.79 | 100.26 | 94.57 | 7.93 | 103.49 | 96.42 | 8.24 |
| 22-Sep-2016 | 30 | 105.20 | 96.94 | 8.94 | 104.30 | 96.75 | 8.30 | 101.58 | 93.11 | 8.03 |
| 22-Sep-2016 | 31 | 107.75 | 99.01 | 9.21 | 98.80 | 91.39 | 6.84 | 103.32 | 97.11 | 8.62 |
| 22-Sep-2016 | 32 | 99.03 | 92.15 | 7.54 | 101.30 | 93.87 | 7.50 | 102.88 | 96.15 | 8.59 |
| 22-Sep-2016 | 33 | 103.62 | 94.99 | 8.05 | 100.04 | 92.92 | 7.78 | 100.80 | 94.06 | 8.12 |
| 22-Sep-2016 | 34 | 104.14 | 96.56 | 8.59 | 107.12 | 98.37 | 9.02 | 112.80 | 104.83 | 11.82 |
| 22-Sep-2016 | 35 | 100.21 | 93.24 | 8.62 | 101.43 | 94.73 | 8.06 | 105.90 | 98.95 | 9.13 |
| 22-Sep-2016 | 36 | 104.99 | 98.46 | 8.71 | 101.59 | 94.04 | 8.15 | 102.32 | 97.39 | 9.43 |
| 22-Sep-2016 | 37 | 106.53 | 99.18 | 9.93 | 110.56 | 102.05 | 10.36 | 106.67 | 100.00 | 9.22 |
| 22-Sep-2016 | 38 | 101.21 | 94.91 | 8.51 | 97.56 | 91.47 | 7.32 | 106.12 | 98.97 | 9.58 |
| 22-Sep-2016 | 39 | 106.17 | 97.89 | 9.38 | 101.54 | 95.26 | 8.43 | 101.03 | 94.40 | 8.66 |
| 22-Sep-2016 | 40 | 101.11 | 94.08 | 7.58 | 101.12 | 94.52 | 8.52 | 100.89 | 95.44 | 8.21 |
| 22-Sep-2016 | 41 | 105.42 | 98.13 | 8.65 | 99.80 | 92.07 | 7.66 | 107.87 | 100.53 | 10.33 |
| 22-Sep-2016 | 42 | 86.53 | 81.26 | 4.98 | 109.62 | 102.31 | 9.45 | 101.81 | 95.02 | 8.95 |
| 22-Sep-2016 | 43 | 108.25 | 99.09 | 10.02 | 106.69 | 99.54 | 9.20 | 97.15 | 91.61 | 7.34 |
| 22-Sep-2016 | 44 | 94.57 | 87.85 | 6.39 | 92.85 | 87.91 | 6.76 | 103.45 | 96.07 | 8.35 |
| 22-Sep-2016 | 45 | 104.87 | 96.56 | 8.57 | 102.86 | 96.41 | 7.78 | 111.77 | 104.05 | 10.39 |
| 22-Sep-2016 | 46 | 103.75 | 96.50 | 8.42 | 102.90 | 96.59 | 8.23 | 103.27 | 96.86 | 8.36 |
| 22-Sep-2016 | 47 | 99.44 | 93.44 | 7.83 | 97.55 | 90.86 | 7.45 | 112.19 | 103.00 | 10.91 |
| 22-Sep-2016 | 48 | 98.29 | 91.01 | 7.15 | 106.41 | 99.22 | 9.19 | 102.29 | 96.17 | 8.63 |
| 22-Sep-2016 | 49 | 104.43 | 97.91 | 8.78 | 108.15 | 101.30 | 9.85 | 96.20 | 89.54 | 7.49 |
| 22-Sep-2016 | 50 | 110.15 | 101.48 | 9.70 | 111.10 | 102.19 | 10.69 | 106.42 | 98.59 | 9.77 |
| 22-Sep-2016 | 51 | 112.53 | 103.02 | 11.53 | 99.23 | 92.75 | 7.60 | 99.51 | 92.64 | 7.38 |
| 22-Sep-2016 | 52 | 99.08 | 93.17 | 8.24 | 108.00 | 99.60 | 9.52 | 106.43 | 99.32 | 9.30 |
| 22-Sep-2016 | 53 | 103.28 | 95.50 | 8.63 | 98.16 | 91.37 | 7.92 | 107.23 | 99.93 | 9.69 |
| 22-Sep-2016 | 54 | 106.98 | 99.03 | 9.20 | 113.81 | 105.52 | 11.36 | 111.04 | 103.73 | 10.95 |
| 22-Sep-2016 | 55 | 109.29 | 101.48 | 9.73 | 106.46 | 100.22 | 8.97 | 115.99 | 108.20 | 12.29 |
| 22-Sep-2016 | 56 | 91.32 | 84.89 | 5.95 | 98.64 | 93.08 | 7.78 | 109.53 | 101.53 | 10.41 |
| 22-Sep-2016 | 57 | 112.17 | 104.02 | 10.25 | 102.27 | 97.64 | 8.16 | 99.45 | 92.72 | 7.62 |
| 22-Sep-2016 | 58 | 97.50 | 90.72 | 7.09 | 105.84 | 99.91 | 8.91 | 111.15 | 103.51 | 10.59 |
| 22-Sep-2016 | 59 | 107.04 | 99.26 | 9.16 | 104.77 | 96.92 | 8.35 | 108.09 | 100.49 | 9.38 |
| 22-Sep-2016 | 60 | 99.23 | 92.48 | 7.77 | 100.22 | 93.29 | 7.75 | 101.32 | 93.44 | 8.48 |
| 22-Sep-2016 | 61 | 104.26 | 97.13 | 9.33 | 105.43 | 97.11 | 8.99 | 109.27 | 102.81 | 10.02 |
| 22-Sep-2016 | 62 | 103.57 | 95.80 | 8.28 | 105.13 | 99.69 | 8.81 | 102.33 | 94.89 | 8.27 |
| 22-Sep-2016 | 63 | 104.78 | 97.11 | 9.28 | 106.03 | 98.19 | 9.40 | 104.71 | 97.04 | 8.80 |
| 22-Sep-2016 | 64 | 99.10 | 91.48 | 6.99 | 103.69 | 95.77 | 8.17 | 108.01 | 100.11 | 9.56 |
| 22-Sep-2016 | 65 | 100.33 | 93.77 | 7.70 | 105.54 | 97.55 | 9.08 | 102.47 | 96.37 | 8.83 |
| 22-Sep-2016 | 66 | 100.74 | 92.65 | 8.26 | 101.91 | 95.59 | 7.98 | 104.63 | 99.01 | 9.29 |
| 22-Sep-2016 | 67 | 110.83 | 102.05 | 10.04 | 94.43 | 87.62 | 6.22 | 106.54 | 99.15 | 9.22 |
| 22-Sep-2016 | 68 | 95.94 | 88.14 | 7.07 | 102.85 | 95.76 | 8.48 | 111.03 | 103.66 | 12.07 |
| 22-Sep-2016 | 69 | 102.74 | 94.95 | 9.25 | 94.93 | 89.87 | 6.91 | 102.26 | 94.58 | 8.19 |
| 22-Sep-2016 | 70 | 108.02 | 100.02 | 9.22 | 114.85 | 106.62 | 10.57 | 106.09 | 98.52 | 9.47 |
| 22-Sep-2016 | 71 | 95.67 | 89.19 | 6.76 | 100.40 | 93.08 | 7.63 | 103.80 | 96.74 | 8.81 |
| 22-Sep-2016 | 72 | 111.34 | 102.26 | 10.26 | 100.67 | 96.25 | 7.32 | 104.21 | 96.94 | 8.58 |
| 22-Sep-2016 | 73 | 97.13 | 89.83 | 7.07 | 88.72 | 82.95 | 5.21 | 110.93 | 102.83 | 10.92 |
| 22-Sep-2016 | 74 | 103.38 | 96.55 | 8.66 | 98.76 | 91.17 | 7.08 | 109.55 | 101.05 | 10.27 |
| 22-Sep-2016 | 75 | 113.10 | 105.05 | 10.96 | 107.07 | 98.32 | 9.06 | 115.27 | 106.89 | 12.05 |
| 22-Sep-2016 | 76 | 108.13 | 100.46 | 9.41 | 95.77 | 89.07 | 7.07 | 103.59 | 97.16 | 8.47 |
| 22-Sep-2016 | 77 | 101.92 | 95.15 | 7.71 | 99.22 | 93.60 | 8.05 | 103.80 | 96.52 | 8.97 |
| 22-Sep-2016 | 78 | 101.91 | 95.17 | 8.29 | 106.34 | 99.18 | 8.69 | 104.40 | 97.69 | 9.13 |
| 22-Sep-2016 | 79 | 106.54 | 98.29 | 9.00 | 106.57 | 99.29 | 9.31 | 104.69 | 99.03 | 9.73 |
| 22-Sep-2016 | 80 | 109.29 | 101.44 | 10.28 | 111.32 | 102.91 | 9.45 | 98.93 | 92.40 | 7.35 |
| 22-Sep-2016 | 81 | 104.27 | 96.39 | 8.52 | 105.82 | 100.43 | 9.09 | 106.55 | 100.58 | 9.57 |
| 22-Sep-2016 | 82 | 103.91 | 95.95 | 8.72 | 104.77 | 96.74 | 9.10 | 101.03 | 94.56 | 8.47 |
| 22-Sep-2016 | 83 | 109.05 | 100.95 | 9.56 | 103.63 | 96.89 | 8.21 | 104.88 | 99.50 | 10.06 |
| 22-Sep-2016 | 84 | 102.31 | 95.07 | 7.87 | 96.18 | 89.82 | 6.59 | 104.63 | 97.52 | 9.24 |
| 22-Sep-2016 | 85 | 100.08 | 93.07 | 7.71 | 97.18 | 90.90 | 6.50 | 110.26 | 103.68 | 11.16 |
| 22-Sep-2016 | 86 | 99.13 | 91.12 | 7.82 | 99.64 | 91.84 | 6.93 | 108.11 | 99.21 | 10.06 |
| 22-Sep-2016 | 87 | 111.11 | 102.16 | 10.45 | 102.54 | 95.38 | 7.93 | 109.67 | 102.48 | 10.51 |
| 22-Sep-2016 | 88 | 109.29 | 101.58 | 9.31 | 107.12 | 99.47 | 9.27 | 110.10 | 103.24 | 10.35 |
| 22-Sep-2016 | 89 | 102.12 | 96.88 | 8.64 | 107.19 | 101.13 | 9.52 | 102.00 | 95.85 | 9.03 |
| 22-Sep-2016 | 90 | 98.48 | 92.40 | 9.55 | 107.40 | 99.53 | 8.66 | 102.96 | 95.45 | 9.38 |
| 22-Sep-2016 | 91 | 100.06 | 92.69 | 7.79 | 96.49 | 90.22 | 6.41 | 101.58 | 94.10 | 8.24 |
| 22-Sep-2016 | 92 | 101.75 | 94.04 | 7.93 | 108.62 | 100.66 | 9.42 | 103.47 | 96.73 | 8.90 |
| 22-Sep-2016 | 93 | 96.80 | 89.68 | 6.78 | 93.63 | 87.36 | 6.39 | 96.73 | 89.81 | 7.28 |
| 22-Sep-2016 | 94 | 106.49 | 97.87 | 8.82 | 102.29 | 95.51 | 7.77 | 101.70 | 94.48 | 8.95 |
| 22-Sep-2016 | 95 | 101.39 | 94.87 | 7.69 | 86.25 | 80.57 | 4.97 | 110.78 | 102.14 | 9.95 |
| 22-Sep-2016 | 96 | 102.92 | 96.21 | 8.13 | 106.65 | 99.40 | 9.12 | 116.02 | 107.69 | 11.48 |
| 22-Sep-2016 | 97 | 104.66 | 98.11 | 10.09 | 106.73 | 100.57 | 8.94 | 98.26 | 92.24 | 7.34 |

Table E.5: Raw Meristic Data of Kokanee at Day 47 of Control, E6, and E3 Treatments for the Minto Mine Fish Hatchery Exposure, September 2016

| Date | Fish # | Control | | | E6 | | | E3 | | |
|-------------|--------|-------------------|------------------|------------|-------------------|------------------|------------|-------------------|------------------|------------|
| | | Total length (mm) | Fork length (mm) | Weight (g) | Total length (mm) | Fork length (mm) | Weight (g) | Total length (mm) | Fork length (mm) | Weight (g) |
| 22-Sep-2016 | 98 | 101.30 | 94.29 | 7.84 | 108.67 | 100.77 | 9.53 | 84.80 | 78.59 | 4.72 |
| 22-Sep-2016 | 99 | 105.09 | 97.89 | 9.30 | 100.87 | 94.77 | 8.19 | 89.28 | 83.88 | 6.17 |
| 22-Sep-2016 | 100 | 106.82 | 98.81 | 9.30 | 106.22 | 98.42 | 9.27 | 107.14 | 101.10 | 10.16 |
| 22-Sep-2016 | 101 | 96.88 | 91.01 | 7.21 | 103.85 | 100.76 | 9.25 | 103.59 | 96.38 | 8.14 |
| 22-Sep-2016 | 102 | 96.26 | 89.22 | 7.00 | 100.95 | 94.59 | 8.06 | 103.28 | 98.15 | 9.34 |
| 22-Sep-2016 | 103 | 95.21 | 89.41 | 6.72 | 101.69 | 95.71 | 8.00 | 109.05 | 101.43 | 10.16 |
| 22-Sep-2016 | 104 | 105.27 | 96.81 | 8.62 | 111.99 | 102.22 | 10.12 | 107.84 | 100.24 | 9.85 |
| 22-Sep-2016 | 105 | 102.76 | 95.57 | 8.10 | 95.10 | 88.93 | 6.41 | 97.75 | 91.71 | 7.24 |
| 22-Sep-2016 | 106 | 106.04 | 97.44 | 9.15 | 97.37 | 92.40 | 6.97 | 105.44 | 99.43 | 9.60 |
| 22-Sep-2016 | 107 | 96.60 | 88.98 | 7.45 | 98.25 | 92.12 | 7.32 | 111.79 | 103.86 | 11.04 |
| 22-Sep-2016 | 108 | 105.35 | 96.49 | 9.11 | 109.80 | 102.19 | 10.22 | 102.01 | 95.65 | 9.40 |
| 22-Sep-2016 | 109 | 113.24 | 104.35 | 10.99 | 106.02 | 98.38 | 8.55 | 105.17 | 96.29 | 9.16 |
| 22-Sep-2016 | 110 | 96.30 | 90.84 | 7.32 | 97.96 | 90.45 | 7.10 | 109.59 | 101.87 | 10.72 |
| 22-Sep-2016 | 111 | 103.73 | 96.63 | 8.45 | 105.91 | 97.81 | 9.40 | 106.11 | 99.33 | 9.35 |
| 22-Sep-2016 | 112 | 104.25 | 97.17 | 8.39 | 110.00 | 101.85 | 9.73 | 109.37 | 100.62 | 9.96 |
| 22-Sep-2016 | 113 | 97.34 | 90.08 | 6.82 | 104.23 | 98.17 | 8.50 | 109.69 | 101.35 | 10.52 |
| 22-Sep-2016 | 114 | 110.52 | 102.70 | 10.43 | 103.07 | 98.75 | 9.32 | 103.37 | 96.11 | 9.19 |
| 22-Sep-2016 | 115 | 110.78 | 103.18 | 9.76 | 107.92 | 99.85 | 8.85 | 104.28 | 96.96 | 9.05 |
| 22-Sep-2016 | 116 | 107.25 | 100.18 | 9.49 | 105.02 | 95.98 | 8.38 | 112.00 | 103.85 | 11.01 |
| 22-Sep-2016 | 117 | 109.92 | 102.13 | 9.94 | 97.92 | 90.31 | 6.73 | 98.78 | 92.65 | 7.82 |
| 22-Sep-2016 | 118 | 94.70 | 88.44 | 6.33 | 110.80 | 102.20 | 10.89 | 104.81 | 98.82 | 9.59 |
| 22-Sep-2016 | 119 | 104.20 | 97.15 | 9.22 | 102.02 | 95.42 | 8.13 | 108.01 | 101.30 | 10.10 |
| 22-Sep-2016 | 120 | 108.14 | 99.83 | 9.84 | 99.02 | 92.29 | 7.23 | 99.23 | 92.48 | 8.00 |
| 22-Sep-2016 | 121 | 103.11 | 96.14 | 8.13 | 95.29 | 89.51 | 6.48 | 105.01 | 98.19 | 8.81 |
| 22-Sep-2016 | 122 | 103.85 | 97.30 | 8.29 | 95.25 | 88.68 | 6.15 | 101.21 | 93.43 | 7.36 |
| 22-Sep-2016 | 123 | 114.04 | 104.38 | 10.67 | 104.15 | 98.28 | 8.73 | 105.67 | 98.67 | 9.44 |
| 22-Sep-2016 | 124 | 103.24 | 95.18 | 8.50 | 95.41 | 89.12 | 6.62 | 110.69 | 103.80 | 10.93 |
| 22-Sep-2016 | 125 | 95.17 | 89.53 | 6.57 | 108.99 | 101.54 | 9.58 | 104.54 | 97.24 | 9.60 |
| 22-Sep-2016 | 126 | 103.01 | 94.93 | 8.35 | 111.09 | 103.33 | 10.72 | 110.47 | 105.05 | 10.39 |
| 22-Sep-2016 | 127 | 103.06 | 95.46 | 8.90 | 105.51 | 98.21 | 9.22 | 96.37 | 89.89 | 7.63 |
| 22-Sep-2016 | 128 | 101.31 | 94.24 | 8.29 | 103.73 | 97.68 | 8.60 | 102.61 | 96.29 | 8.74 |
| 22-Sep-2016 | 129 | 101.90 | 94.43 | 8.72 | 103.73 | 96.90 | 8.33 | 111.07 | 104.04 | 11.06 |
| 22-Sep-2016 | 130 | 101.31 | 94.18 | 7.84 | 98.76 | 90.38 | 7.29 | 100.71 | 94.74 | 8.36 |
| 22-Sep-2016 | 131 | 105.25 | 96.96 | 8.80 | 106.41 | 98.88 | 9.18 | 106.77 | 99.53 | 9.98 |
| 22-Sep-2016 | 132 | 92.16 | 86.31 | 6.68 | 102.51 | 94.24 | 8.00 | 93.23 | 87.30 | 6.20 |
| 22-Sep-2016 | 133 | 111.08 | 104.31 | 10.73 | 99.50 | 93.23 | 7.45 | 98.73 | 91.86 | 7.95 |
| 22-Sep-2016 | 134 | 103.69 | 97.30 | 8.75 | 105.56 | 98.06 | 9.03 | 109.36 | 100.89 | 9.88 |
| 22-Sep-2016 | 135 | 99.22 | 93.02 | 7.55 | 104.08 | 97.55 | 8.85 | 104.80 | 95.94 | 9.55 |
| 22-Sep-2016 | 136 | 99.87 | 92.28 | 7.38 | 99.22 | 91.69 | 7.10 | 96.92 | 89.58 | 7.42 |
| 22-Sep-2016 | 137 | 112.21 | 105.18 | 10.84 | 98.27 | 91.59 | 6.68 | 107.24 | 100.45 | 10.06 |
| 22-Sep-2016 | 138 | 95.08 | 88.90 | 6.04 | 107.89 | 99.79 | 8.40 | 103.20 | 96.43 | 9.11 |
| 22-Sep-2016 | 139 | 108.67 | 101.53 | 10.06 | 92.89 | 85.28 | 5.03 | 96.43 | 90.61 | 7.36 |
| 22-Sep-2016 | 140 | 107.11 | 98.81 | 9.59 | 106.40 | 98.74 | 8.82 | 110.84 | 102.97 | 10.78 |
| 22-Sep-2016 | 141 | 100.29 | 94.60 | 7.45 | 102.54 | 95.15 | 8.04 | 97.42 | 91.74 | 7.82 |
| 22-Sep-2016 | 142 | 110.98 | 103.09 | 10.01 | 104.39 | 98.78 | 8.99 | 96.33 | 90.18 | 6.83 |
| 22-Sep-2016 | 143 | 105.64 | 98.97 | 9.18 | 110.29 | 102.57 | 10.66 | 102.04 | 94.88 | 8.88 |
| 22-Sep-2016 | 144 | 106.35 | 97.61 | 8.27 | 105.70 | 98.37 | 9.04 | 103.01 | 95.73 | 8.71 |
| 22-Sep-2016 | 145 | 111.22 | 104.09 | 9.97 | 100.78 | 94.11 | 8.60 | 104.18 | 96.86 | 8.31 |
| 22-Sep-2016 | 146 | 97.06 | 91.96 | 7.37 | 94.74 | 88.43 | 6.34 | 109.90 | 103.07 | 10.91 |
| 22-Sep-2016 | 147 | 106.19 | 99.13 | 8.93 | 104.33 | 96.81 | 8.82 | 98.29 | 91.34 | 7.63 |
| 22-Sep-2016 | 148 | 107.13 | 99.75 | 9.56 | 107.47 | 99.47 | 9.22 | 103.24 | 96.86 | 8.93 |
| 22-Sep-2016 | 149 | 105.99 | 99.08 | 9.09 | 105.90 | 98.90 | 8.63 | 108.40 | 100.30 | 10.63 |
| 22-Sep-2016 | 150 | 99.80 | 92.75 | 7.02 | 101.35 | 95.30 | 7.48 | 103.82 | 97.56 | 8.41 |
| 22-Sep-2016 | 151 | 110.92 | 102.34 | 10.55 | 103.88 | 95.61 | 8.25 | 101.91 | 95.99 | 8.91 |
| 22-Sep-2016 | 152 | 101.40 | 94.13 | 8.58 | 109.83 | 101.16 | 10.22 | 107.96 | 99.46 | 9.82 |
| 22-Sep-2016 | 153 | 103.43 | 95.58 | 8.58 | 94.09 | 87.82 | 6.29 | 104.27 | 98.24 | 8.43 |
| 22-Sep-2016 | 154 | - | - | - | 107.37 | 99.65 | 9.50 | 104.03 | 95.54 | 9.67 |
| 22-Sep-2016 | 155 | - | - | - | 105.43 | 97.78 | 9.03 | 106.39 | 99.37 | 9.61 |
| 22-Sep-2016 | 156 | - | - | - | 105.79 | 99.35 | 8.82 | 103.61 | 96.44 | 8.72 |
| 22-Sep-2016 | 157 | - | - | - | - | - | - | 92.98 | 87.60 | 6.09 |
| 22-Sep-2016 | 158 | - | - | - | - | - | - | 110.25 | 103.40 | 11.12 |
| 22-Sep-2016 | 159 | - | - | - | - | - | - | 99.90 | 93.58 | 8.03 |

Table E.6: Descriptive Summary Statistics of Kokanee Size and Weight in Control, E6, and E3 Treatments for the Minto Mine Fish Hatchery Exposure, 2016

| Time | Summary Statistic | Treatment | | | | | | | | |
|---------------------|--------------------|-------------------|------------------|------------|-------------------|------------------|------------|-------------------|------------------|------------|
| | | Control | | | E6 | | | E3 | | |
| | | Total Length (mm) | Fork Length (mm) | Weight (g) | Total Length (mm) | Fork Length (mm) | Weight (g) | Total Length (mm) | Fork Length (mm) | Weight (g) |
| Pre-exposed (Day 0) | N | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 |
| | Mean | 76.84 | 72.36 | 3.51 | 77.43 | 72.84 | 3.60 | 76.86 | 72.30 | 3.50 |
| | Median | 77.45 | 73.02 | 3.54 | 78.00 | 73.20 | 3.67 | 77.20 | 72.55 | 3.48 |
| | Minimum | 62.20 | 58.90 | 1.73 | 63.50 | 59.20 | 1.85 | 63.50 | 59.20 | 1.84 |
| | Maximum | 86.80 | 83.20 | 5.29 | 91.00 | 86.20 | 5.80 | 86.20 | 81.20 | 5.39 |
| | Standard Deviation | 5.09 | 4.85 | 0.73 | 4.76 | 4.50 | 0.70 | 4.69 | 4.50 | 0.71 |
| | Standard Error | 0.40 | 0.38 | 0.06 | 0.38 | 0.36 | 0.06 | 0.37 | 0.36 | 0.06 |
| Day 26 | N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| | Mean | 89.71 | 83.61 | 5.63 | 91.39 | 85.02 | 6.05 | 91.54 | 85.15 | 6.09 |
| | Median | 90.18 | 84.14 | 5.72 | 92.48 | 85.85 | 6.19 | 91.33 | 85.15 | 6.02 |
| | Minimum | 81.59 | 75.74 | 4.51 | 78.96 | 74.09 | 3.83 | 83.09 | 78.08 | 4.32 |
| | Maximum | 96.02 | 91.54 | 6.91 | 97.72 | 91.27 | 7.85 | 97.59 | 91.20 | 7.58 |
| | Standard Deviation | 3.24 | 3.36 | 0.64 | 4.14 | 3.72 | 0.84 | 3.48 | 3.13 | 0.78 |
| | Standard Error | 0.46 | 0.48 | 0.09 | 0.59 | 0.53 | 0.12 | 0.49 | 0.44 | 0.11 |
| Day 47 | N | 153 | 153 | 153 | 156 | 156 | 156 | 159 | 159 | 159 |
| | Mean | 103.31 | 95.93 | 8.56 | 103.14 | 96.13 | 8.36 | 104.47 | 97.46 | 9.15 |
| | Median | 103.57 | 96.29 | 8.58 | 103.87 | 96.90 | 8.46 | 104.40 | 97.39 | 9.16 |
| | Minimum | 86.53 | 79.96 | 4.96 | 86.25 | 80.57 | 4.97 | 84.80 | 78.59 | 4.72 |
| | Maximum | 114.04 | 105.18 | 11.53 | 114.85 | 106.62 | 11.36 | 116.02 | 108.20 | 12.29 |
| | Standard Deviation | 5.42 | 4.93 | 1.30 | 4.98 | 4.52 | 1.20 | 5.08 | 4.67 | 1.32 |
| | Standard Error | 0.44 | 0.40 | 0.10 | 0.40 | 0.36 | 0.10 | 0.40 | 0.37 | 0.10 |

Table E.7: Statistical Differences on Day 0 between Exposure and Reference Kokanee Used in the Hatchery Exposure, Minto Mine Phase 4 EEM, 2016

| Indicator | Endpoint | Variables | | Comparison | Sample Size | | Test | ANCOVA Statistics | | | Summary Statistics | | | Test P-value | Magnitude of Difference Relative to Control (%) | Estimated Minimum Detectable Difference Between Groups (%) with $\alpha=\beta=0.1$ | |
|----------------|-------------------------------|-------------------------------------|--------------------------------------|------------|-------------|------------------|--------------|---------------------|-------------------|--|---------------------------|------|------|--------------|---|--|--------------|
| | | Response | Covariate | | Ref | Exp | | Interaction P-value | Covariate P-value | Covariate Value for Comparisons ^a | Statistic | Ref | Exp | | | Decrease (%) | Increase (%) |
| Survival | Length Frequency Distribution | Fork Length (cm) | - | E6 vs. Ref | 160 | 160 | 2-sample K-S | - | - | - | - | - | - | 0.759 | -6.9 ^b | - | - |
| | | | | E3 vs. Ref | 160 | 160 | 2-sample K-S | - | - | - | - | - | - | - | 0.400 | 3.8 ^b | - |
| Energy Usage | Fork Length | Fork Length (cm) | - | E6 vs. Ref | 160 | 160 | T-test | - | - | - | Mean | 7.24 | 7.28 | 0.361 | - | -2.1 | 2.1 |
| | | | | E3 vs. Ref | 160 | 160 | T-test | - | - | - | Mean | 7.24 | 7.23 | 0.918 | - | -2.0 | 2.0 |
| | Body Weight | Body Weight (g) | - | E6 vs. Ref | 160 | 160 | T-test | - | - | - | Mean | 3.51 | 3.60 | 0.228 | - | -6.6 | 6.6 |
| | | | | E3 vs. Ref | 160 | 160 | T-test | - | - | - | Mean | 3.51 | 3.50 | 0.902 | - | -6.7 | 6.7 |
| Energy Storage | Condition | Log ₁₀ [Body Weight (g)] | Log ₁₀ [Fork Length (cm)] | E6 vs. Ref | 160 | 159 ^c | ANCOVA | 0.499 | <0.001 | 7.24 | Adjusted Mean (Geometric) | 3.46 | 3.49 | 0.207 | - | -1.6 | 1.7 |
| | | | | E3 vs. Ref | 160 | 160 | ANCOVA | 0.964 | <0.001 | 7.22 | Adjusted Mean (Geometric) | 3.42 | 3.43 | 0.824 | - | -1.7 | 1.7 |

Notes:

 P-value < 0.05.

Bold text Magnitude of Difference > 25% (10% if compared to Condition).

^a Mean for all data with outliers removed. For log-transformed data, the geometric mean is reported.

^b Magnitude of difference is the largest difference (as a percentage) between the cumulative relative frequency distributions for the two sampling areas. A negative difference implies the exposure area has smaller fish compared to reference.

^c One fish was identified as an outlier (E6 Fish #110) with a Studentized residual of 5.786.

Table E.8: Statistical Differences on Day 26 between Exposure and Reference Kokanee Used in the Hatchery Exposure, Minto Mine Phase 4 EEM, 2016

| Indicator | Endpoint | Variables | | Comparison | Sample Size | | Test | ANCOVA Statistics | | | Summary Statistics | | | Test P-value | Magnitude of Difference Relative to Control (%) | Estimated Minimum Detectable Difference Between Groups (%) with $\alpha=\beta=0.1$ | |
|----------------|-------------------------------|-------------------------|--------------------------|------------|-------------|-----|--------------|---------------------|-------------------|--|---------------------------|------|------|--------------|---|--|--------------|
| | | Response | Covariate | | Ref | Exp | | Interaction P-value | Covariate P-value | Covariate Value for Comparisons ^a | Statistic | Ref | Exp | | | Decrease (%) | Increase (%) |
| Survival | Length Frequency Distribution | Fork Length (cm) | - | E6 vs. Ref | 50 | 50 | 2-sample K-S | - | - | - | - | - | - | 0.012 | -12 ^b | - | - |
| | | | | E3 vs. Ref | 50 | 50 | 2-sample K-S | - | - | - | - | - | - | 0.178 | -14 ^b | - | - |
| Energy Usage | Fork Length | Fork Length (cm) | - | E6 vs. Ref | 50 | 50 | T-test | - | - | - | Mean | 8.36 | 8.50 | 0.049 | 1.6 | - | - |
| | | | | E3 vs. Ref | 50 | 50 | T-test | - | - | - | Mean | 8.36 | 8.52 | 0.020 | 1.8 | - | - |
| | Body Weight | Body Weight (g) | - | E6 vs. Ref | 50 | 50 | T-test | - | - | - | Mean | 5.63 | 6.05 | 0.006 | 7.5 | - | - |
| | | | | E3 vs. Ref | 50 | 50 | T-test | - | - | - | Mean | 5.63 | 6.09 | 0.002 | 8.2 | - | - |
| Energy Storage | Condition | Body Weight (g) | Fork Length (cm) | E6 vs. Ref | 50 | 50 | ANCOVA | 0.062 | <0.001 | 8.43 | Adjusted Mean | 5.76 | 5.90 | 0.078 | 2.6 | - | - |
| | | Log10 [Body Weight (g)] | Log10 [Fork Length (cm)] | E3 vs. Ref | 50 | 50 | ANCOVA | 0.009 | <0.001 | 8.43 | Adjusted Mean (Geometric) | 5.72 | 5.86 | 0.009 | 2.4 | - | - |

Notes:

 P-value < 0.05.

Bold text Magnitude of Difference > 25% (10% if compared to Condition).

^a Mean for all data with outliers removed. For log-transformed data, the geometric mean is reported.

^b Magnitude of difference is the largest difference (as a percentage) between the cumulative relative frequency distributions for the two sampling areas. A negative difference implies the exposure area has smaller fish compared to reference.

Table E.9: Statistical Differences on Day 47 between Exposure and Reference Kokanee Used in the Hatchery Exposure, Minto Mine Phase 4 EEM, 2016

| Indicator | Endpoint | Variables | | Comparison | Sample Size | | Test | ANCOVA Statistics | | | Summary Statistics | | | Test P-value | Magnitude of Difference Relative to Control (%) | Estimated Minimum Detectable Difference Between Groups (%) with $\alpha=\beta=0.1$ | |
|----------------|-------------------------------|-------------------------|--------------------------|------------|------------------|-----|--------------|---------------------|-------------------|--|---------------------------|------|------|--------------|---|--|--------------|
| | | Response | Covariate | | Ref | Exp | | Interaction P-value | Covariate P-value | Covariate Value for Comparisons ^a | Statistic | Ref | Exp | | | Decrease (%) | Increase (%) |
| Survival | Length Frequency Distribution | Fork Length (cm) | - | E6 vs. Ref | 153 | 156 | 2-sample K-S | - | - | - | - | - | - | 0.160 | 1.0 ^b | - | - |
| | | | | E3 vs. Ref | 153 | 159 | 2-sample K-S | - | - | - | - | - | - | 0.024 | -8.0 ^b | - | - |
| Energy Usage | Fork Length | Fork Length (cm) | - | E6 vs. Ref | 153 | 156 | T-test | - | - | - | Mean | 9.59 | 9.61 | 0.709 | - | -2.2 | 2.2 |
| | | | | E3 vs. Ref | 153 | 159 | T-test | - | - | - | Mean | 9.59 | 9.75 | 0.005 | 1.6 | - | - |
| | Body Weight | Body Weight (g) | - | E6 vs. Ref | 153 | 156 | T-test | - | - | - | Mean | 8.56 | 8.36 | 0.162 | - | -5.8 | 5.8 |
| | | | | E3 vs. Ref | 153 | 159 | T-test | - | - | - | Mean | 8.56 | 9.15 | <0.001 | 6.9 | - | - |
| Energy Storage | Condition | Log10 [Body Weight (g)] | Log10 [Fork Length (cm)] | E6 vs. Ref | 152 ^c | 156 | ANCOVA | 0.490 | <0.001 | 9.59 | Adjusted Mean (Geometric) | 8.47 | 8.24 | <0.001 | -2.7 | - | - |
| | | | | E3 vs. Ref | 152 ^c | 159 | ANCOVA | 0.614 | <0.001 | 9.66 | Adjusted Mean (Geometric) | 8.65 | 8.84 | <0.001 | 2.3 | - | - |

Notes:

 P-value < 0.05.

Bold text Magnitude of Difference > 25% (10% if compared to Condition).

^a Mean for all data with outliers removed. For log-transformed data, the geometric mean is reported.

^b Magnitude of difference is the largest difference (as a percentage) between the cumulative relative frequency distributions for the two sampling areas. A negative difference implies the exposure area has smaller fish compared to reference.

^c One fish was identified as an outlier (Control Fish #90) with a Studentized residual of 4.847.

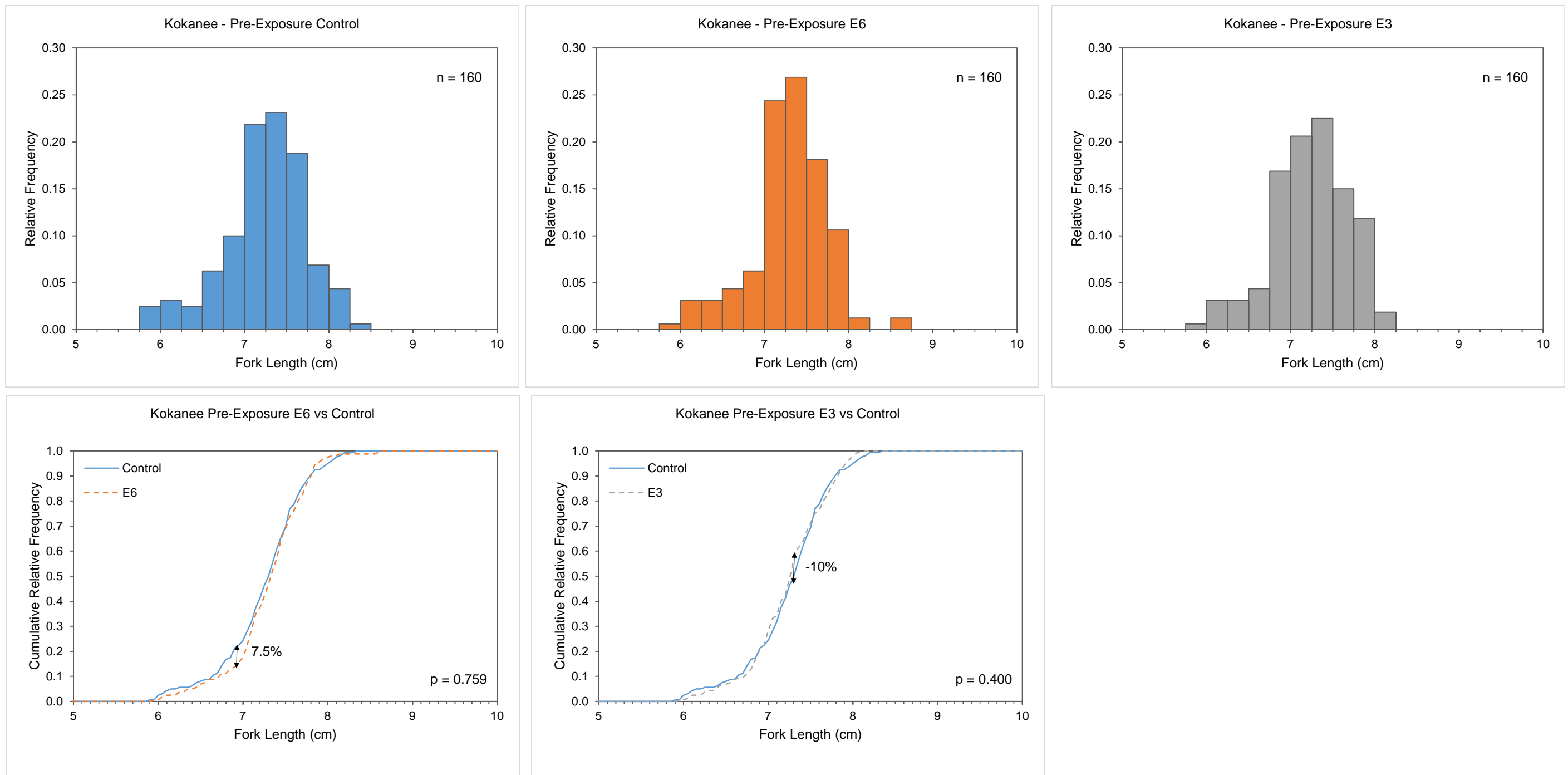


Figure E.1: Length-frequency Distributions and Cumulative Length-frequency Distributions for Pre-exposed Kokanee in Control, E6, and E3 Treatments for Minto Mine Fish Hatchery Exposure, August 2016

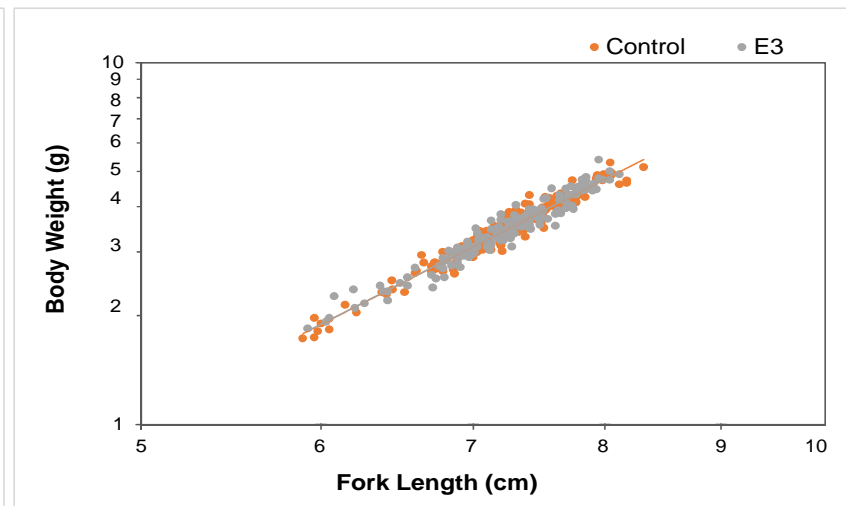
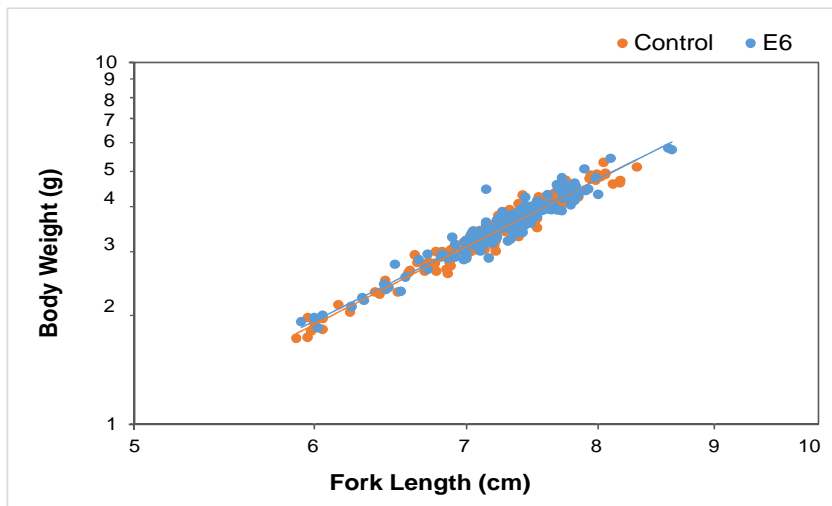
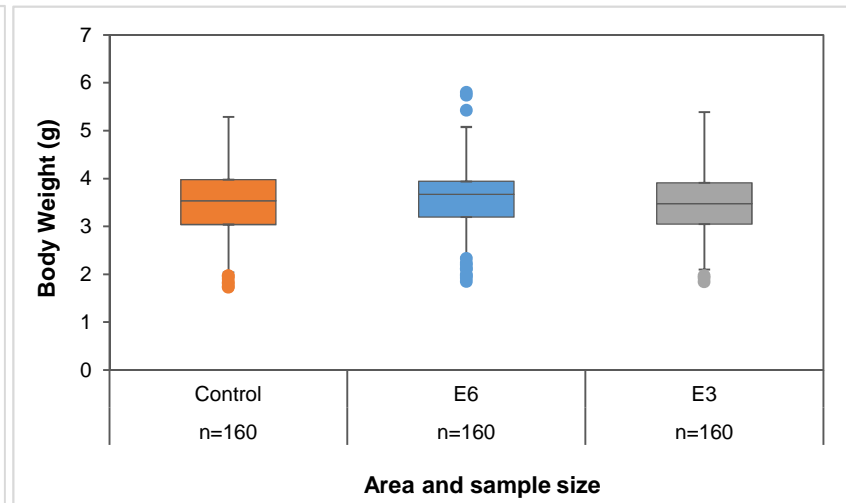
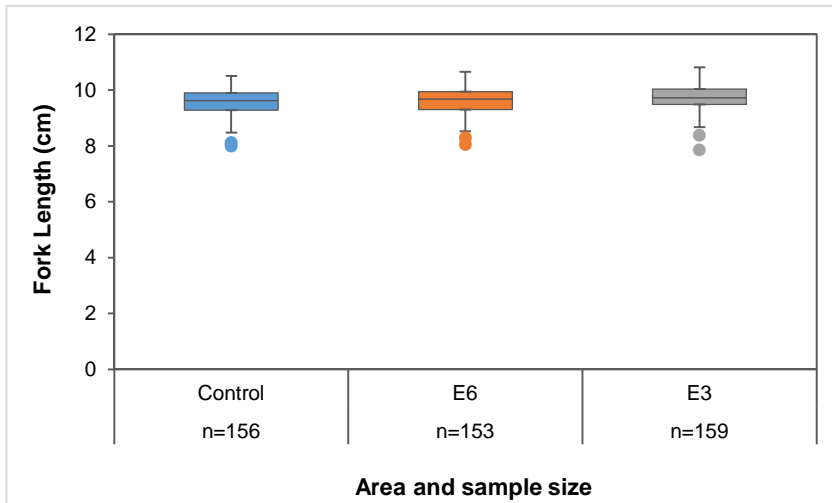


Figure E.2: Boxplots of Fork Length, Body Weight, and Regression (Body Weight on Fork Length) for Pre-exposed Kokanee in Control, E6, and E3 Treatments, Minto Mine Fish Hatchery Exposure, August 2016

Note: Boxplots for body weight and regression are plotted on a log scale.

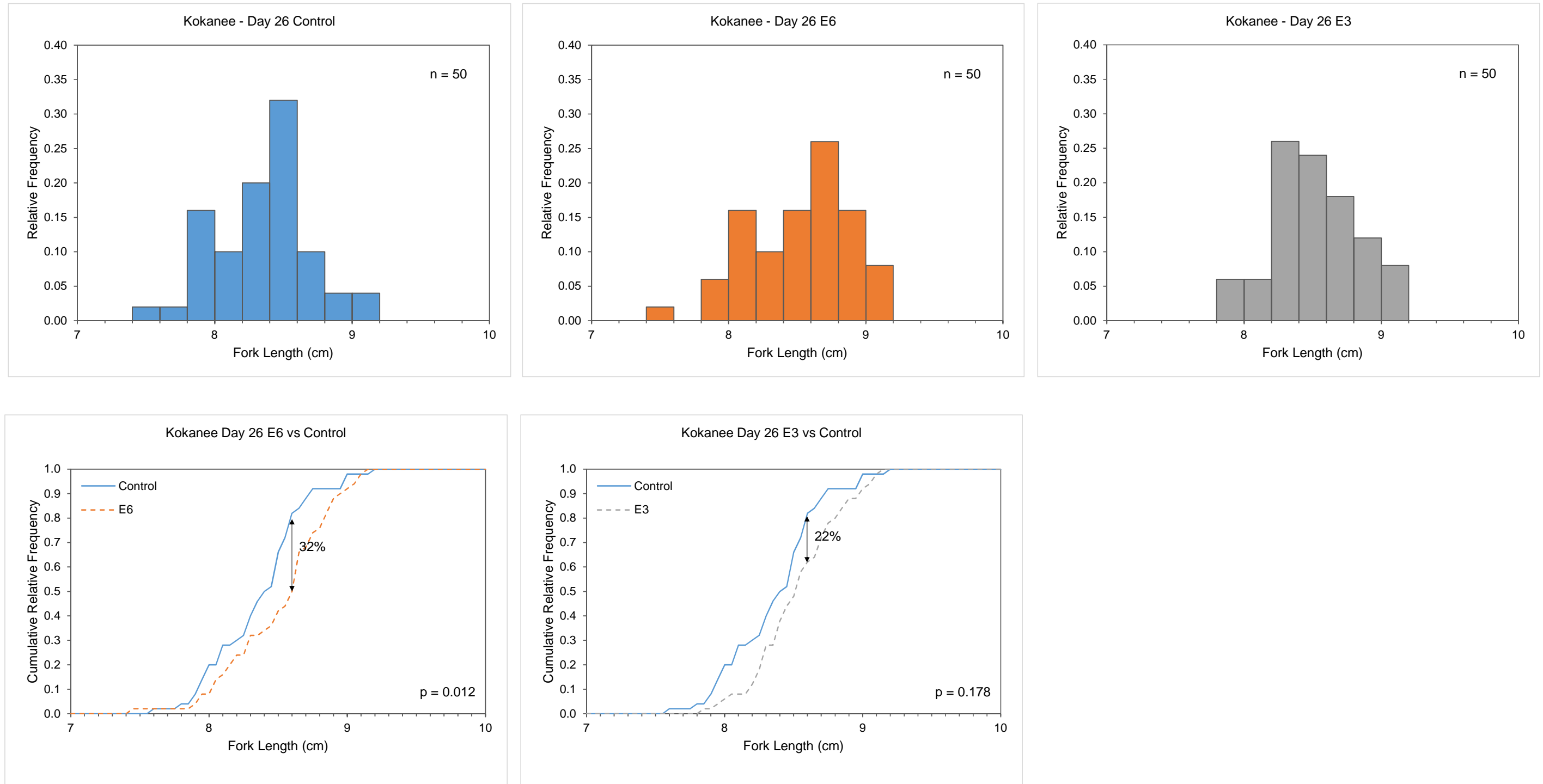


Figure E.3: Length-frequency Distributions and Cumulative Length-frequency Distributions for Day 26 Kokanee in Control, E6, and E3 Treatments for Minto Mine Fish Hatchery Exposure, August 2016

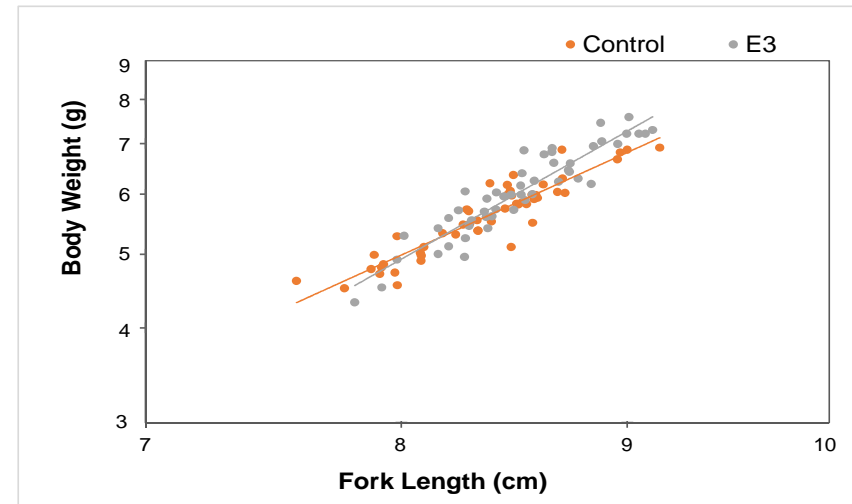
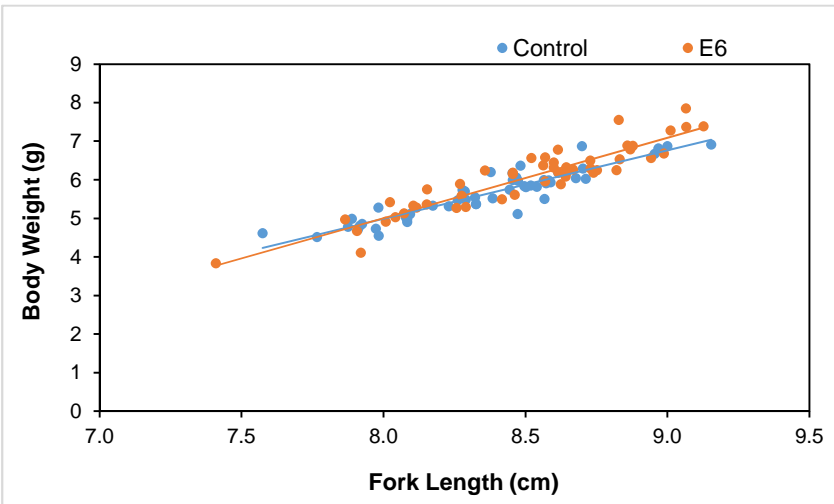
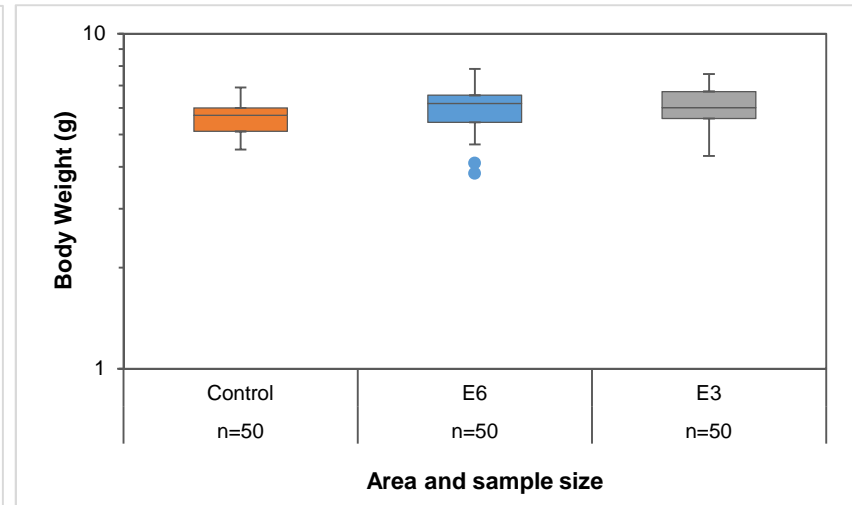
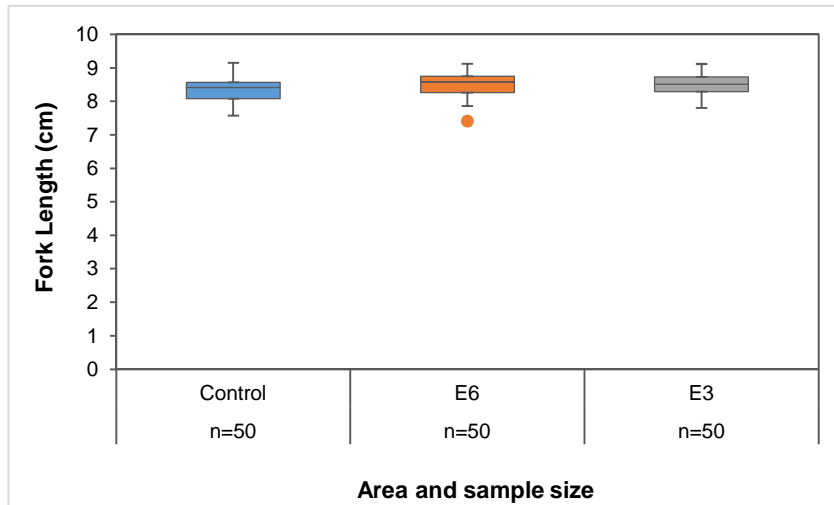


Figure E.4: Boxplots of Fork Length, Body Weight, and Regression (Body Weight on Fork Length) for Day 26 Kokanee in Control, E6, and E3 Treatments, Minto Mine Fish Hatchery Exposure, August 2016

Note: Boxplots for body weight and Control and E3 regression are plotted on a log scale.

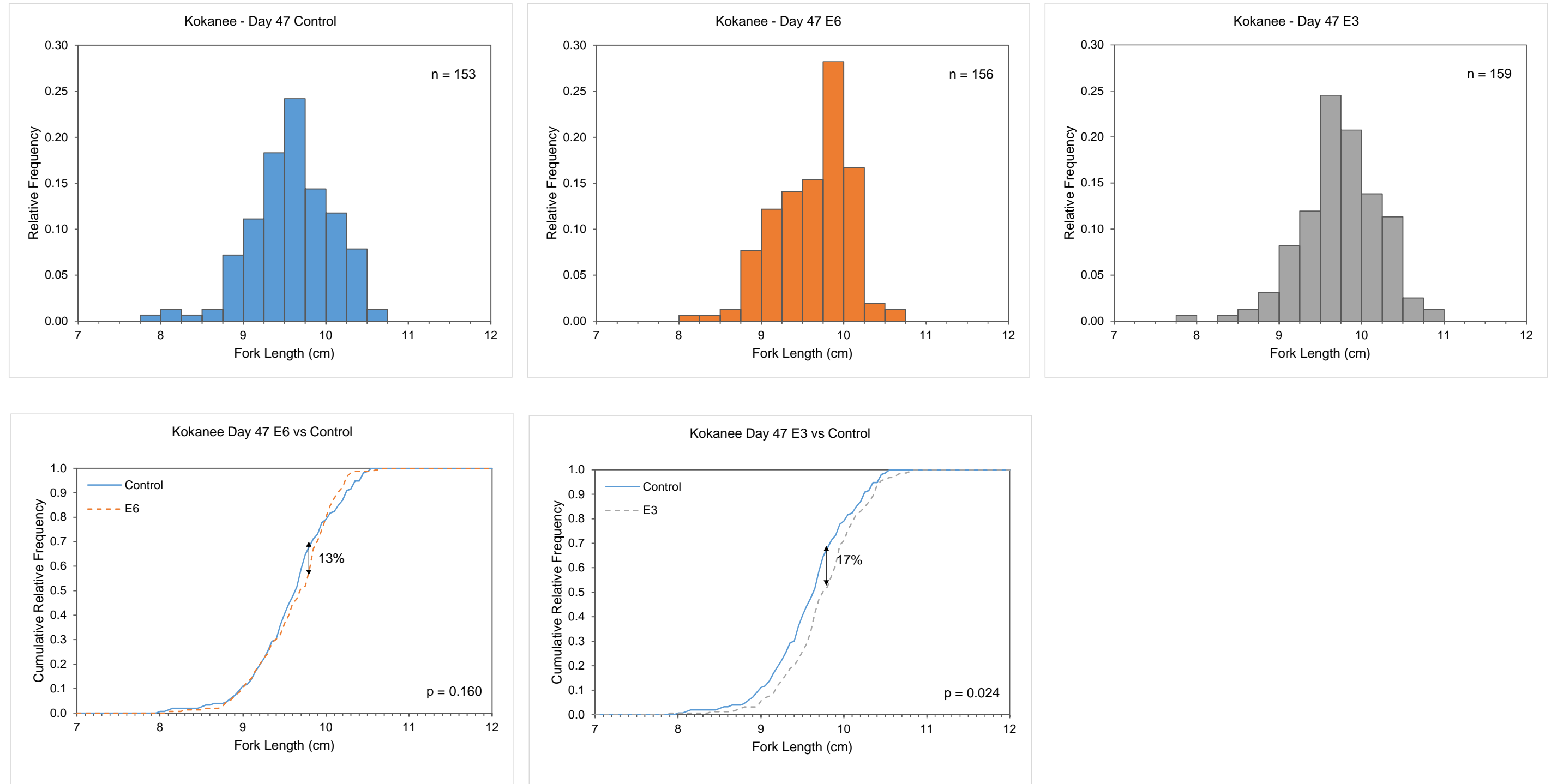


Figure E.5: Length-frequency Distributions and Cumulative Length-frequency Distributions for Day 47 Kokanee in Control, E6, and E3 Treatments for Minto Mine Fish Hatchery Exposure, August 2016

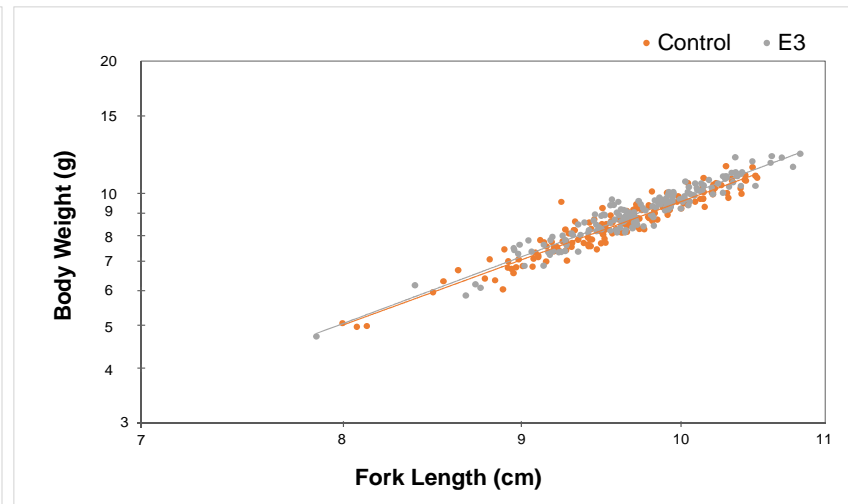
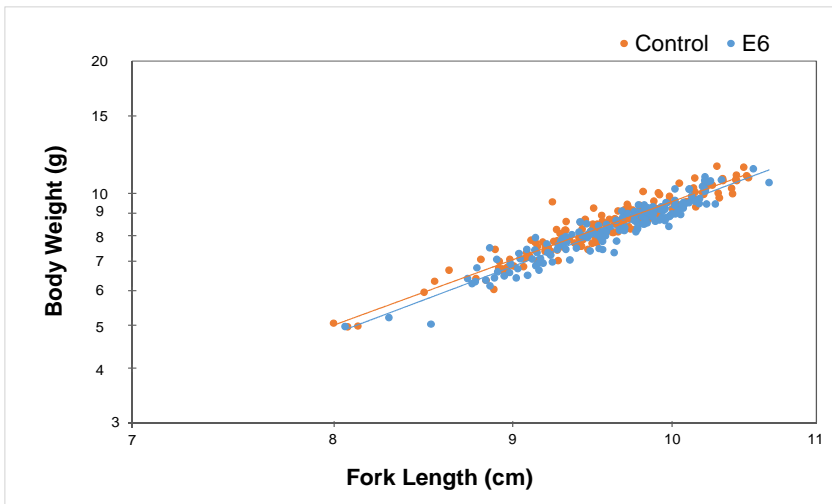
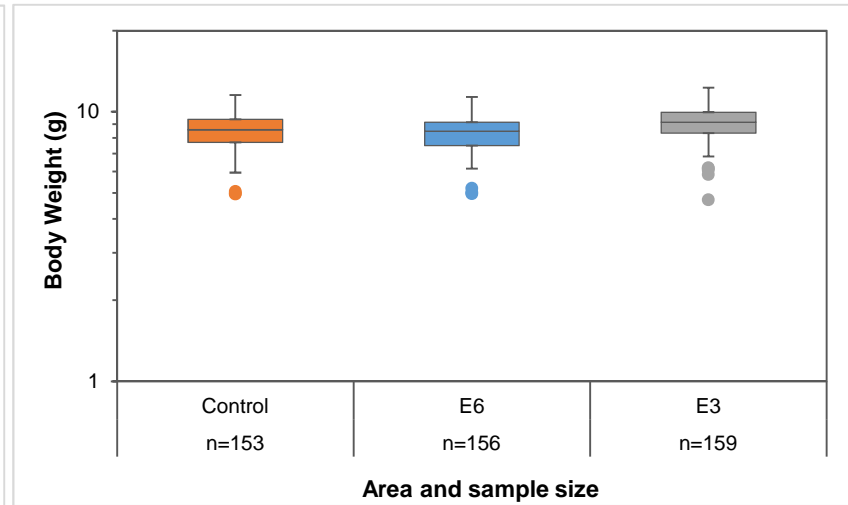
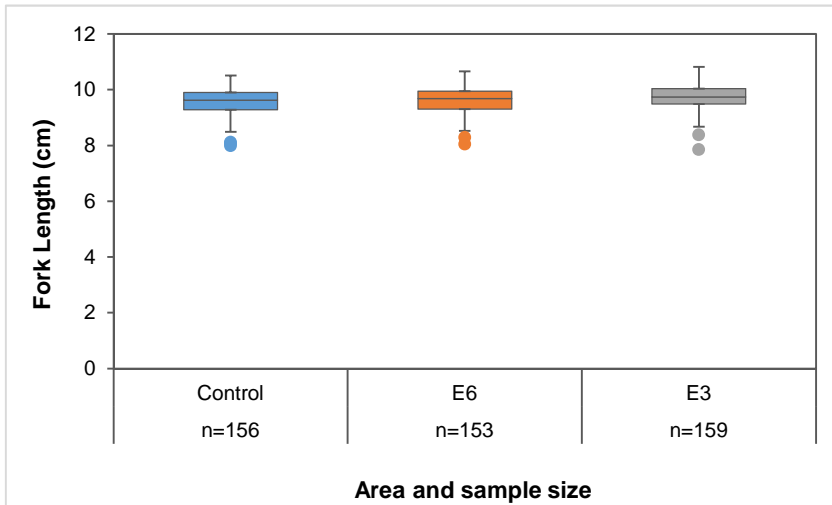


Figure E.6: Boxplots of Fork Length, Body Weight, and Regression (Body Weight on Fork Length) for Day 47 Kokanee in Control, E6, and E3 Treatments, Minto Mine Fish Hatchery Exposure, August 2016

Note: Boxplots for body weight and regressions are plotted on a log scale.

APPENDIX F
SUPPORTING PHOTOGRAPHS



Photo 1: Upper Minto Creek (UMC-1), September 25, 2016



Photo 2: Upper Minto Creek (UMC-2), September 22, 2016





Photo 3: Upper Minto Creek (UMC-3), September 22, 2016



Photo 4: Upper Minto Creek (UMC-4), September 25, 2016





Photo 5: Upper Minto Creek (UMC-5), September 22, 2016



Photo 6: Reference Creek 1 (REF-1), September 25, 2016





Photo 7: Reference Creek 2 (REF-2), September 24, 2016



Photo 8: Reference Creek 3 (REF-3), September 24, 2016





Photo 9: Reference Creek 4 (REF-4), September 24, 2016



Photo 10: Reference Creek 5 (REF-5), September 23, 2016





Photo 11: Reference Creek 6 (REF-6), September 24, 2016



Photo 12: Reference Creek 7 (REF-7), September 24, 2016





Photo 13: Reference Creek 8 (REF-8), September 25, 2016



Photo 14: Reference Creek 9 (REF-9), September 23, 2016





Photo 15: Reference Creek 10 (REF-10), September 23, 2016



Photo 16: On-site Fish Exposure Laboratory, September 2016





Photo 17: Fish Exposure Tank, September 2016



Photo 18: Kokanee prior to Measurement, September 2016





Photo 19: Measuring Kokanee Length, September 2016



Photo 20: Measuring Kokanee Length (2), September 2016





Photo 21: Measuring Kokanee Weight, September 2016



Appendix K – Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment 2017 Update



**Minto Creek Sediment, Periphyton, and
Benthic Invertebrate Community
Assessment - 2017**

Prepared for:
Minto Mine
Whitehorse, Yukon

Prepared by:
Minnow Environmental Inc.
Victoria, British Columbia

March 2018

**Minto Creek Sediment, Periphyton, and
Benthic Invertebrate Community
Assessment - 2017**

Lisa Bowron, M.Sc., R.P.Bio
Project Manager



Pierre Stecko, M.Sc., EP, R.P.Bio
Senior Project Advisor



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1 INTRODUCTION

1.1 Site Description

The Minto Mine is a high-grade copper mine located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R-6A approximately 240 km northwest of Whitehorse, Yukon Territory (62°37'N latitude and 137°15'W longitude; Figure 1.1). It is owned and operated by Minto Explorations Ltd. (MintoEx), a wholly owned subsidiary of Capstone Mining Corporation (Capstone). Mine development was initiated in 1997 and commercial operations started in October 2007. The facility is permitted to conduct open pit and underground mining with milling at a rate of 4,200 tonnes of copper/gold/silver ore per day, and produced 35.9 million pounds of copper in 2017. Mill tailings are stored in the Main Pit and in in the Area 2 Pit (Figure 1.2). Mine-impacted seepage from the dry stack TSF and under the Mill Valley Fill Extension (MVFE) is collected at the toe of the MVFE and pumped to the main pit (Figure 1.2). Non-impacted water and treated mine-impacted water are collected in a Water Storage Pond (WSP; Figure 1.2). Effluent from the WSP is periodically discharged to Minto Creek under conditions specified in Water Use Licence (WUL) QZ14-031 (August 2015). Minto Creek, in turn, discharges to the Yukon River approximately 7.7 km south-east of the WSP (Figure 1.2).

1.2 Background

Under the WUL, the Minto Mine implements an Environmental Monitoring, Surveillance, and Reporting Plan (EMSRP) that includes routine water quality monitoring during the ice-free period (typically from April to October or November) in Minto Creek and reference tributaries at sampling frequencies varying from weekly to monthly. In accordance with the WUL, the Minto Mine submits water quality data to the Yukon Water Board as original laboratory reports and monthly summary reports within 30 days of month-end. Water quality monitoring data indicates that total suspended solids concentrations can increase dramatically during high flow events and concurrent concentrations of many metals (including aluminum, chromium, copper and iron) are higher than Canadian Water Quality Guidelines (CWQGs) for the protection of aquatic life even under background and reference conditions (e.g., HKP 1994, Minnow 2009a, 2010a,b).

The Minto Mine also implements biological monitoring under the EMSRP, including Environmental Effects Monitoring (EEM) in accordance with federal requirements under the *Fisheries Act* and an Aquatic Environmental Monitoring Plan (AEMP). Biological monitoring under EEM is implemented every three years and Phase 4 of the EEM was recently completed (Minnow 2018). Some mine influence was observed in routine water quality monitoring and water samples collected in conjunction with benthic invertebrate sampling. Analytes with concentrations higher than reference (or the reference range) include conductivity, hardness, nitrate, total Kjeldahl

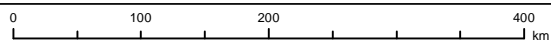




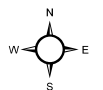
Map of Canada



Location of the Minto Mine



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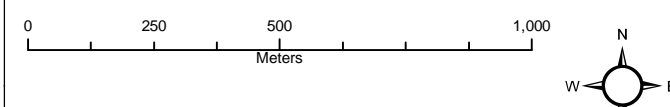
Date February 2018
 Project 177202.0039



Figure 1.1



- LEGEND**
- Final Effluent Discharge Point
 - Mine Footprint
 - Water Retention Dam
 - Building



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Minto Mine Site Layout and Receiving Environment

Date February 2018
 Project 177202.0039



Figure 1.2

nitrogen, total phosphorous, aluminum, arsenic, copper, iron, molybdenum, and selenium. Concentrations of nitrate were most strongly associated with the release of water from the Water Storage Pond, but remained below the CWQG. Mean concentrations of aluminum and arsenic were above CWQG but at both reference and exposed areas. Copper exceeded CWQG but was lower than the site specific water quality objectives. Primary EEM metrics (density, taxon richness, Simpson's evenness, and Bray-Curtis index) were within reference condition at upper Minto Creek but density was significantly lower at upper Minto Creek than reference in a control-impact comparison (Minnow 2018). The magnitude of difference was below the critical effect size (CES) of ± 2 standard deviation and considered not to be ecologically meaningful (Minnow 2018). Fish exposed to the highest concentrations of Minto Mine effluent (25%) for 47 days were slightly larger, of better condition than reference fish, but differences were less than the CES of 10%, and considered not to be ecologically meaningful (Minnow 2018).

Biological monitoring under the AEMP is implemented annually, and includes monitoring of water, sediment, periphyton, benthic invertebrates, fish, and fish habitat. Data from 1994 (baseline) and 2006 to 2016 have been reported previously (e.g., Minnow 2017), with some program modification over time. AEMP water quality monitoring has indicated that analytes were all below WUL water quality objectives. Fluoride was above CWQG at both the exposed and reference areas. Total copper was above CWQG at upper and lower Minto creeks as well as at reference areas for lower Minto Creek. Concentrations of copper in upper and lower Minto Creek were greater than the Interim Sediment Quality Guidelines (ISQGs) for the protection of aquatic life and the reference areas. Similar concentrations were observed in previous years. In 2016, the periphyton community at lower Minto Creek had higher density/biomass and taxon richness but had a different community composition compared to the reference area (lower Wolverine Creek). Temporal variability was observed in periphyton community metrics and composition due to within year differences (i.e., differences in the number of taxa and Bray-Curtis index) between lower Minto and lower Wolverine creeks. Benthic invertebrate community Bray-Curtis index was significantly higher at lower Minto Creek compared to two reference areas. The high temporal variability observed was presumably due to inter-annual variability in environmental conditions.

1.3 Objectives

The objectives of this study and report are to characterize and interpret current (2017) sediment quality, periphyton and benthic invertebrate community condition, and tissue quality (periphyton and benthic invertebrate) of Minto Creek relative to reference and previous years' conditions. Supporting environmental data are also reported.



2 METHODS

Minnow Environmental Inc. implemented the Minto Creek sediment, periphyton, and benthic invertebrate assessment from September 20th to 26th, 2017 with the assistance of Minto Mine staff. The Minto Mine was not actively discharging during the study and had not been discharging since August 5th, 2017. The study was completed in accordance with specifications of the Minto Mine WUL (QZ14-031). Sediment sampling was undertaken in upper Minto Creek, lower Minto Creek, and corresponding reference areas (Table 2.1; Figure 2.1). Toxicity tests were run on sediment from lower Minto and lower Wolverine creeks (Table 2.1; Figure 2.1). Periphyton and benthic invertebrate community sampling were undertaken in erosional habitat of lower Minto Creek and their corresponding reference areas (Table 2.1; Figure 2.1). Tissue sampling (periphyton and benthic invertebrate) was undertaken in lower Minto Creek and corresponding reference areas (Table 2.1; Figure 2.1). Supporting measures (e.g., field meter measures, water quality samples, depth, flow, habitat observations) were collected at all sampling areas.

2.1 Supporting Measures

2.1.1 Field Collection

Many environmental variables were measured to support the sediment quality, periphyton community, benthic invertebrate community, and tissue chemistry data collected for the Minto Creek assessment. The location of each station was recorded using a handheld Geographic Positioning System (GPS) with coordinates recorded in Universal Transverse Mercator (UTM) units (using the North American Datum of 1983).

Supporting measures collected concurrent with sediment sampling (i.e., at depositional areas) included core penetration depth (lower creek areas only), sample texture, and the presence or absence of organic detritus. *In situ* measurements, including temperature, dissolved oxygen, specific conductance, and pH were taken at each station using either a YSI ProPlus field meter (Yellow Springs Instruments, Yellow Springs, OH) or a Hanna 4M multiparameter field meter (Woonsocket, RI).

At periphyton and benthic invertebrate stations (community and tissue), *in situ* water quality measurements (by field meter as described above), water depth (by meter stick), and water velocity (by HACH FH950 handheld flow meter [HACH Company, Loveland, CO]) were measured. Habitat was characterized at each periphyton and benthic invertebrate sampling area and included elevation, gradient, creek wetted and bankfull widths (by tape measure or range finder), water appearance, creek morphology, bank condition, substrate texture, instream cover, instream features, overhead canopy, aquatic vegetation, riparian vegetation, surrounding land use and anthropogenic disturbance. At each benthic invertebrate station, the intermediate axis lengths of



Table 2.1: Minto Mine Water Use Licence Sediment, Periphyton, and Benthic Invertebrate Monitoring Program Overview, September 2017

| Area Type | Area | Station | Minto Mine Water Use Licence (QZ14-031, Amendment 10) | | | | | | | | | |
|-------------------|-----------------------------------|---------|---|--------------------------------|--|---------------------------|--------------------------|----------------------|--------------------------------|--|--|---|
| | | | Water | Sediment by Spoon ^a | Sediment by Hand Corer/Petite Ponar ^b | Sediment Toxicity Testing | Periphyton Chlorophyll-a | Periphyton Community | Periphyton Tissue ^c | Benthic Community by Hess Sampler ^d | Benthic Invertebrate Tissue ^c | |
| Lower Creek Areas | Lower Wolverine Creek (Reference) | LWC-1 | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | LWC-2 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| | | LWC-3 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| | | LWC-4 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| | | LWC-5 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| | Lower Big Creek (Reference) | LBC-1 | ✓ | | | | | | ✓ | ✓ | ✓ | ✓ |
| | | LBC-2 | | | | | | ✓ | ✓ | ✓ | ✓ | |
| | | LBC-3 | | | | | | ✓ | ✓ | ✓ | ✓ | |
| | | LBC-4 | | | | | | ✓ | ✓ | ✓ | ✓ | |
| | | LBC-5 | | | | | | ✓ | ✓ | ✓ | ✓ | |
| | Lower Minto Creek (Exposed) | LMC-1 | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | LMC-2 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | | LMC-3 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | | LMC-4 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| | | LMC-5 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Upper Creek Areas | Upper McGinty Creek (Reference) | URC-1 | ✓ | ✓ | | | | | | | | |
| | | URC-2 | | ✓ | | | | | | | | |
| | | URC-3 | | ✓ | | | | | | | | |
| | | URC-4 | | ✓ | | | | | | | | |
| | | URC-5 | | ✓ | | | | | | | | |
| | Upper Minto Creek (Exposed) | UMC-1 | ✓ | ✓ | | | | | | | | |
| | | UMC-2 | | ✓ | | | | | | | | |
| | | UMC-3 | | ✓ | | | | | | | | |
| | | UMC-4 | | ✓ | | | | | | | | |
| | | UMC-5 | | ✓ | | | | | | | | |

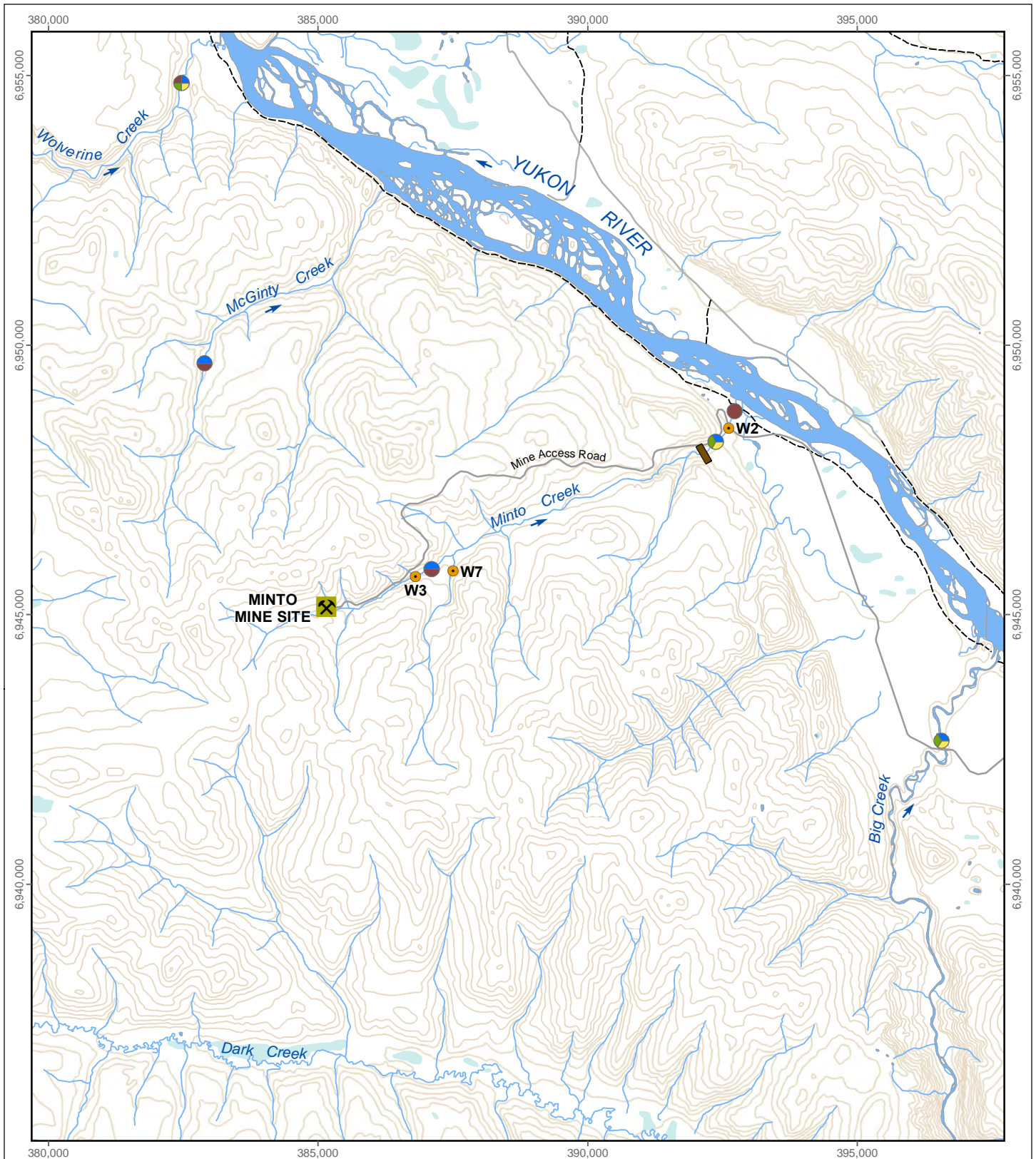
✓ - Included in the Monitoring Program.

^a Top 2 centimeters collected; minimum 3-grab composite.

^b Top 2 centimeters collected; 3-grab composite.

^c Productivity permitting; in some cases, replication (of 5) may not be achieved with reasonable effort.

^d 500 µm mesh; 3-grab composite.



LEGEND

- Samples Collected**
- Routine Water Station
 - Fish Barrier
 - Water
 - Sediment
 - Periphyton
 - Benthos

Water, Sediment, Periphyton, and Benthic Invertebrate Monitoring Areas, 2017

0 1.25 2.5 5 km

Datum: NAD 83 Map Projection: UTM Zone 8V
 Data Source: National Topographic Data Base (NTDB) compiled by Department of Natural Resources Canada at a scale of 1:50,000. All rights reserved.



Date: February 2018
 Project 177202.0039



Figure 2.1

100 rocks that were washed during collection of the community sample were measured and the percent embeddedness of ten randomly selected rocks were evaluated and recorded. This type of substrate characterization is similar to those recommended under the Canadian Aquatic Biomonitoring Network (CABIN) protocol (CABIN 2012) for characterizing benthic invertebrate habitat. This provides additional information to assess and standardize habitat conditions among sampling stations and areas. Summary statistics of intermediate axis lengths (including the median and geometric mean) and median embeddedness were calculated for each station as per the CABIN protocol.

Water samples for chemical analysis were collected at all sampling areas (Table 2.1, Figure 2.1). Samples were collected using a master bottle from which the collected water was poured into pre-labeled sample bottles and preservatives were added, as required. A field duplicate was collected from one area using a split sample method; water from the master bottle was poured into one bottle and then into a duplicate bottle. Water samples for dissolved organic carbon (DOC) and for dissolved Inductively Coupled Plasma-Optical Emission Spectrophotometry (ICP-OES) metals were filtered in the field using 0.45 µm polypropylene filters. Immediately after collection, water samples were placed in a cooler and later into a refrigerator at approximately 4°C. They were later submitted to ALS Environmental in Whitehorse, YT, for analysis of alkalinity by auto titration, anions by ion chromatography, total and dissolved organic carbon by combustion, total inorganic carbon by CO₂ purge, total cyanide by Continuous Flow Analyzer (CFA), conductivity by electrode, hardness by calculation, total and dissolved mercury by Cold Vapour Atomic Fluorescence Spectrophotometry (CVAFS [low]), total and dissolved metals by Collision Cell Mass Spectrometry (CCMS) and ICP-OES, total and dissolved phosphorus by colour, total dissolved and suspended solids by gravimetrics, pH and turbidity by meter, and ammonia by fluorescence.

The productivity of lower Minto and lower Wolverine creeks was evaluated using measurements of chlorophyll-a in periphyton. Chlorophyll-a is the primary photosynthetic pigment of all oxygen-evolving photosynthetic organisms (Wetzel 2001) and therefore provides an indicator of the standing stock of photosynthetic organisms representing the lowest trophic level. Minto Creek is a lotic system and measuring chlorophyll-a in periphyton was considered more representative of productivity than measuring in water. A stainless steel razor blade was used to scrape periphyton from five rocks and then periphyton was transferred to filter paper which was placed in a pre-labeled opaque sampling jar. The surface area sampled was measured and recorded. All samples were maintained in coolers with ice packs during transport and then kept frozen on site until submission to ALS Environmental (Whitehorse, YT).



2.1.2 Data Analysis

A formal data quality report (DQR) was completed to assess the water data quality (Appendix A). The quality of the data were evaluated by comparing laboratory method detection limits (MDL) to target detection limits, which are ideally $\leq 1/10^{\text{th}}$ of guideline values. On a subset of samples, the laboratory conducted Quality Assurance/Quality Control (QA/QC) analysis, including method blanks, laboratory duplicates, matrix spikes, spiked blanks, and certified reference materials. Field duplicates were collected and analyzed as a part of the DQR.

Water quality of Minto Creek was evaluated relative to WUL objectives, concentrations measured at reference areas, applicable water quality guidelines, and historical water quality. Supporting field measures (temperature, dissolved oxygen, pH, and specific conductance) and chlorophyll-a results were tested for differences between lower Minto Creek and reference areas (lower Wolverine and lower Big creeks) using two-sample t-tests. The assumption of normality was assessed using the Shapiro Wilks' test ($\alpha = 0.05$) and homogeneity of variance was assessed using Levene's Test ($\alpha = 0.05$). If variances were unequal, then the two-sample t-test for unequal variances was conducted (Ruxton 2006). Data that could not be normalized were log, square root, or fourth root transformed. A value of 1 was added before taking the logarithm if values of zero were in the data set. If data could not be normalized after transformation, a non-parametric Mann-Whitney test was applied. The significant p-value was set at 0.050 for all tests of supporting field measures. Statistical comparisons were conducted in excel using Real Statistics (Zaiontz 2018). Chlorophyll-a was compared to the British Columbia Water Quality Guideline (BCWQG). Creek productivity was characterized by comparing chlorophyll-a concentrations to the Dodds et al. (1998) productivity classification system for temperate streams.

2.2 Sediment Quality

2.2.1 Sample Collection and Laboratory Analysis

Sediment samples were collected for particle size and chemical analysis at depositional areas within Minto Creek and reference creeks (Table 2.1, Figure 2.1). At lower Minto and lower Wolverine creeks, sediment samples for particle size analysis were collected using a 15.24 cm x 15.24 cm (6" x 6") stainless steel petite ponar grab sampler (0.023 m² sampling area). A composite sample was created by collecting the surficial 2 cm of sediment from each of three acceptable grabs (i.e., full to each edge of the sampler) using a stainless steel spoon. Each sample that formed the composite was added to a plastic bin and mixed together. The mixed composite samples was placed into pre-labeled glass sampling jars. Sediment samples for chemical analyses were collected using a 4.7 cm (2"; inside diameter) Lexan™ core tube, which was carefully inserted into sediment deposits, capped using a fitted plastic cap, and retrieved by



hand. From each acceptable core (i.e., each core containing an intact, representative sediment-water interface), the surficial 2 cm of sediment was manually extruded upwards into a graded core collar, cut with a stainless steel core knife, and placed into a pre-labeled glass sampling jar. Samples from three cores were composited to form a single sample from each station. At upper Minto and upper McGinty creeks, sediment deposits were rare and typically very shallow (i.e., deposits were less than one centimeters in depth). Collection of sediment by ponar or coring was ineffective in the upper creek areas and therefore sediments were collected using a stainless steel spoon. At locations of sediment deposition, surficial sediment was carefully collected by slowly spooning the sediment into a pre-labeled glass jar, with care taken to avoid the loss of fine material. In order to be as consistent as possible with the sediment collected in the lower creek areas, samples included no more than the top 1 cm of deposited sediment. Immediately after collection, sediment samples were placed in a cooler and later into a refrigerator at approximately 4°C. They were later submitted to ALS Environmental in Whitehorse, YT or Burnaby, BC, for analysis of particle size by dry and wet sieving and pipette sedimentation method, total organic carbon and loss on ignition by combustion, inorganic carbon was derived from a calculation, metals by collision/reaction cell-inductively coupled plasma mass spectrometry (CRC ICP-MS), mercury by CVAFS, total Kjeldahl nitrogen by colorimetric analysis, and pH by probe.

Survival and growth were measured in a 10-day *Chironomus dilutus* and a 14-day *Hyalella azteca* sediment toxicity tests at lower Minto and lower Wolverine creeks (Environment Canada 1997, 2013). Sediment for toxicity testing was collected using a 15.24 cm x 15.24 cm (6" x 6") stainless steel petite ponar grab sampler (0.023 m² sampling area) and the top 2 cm from three grabs were collected to form a composite sample from each station (five stations formed the replicates in the toxicity tests). Samples from each station were placed into a pre-labeled 1 L jar and mixed with a stainless steel spoon. Immediately after collection, samples were placed in a cooler, then later transferred to a refrigerator and stored at approximately 4°C until they were submitted to Nautilus Environmental Inc. in Burnaby, BC for sediment toxicity testing.

2.2.2 Data Analysis

A formal DQR was completed to assess the sediment data quality (Appendix A). The MDLs achieved by the laboratory were compared to target limits, generally $\leq 1/10^{\text{th}}$ guideline values. Laboratory QA/QC analysis included method blanks, laboratory duplicates, spiked blanks and certified reference materials (Appendix A). Sediment chemistry endpoints were summarized by reporting mean, standard deviation, minimum, and maximum for each area. Sediment quality data were evaluated relative to sediment quality guidelines (SQGs) for the protection of aquatic life (e.g., CCME 1999) and reference concentrations to identify metals with the potential to adversely affect aquatic life and/or that could be elevated due to mine activity. Sediment quality



data were also compared to results obtained in previous years of sampling (1994 and 2006 to 2016). Interpretation was conducted with careful consideration of a significant methodological change made in 2010 and carried through to 2017 (sediments collected as described in Section 2.2.1) relative to previous years. Sediments collected in years before 2010 were collected within the active channel of the creek using an aluminum or Teflon scoop. Samples were submitted whole for analysis of particle size distribution, which generally included significant quantities of gravel and sand. Only material passing through a 230 mesh sieve (<63 µm; silt and clay) was digested and analyzed for metals. While this approach does analyze the geochemically-relevant fine sediment (e.g., Horowitz 1991), it impedes with interpreting the biological significance of sediment chemistry. Organisms are exposed to whole sediment (not just fines) and SQGs for the protection of aquatic life (e.g., CCME 1999) apply to whole sediment.

The laboratory performed QA/QC on sediment toxicity tests by comparing results to reference toxicant tests. Ammonia was monitored in lower Wolverine Creek treatments to ensure concentrations stayed below 0.20 mg/L of un-ionized ammonia (as N). Sediment from lower Minto Creek was compared to lower Wolverine Creek and laboratory control sediment. Results were also compared to previous sediment toxicity testing conducted in 2011, 2015, and 2016 (Minnow 2012, 2016, 2017). The mean ± standard deviation were compared for the survival and growth toxicity tests. Statistical analysis were conducted and summarized in a report by Nautilus Environmental (Appendix C).

2.3 Periphyton Community

2.3.1 Sample Collection and Laboratory Analysis

Periphyton is the assemblage of algae, bacteria, fungi, and meiofauna attached to submerged substrate in freshwaters. However, periphyton communities are generally characterized based on the attached alga community, which represent the lowest trophic level and are indicators of primary productivity. Periphyton community samples were collected in erosional habitat of lower Minto, lower Wolverine, and lower Big creeks (Table 2.1, Figure 2.1). A stainless steel razor blade was used to scrape periphyton from five randomly selected rocks in each of the five replicate stations per area. The area sampled was measured and recorded. Samples preserved with Lugol's iodine solution were placed in pre-labeled sampling jars. The samples were placed in a cooler, then later transferred to a refrigerator and stored at approximately 4 °C until they were shipped to Plankton R Us Inc. (Winnipeg, MB) for analysis to species level.

2.3.2 Data Analysis

A formal DQR was completed to assess the periphyton community data quality (Appendix A). Laboratory duplicate samples were collected on 10% of the periphyton community samples.



Periphyton communities were compared between lower Minto Creek and reference areas, lower Wolverine and lower Big creeks. Temporal comparisons were made to data collected in 1994 and 2011 to 2017.

Total organism density (cells/cm²) and biomass (µg/cm²) were calculated for periphyton community samples. The diversity metric “number of taxa” (also known as taxon richness) included all separate taxa identified to the species level. Simpson’s Diversity and Simpson’s Evenness indices were computed according to formulae presented by Smith and Wilson (1996) and recommended by Environment Canada (2012). These indices take into account the relative abundance of taxa and number of taxa, with values ranging from 0 (low diversity or evenness) to 1 (high diversity or evenness). The Bray-Curtis index was also calculated according to Environment Canada (2012). This metric takes into account the abundance of each taxon at each station compared to the median reference abundance (lower Wolverine Creek), to compute an index of the relative “dissimilarity” of each station from the hypothetical reference median station. Larger Bray-Curtis index values indicate greater dissimilarity from reference.

Periphyton community endpoints were summarized by reporting mean, median, minimum, maximum, and standard deviation for each study area. Differences among Minto Creek and the reference areas were tested using a two-sample t-test, with a p-value <0.10. A p-value of 0.10 was used as per suggested EEM guidelines (Environment Canada 2012). The assumptions of normality was assessed using the Shapiro Wilks’ test ($\alpha = 0.05$) and homogeneity of variance was assessed using Levene’s Test ($\alpha = 0.05$). If variances were unequal, then the two-sample t-test for unequal variances was conducted (Ruxton 2006). Data that could not be normalized were log, square root, or fourth root transformed. A value of 1 was added before taking the logarithm if values of zero were in the data set. If data could not be normalized after transformation, a non-parametric Mann-Whitney test was applied. Statistical comparisons were conducted using Real Statistics in excel (Zaiontz 2018). An observed effect size was calculated for each community metric as:

$$\text{Observed Effect Size} = (\text{Exposed mean} - \text{Reference mean})/\text{SD}$$

where the SD is an estimate of the reference standard deviation. The estimate of the reference standard deviation was the pooled standard deviation in the two-sample t-test for equal variances or the reference standard deviation when the two-sample t-test for unequal variances was applied. The effect size calculations will be conducted on the transformed scale when the data are transformed for analysis. A study design with two areas and $n = 5$ samples per area has an approximate power of 0.9 to detect a two standard deviation difference between areas using $\alpha = 0.1$ (Environment Canada 2012).



Periphyton data collected in 2017 were compared to data collected in baseline studies (HKP 1994) and from 2011 to 2016. Due to differences in reporting of periphyton community data in the 1994 baseline report (e.g., taxa were only identified as present, common or dominant), a non-statistical comparison was performed against 1994 data using proportional abundances at the taxonomic level of Phylum.

2.4 Benthic Invertebrate Community

2.4.1 Sample Collection and Laboratory Analysis

Benthic invertebrate community samples were collected in erosional habitat of lower Minto, lower Wolverine, and lower Big creeks as required under the WUL (Table 2.1, Figure 2.1). Benthic invertebrate community samples were collected from riffle/run habitat with cobble and gravel substrate using a Hess sampler (0.10 m²) outfitted with 500 µm mesh. Three grab composites (0.30 m² area in total) were collected at five replicate stations within each sampling area. For each grab, the substrate within the sampler was disturbed and scrubbed (by hand and nail brush) with care taken to ensure that all dislodged organic material was swept into the sampler collection net. The substrate was disturbed to a depth of approximately 5 cm over a period of approximately ten minutes. This procedure was repeated for the second and third grab, following which all of the material contained in the collection net was carefully transferred to a pre-labeled 2 L wide-mouth plastic jar using a stainless steel spoon and a wash bottle while working over a plastic bin to avoid any potential loss of organisms. Any organisms that adhered to the sieve bag were removed by hand and added to the sample. All samples were labeled internally (using wooden sticks) and externally with the station number, area identifier, Minnow project number, date and field personnel in order to ensure correct identification at the laboratory. Samples were preserved within six hours of collection using buffered formalin solution to a nominal concentration of 10% in ambient water.

All benthic invertebrate samples were shipped to Cordillera Consulting in Summerland, BC. Each sample was elutriated to remove sand, gravel and clay, and the remaining organic material was preserved in 70% ethanol. Elutriate was examined for any mollusc or Trichoptera cases, then each sample was examined to estimate the total number of invertebrates. If the estimated number of organisms were greater than 600 and the sample was fine and non-clumping, a subsample was taken using a Folsom Plankton Splitter (Motodo 1959, Van Guelpen et al. 1982). Empty snail or bivalve shells, empty caddisfly cases, and invertebrate fragments such as legs, gills, antennae etc. were kept but excluded from the count. When organism fragments were encountered, only the heads were counted towards the total. Larval and pupal exuviae were excluded while terrestrial stages and terrestrial drop-ins were indicated as such but excluded from the total count. Benthic invertebrates were identified to the “lowest practicable taxonomic level” (which in most



cases were genus) and counted. Following identification and counting, representative specimens of each new taxon were preserved in a museum quality vial with a polyseal lid and added to the Minto Mine voucher collection. Internal labels were used to identify the taxa, the client, date collected, site code, and the project.

2.4.2 Data Analysis

A formal DQR was completed to assess the benthic invertebrate community data quality (Appendix A). Laboratory QA/QC included an assessment of sub-sampling error and sorting efficiency on at least 10% of the samples (Appendix A). Benthic invertebrate communities were evaluated using summary metrics, including invertebrate density (number of organisms per m², calculated based on a sample area of 0.30 m²), number of taxa, Simpson's Diversity and Evenness, and Bray-Curtis index. Before these endpoints could be calculated, abundances of organisms identified to a less-specific level were first added to abundances of organisms within that grouping identified to a more-specific level (e.g. abundances of organisms only identified to Order were added to abundances of organisms identified to Family, Genus, or Species within that Order). This process is referred to as data compression and assess benthic invertebrate taxonomic richness without redundancy. Abundance of a less-specific taxon was redistributed within that taxon proportionally according to abundances of organisms identified to more-specific levels. Data compression was conducted proportionally because the distribution of organisms identified beyond the Family-level likely reflect the proportional distribution of organisms identified to associated less-specific levels, because those organisms are frequently at early developmental stages and lack some differentiating features. Total organism density (individuals/m²), taxon richness, Simpson's Diversity and Evenness, and Bray-Curtis index were calculated in the same manner as periphyton community data (Section 2.3.2). Bray-Curtis index was calculated based on the median of each reference area as well as the combined reference median. The combined reference median was presented within the text, as this is the optimal method for determining potential effluent effects, since using a reference median value calculated from only one area biases the outcome toward detecting a difference between two areas regardless of potential anthropogenic stressors. This occurs because the area used to calculate the median was inherently more similar to itself than any other area (Huebert et al. 2011), even if the two areas in question are 'natural-pristine' areas.

The relative proportions of the most abundant taxa were calculated relative to the total number of organisms in the sample. Dominant taxon groups were defined as groups representing greater than 10% of total organism abundance in one or more areas or any groups considered important indicators of environmental stress. In this study, relative proportions of the major groups, such as chironomids and EPT taxa (Ephemeroptera [mayfly], Plecoptera [stonefly], Trichoptera



[caddisfly] taxa) were examined. It is often possible to relate low relative abundance of sensitive taxonomic groups (e.g., EPT taxa) to environmental stress (e.g., Taylor and Bailey 1997). Similarly, high relative abundance of tolerant taxonomic groups (e.g., oligochaetes) may also indicate higher environmental stress (Chapman et al. 1982a,b).

Differences among Minto Creek and the reference areas were tested using ANOVA with a post hoc test (Tukey's), with significance set at a p-value of <0.10, as per suggested EEM guidelines (Environment Canada 2012). Prior to ANOVA, all data were transformed (log, square root, or fourth root transformation) as necessary to meet assumptions of normality (Shapiro Wilks' test; $\alpha = 0.05$) and homogeneity of variance (Levene's test; $\alpha = 0.05$). A value of 1 was added before taking the logarithm if values of zero were in the data set. If data failed the assumptions of normality and homogeneity of variance, then a non-parametric Kruskal-Wallis test was conducted using a Dunn's post hoc test. All statistical comparisons were conducted using Real Statistics in excel (Zaiontz 2018). An observed effect size was calculated for each community metric as:

$$\text{Observed Effect Size} = (\text{Group 1 mean} - \text{Group 2 mean})/\text{SD}$$

where the SD is an estimate of the reference standard deviation.

Benthic invertebrate community data were also evaluated in comparison to results obtained in previous years of sampling (1994, 2006, 2008, and 2010 to 2016). Summary metrics from earlier years were previously re-calculated (Minnow 2011) to ensure consistency and appropriate comparisons over time.

2.5 Tissue Chemistry

2.5.1 Sample Collection and Laboratory Analysis

Periphyton and benthic invertebrate tissue samples were collected from lower Minto (exposed), lower Wolverine (reference), and lower Big creeks (reference; Table 2.1, Figure 2.1). Periphyton samples were collected by scraping submerged cobble-size rocks with a stainless steel razor blade. Scraped material (periphyton) was placed in pre-labeled sample jars. Benthic invertebrate tissue samples were collected in areas with cobble substrate using a kick-net, and by overturning rocks and collecting organisms by hand. Periphyton and benthic invertebrate tissue samples (2 to 5 grams) were placed into pre-labeled sample jars and Whirl-Pak™ bags, respectively. A total of five periphyton and five benthic invertebrate samples were collected at each area. Immediately after collection, all tissue samples were placed in a cooler, and later in a freezer until they were submitted to ALS Environmental in Burnaby, BC. Samples were analyzed for percent moisture and for metals by High-Resolution ICP-MS, and later converted to dry weight using percent moisture.



2.5.2 Data Analysis

A formal DQR was completed to assess the periphyton and benthic invertebrate tissue data quality (Appendix A). The MDLs achieved were compared to the detection limits quoted by the laboratory. Method blanks, laboratory duplicates, spiked blanks, and certified reference materials were included in the DQR for both tissue types (Appendix A). Tissue chemistry data were summarized (mean and standard deviation). Any analyte that had values with poor detection limits (a value below the detection limit that exceeds the maximum detected value) were removed from the data set when they consisted of fewer than 80% of the data values. The removal of the poor detection limits is irrelevant to the estimation of the mean or standard deviation, but does influence the overall sample size. Analytes with one or more values below a detection limit or with poor detection limits were analyzed using the non-parametric Kaplan-Meier method using a data analysis package (NADA: non-detects and data analysis for environmental data; Helsel 2012) in R statistical software (R Core Team 2016). This method involves transforming the left censored (i.e., < value) dataset to a right censored (i.e., > value) dataset, and then using the Kaplan-Meier estimator (used to estimate the mean survival time in survival analysis) to estimate the mean. The calculation was conducted using the `survfit()` function in the survival package (Therneau 2017) in R and involves calculating the area under the Kaplan-Meier survival curve. The Kaplan-Meier method is non-parametric and can accommodate multiple detection limits. This method of estimating the mean is equivalent to using the distribution of detectable values below the detection limit to represent values that are <MDL. If the minimum value in the data set was below the detection limit, then it was replaced with the detection limit. Therefore, if there was only one detection limit and no detected values <MDL, then the Kaplan-Meier estimate of the mean was equivalent to replacing the value below the detection limit with the detection limit (i.e., the best estimate for the values <MDL is the detection limit). The standard deviation was also estimated using the Kaplan-Meier method using the `survfit()` function in the survival package. When a standard deviation could not be estimated, it was reported as NA (not available). This can occur with a data set with a high proportion of censored values.

The primary objective of tissue collection was to support a selenium assessment reported under a separate cover. Accordingly, data are reported herein for future reference with limited interpretation. Tissue quality data were interpreted by statistically comparing metal concentrations at the exposed area to those collected at the reference areas using ANOVA with post-hoc testing (Tukey's) with a p-value of 0.050. Data were first tested for normality (Shapiro Wilks' test; $\alpha = 0.05$) and equality of variance (Levene's test; $\alpha = 0.05$) and if data were not normally distributed, data were transformed by either log, square root, or fourth root transformations. A value of 1 was added before taking the logarithm if values of zero were in the data set. Some analytes were could not be normalized, and a non-parametric Kruskal-Wallis test



with a Dunn's post-hoc was conducted. All statistical tests were conducted using Real Statistics in excel (Zaiontz 2018). When one or more values were below a detection limit, the data were analyzed using the generalized Wilcoxon score test as described in Helsel (2012). The test is nonparametric, accommodates multiple detection limits, and compares the survival curves for two or more groups. If a significant difference among groups was detected for three-group comparisons, then pairwise comparisons were conducted using two-group generalized Wilcoxon score tests. The tests were conducted using cendiff function in the NADA package (Lee 2017) in R (R Core Team 2016).



3 SUPPORTING MEASURES

3.1 Field Measures

Mean temperature at the sediment sampling area of upper Minto Creek (2.7 °C) was significantly higher than in upper McGinty Creek (1.6 °C; Figure 3.1, Appendix Table B.3). Lower Minto Creek (3.9 °C) had significantly lower temperature compared to the reference area, lower Wolverine Creek (6.2 °C; Figure 3.1, Appendix Table B.3). Specific conductance was significantly higher in upper Minto Creek (602 µS/cm) than in upper McGinty Creek (174 µS/cm). Lower Minto Creek (430 µS/cm) had significantly higher specific conductance than compared to the lower Wolverine Creek reference (247 µS/cm; Figure 3.1). Dissolved oxygen was significantly higher at lower Minto Creek (68.1% saturation) than at lower Wolverine Creek (36.6% saturation; Figure 3.1, Appendix Table B.3). Lower dissolved oxygen at lower Wolverine Creek could be attributed to sampling in back eddies, which were the only areas that support sediment deposition. No significant differences were observed between exposed areas and associated reference areas for pH (Figure 3.1, Appendix Table B.3).

Physico-chemical measurements were also taken in erosional areas of lower Minto, lower Wolverine, and lower Big creeks in support of benthic invertebrate community sampling. Temperature was significantly lower at lower Minto Creek (2.0 °C) compared to lower Big Creek (6.4 °C) but were similar to lower Wolverine Creek (3.8 °C; Figure 3.2, Appendix Table B.4). Specific conductance was the only parameter measured that was significantly higher at lower Minto Creek (412 µS/cm) compared to both reference areas, lower Wolverine (259 µS/cm) and lower Big (248 µS/cm) creeks, which was consistent with the measures supporting the sediment collections and suggest a mine influence on water quality. No significant differences were observed between lower Minto Creek and reference creeks for dissolved oxygen and pH. All areas were within the range of the WUL objective for pH.

3.2 Water Chemistry and Chlorophyll-a

Water chemistry data quality were assessed prior to data analysis and interpretation, and were judged to be of good quality (Appendix A). Fluoride exceeded the interim CWQG in Minto Creek and associated reference areas (Table 3.1). Total copper concentrations (a metal of particular interest at the Minto Mine) were above CWQG at upper Minto Creek but dissolved copper was well below water quality objectives set out in the WUL (Table 3.1, Appendix Table B.7).

Chlorophyll-a data quality was assessed prior to data analysis and interpretation, and was judged to be of good quality (Appendix A). Concentration of chlorophyll-a in periphyton was significantly higher at lower Minto Creek (51 mg/m²) than at lower Wolverine Creek (13 mg/m²; Figure 3.3) but was below the BCWQG of 100 mg/m² for the protection of aquatic life (BCMOE 1985).



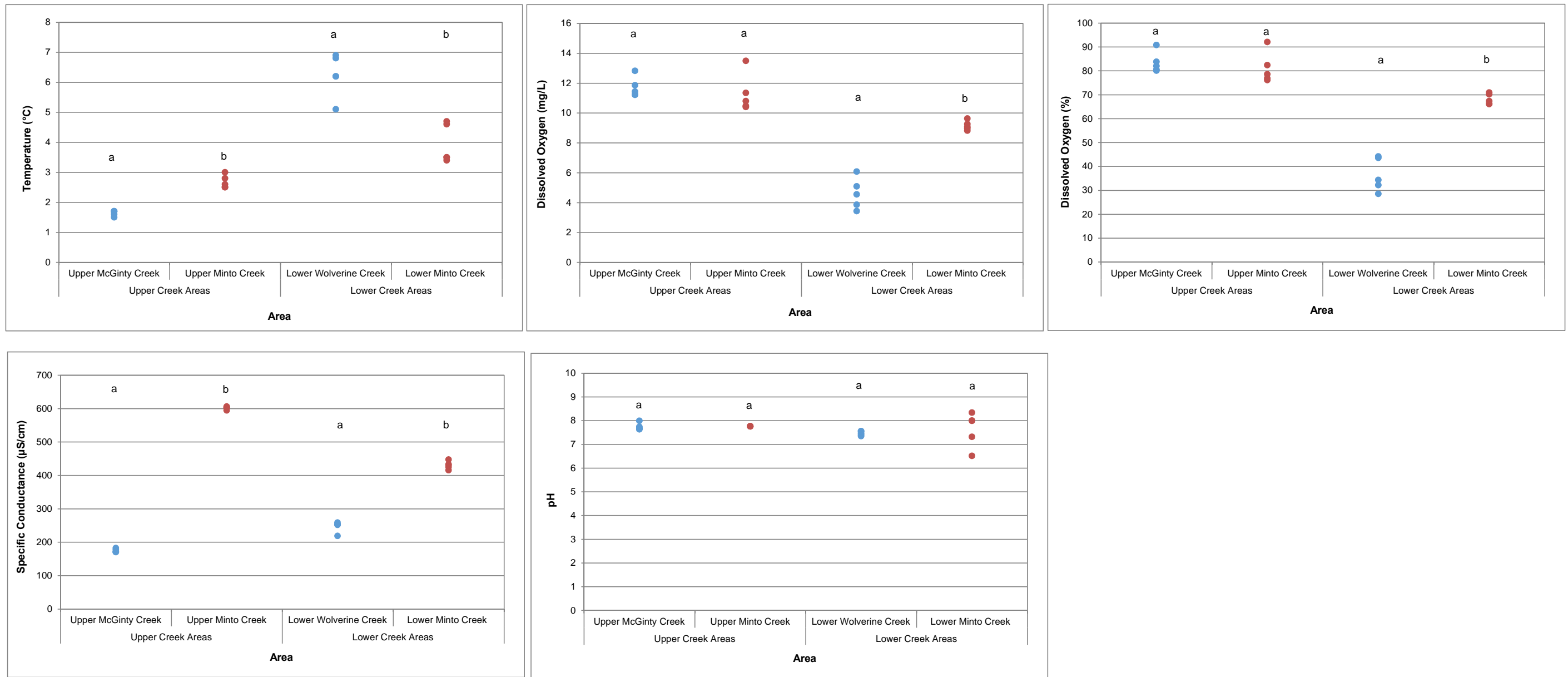


Figure 3.1: Physico-chemical Measurements in Depositional Areas of Upper and Lower Minto Creek Relative to Reference Areas, Minto Mine, 2017

Notes: Samples sizes were n = 5 in all areas (except for pH at upper Minto Creek, n = 4). Different letters represent a significant difference between areas within each creek area.

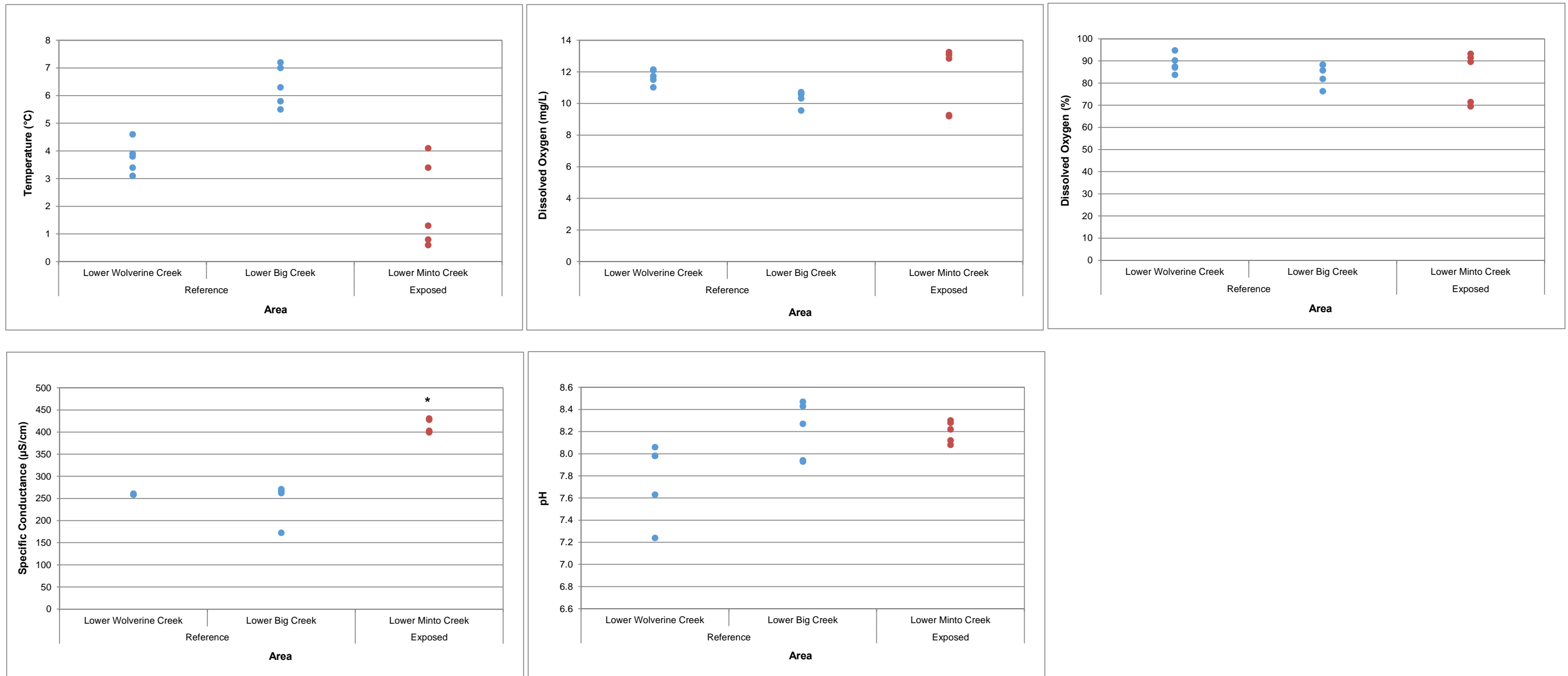


Figure 3.2: Physico-chemical Measurements in Erosional Areas in Lower Minto Creek and Reference Areas, Minto Mine, 2017

Notes: Samples sizes were n = 5 in all areas. Asterisk (*) indicate when lower Minto Creek was significantly different from lower Wolverine and lower Big creeks.

Table 3.1: Water Quality Results at Exposed and Reference Areas, Minto Mine WUL, September 2017

| | Analyte | Units | CCME Water Quality Guidelines ^a | | WUL Objectives at W2 | Upper McGinty Creek (Reference) | Upper Minto Creek (Exposed) | Lower Wolverine Creek (Reference) | Little Big Creek (Reference) | Lower Minto Creek (Exposed) |
|------------------------|----------------------------------|----------|--|---------------------|--------------------------|---------------------------------|-----------------------------|-----------------------------------|------------------------------|-----------------------------|
| | | | 30 Day | Max | | | | | | |
| Physical Tests | Conductivity | µS/cm | - | - | - | 164 | 523 | 219 | 217 | 340 |
| | Hardness (as CaCO ₃) | mg/L | - | - | - | 113 | 260 | 107 | 103 | 175 |
| | pH | pH Units | 6.5 - 9.0 | - | 6.0 - 9.0 | 7.82 | 8.08 | 8.03 | 8.18 | 8.22 |
| | Total Suspended Solids | mg/L | - | - | - | <3.0 | <3.0 | 3.1 | <3.0 | 3.5 |
| | Total Dissolved Solids | mg/L | - | - | - | 163 | 317 | 165 | 152 | 225 |
| | Turbidity | NTU | - | - | - | 0.87 | 0.20 | 0.87 | 0.89 | 0.75 |
| Anions and Nutrients | Total Alkalinity | mg/L | - | - | - | 77 | 234 | 105 | 105 | 172 |
| | Total Ammonia (as N) | mg/L | 0.41 ^b | - | 0.25 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| | Chloride (Cl) | mg/L | 120 | 640 | - | 0.27 | 4.4 | 0.45 | 0.59 | 1.7 |
| | Fluoride (F) | mg/L | 0.12 | - | - | 0.33 | 0.58 | 0.13 | 0.13 | 0.44 |
| | Nitrate (as N) | mg/L | 3.0 | 124 | 9.1 | 0.069 | 0.16 | <0.0050 | 0.0053 | 0.042 |
| | Nitrite (as N) | mg/L | 0.060 | - | 0.060 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Phosphorus (P)-Total dissolved | mg/L | - | - | - | 0.011 | 0.0056 | 0.0055 | 0.0023 | 0.0038 |
| | Phosphorus (P)-Total | mg/L | - | - | - | 0.0089 | 0.0053 | 0.0063 | 0.0037 | 0.0050 |
| | Sulfate (SO ₄) | mg/L | - | - | - | 14 | 55 | 21 | 16 | 20 |
| Other | Total Cyanide | mg/L | - | - | - | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| | Dissolved Organic Carbon | mg/L | - | - | - | 10 | 5.8 | 14 | 7.6 | 9.0 |
| | Total Inorganic Carbon | mg/L | - | - | - | 16 | 54 | 22 | 22 | 38 |
| | Total Organic Carbon | mg/L | - | - | - | 12 | 5.5 | 14 | 7.5 | 9.0 |
| Total Metals | Total Aluminum (Al) | mg/L | 0.10 ^c | - | - | 0.022 | 0.0055 | 0.038 | 0.038 | 0.018 |
| | Total Antimony (Sb) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | 0.00014 | <0.00010 |
| | Total Arsenic (As) | mg/L | 0.0050 | - | - | 0.00042 | 0.00025 | 0.00045 | 0.00081 | 0.00048 |
| | Total Barium (Ba) | mg/L | - | - | - | 0.032 | 0.068 | 0.041 | 0.066 | 0.060 |
| | Total Beryllium (Be) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Total Bismuth (Bi) | mg/L | - | - | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Total Boron (B) | mg/L | 1.5 | 29 | - | <0.010 | 0.025 | <0.010 | <0.010 | <0.010 |
| | Total Cadmium (Cd) | mg/L | 0.00016 ^d | 0.0022 ^d | - | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000078 | <0.0000050 |
| | Total Calcium (Ca) | mg/L | - | - | - | 24 | 59 | 24 | 26 | 45 |
| | Total Chromium (Cr) | mg/L | 0.0010 Cr(VI) | - | - | 0.00034 | <0.00010 | 0.00052 | 0.00030 | 0.00024 |
| | Total Cobalt (Co) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Total Copper (Cu) | mg/L | 0.0024 ^d | - | - | 0.0012 | 0.0025 | 0.0019 | 0.0019 | 0.0016 |
| | Total Iron (Fe) | mg/L | 0.30 | - | - | 0.26 | 0.025 | 0.13 | 0.079 | 0.067 |
| | Total Lead (Pb) | mg/L | 0.0033 ^d | - | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Total Lithium (Li) | mg/L | - | - | - | <0.0010 | 0.0032 | 0.0016 | 0.0012 | 0.0014 |
| | Total Magnesium (Mg) | mg/L | - | - | - | 6.6 | 29 | 13 | 10 | 16 |
| | Total Manganese (Mn) | mg/L | - | - | - | 0.021 | 0.047 | 0.0058 | 0.015 | 0.0034 |
| | Total Mercury (Hg) | mg/L | 0.000026 | - | - | <0.0000050 | <0.0000050 | <0.0000050 | <0.000025 | <0.0000050 |
| | Total Molybdenum (Mo) | mg/L | 0.073 | - | - | 0.0013 | 0.0048 | 0.00057 | 0.0013 | 0.0016 |
| | Total Nickel (Ni) | mg/L | 0.098 ^d | - | - | 0.00091 | 0.00092 | 0.0017 | 0.0011 | 0.00097 |
| | Total Phosphorus (P) | mg/L | - | - | - | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Total Potassium (K) | mg/L | - | - | - | 0.59 | 2.4 | 0.76 | 0.87 | 1.5 |
| | Total Selenium (Se) | mg/L | 0.0010 | - | - | 0.00036 | 0.00031 | 0.00011 | 0.00072 | 0.00081 |
| | Total Silicon (Si) | mg/L | - | - | - | 6.4 | 6.3 | 5.2 | 5.9 | 6.2 |
| | Total Silver (Ag) | mg/L | 0.00025 | - | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Total Sodium (Na) | mg/L | - | - | - | 4.4 | 19 | 8.5 | 7.8 | 10 |
| | Total Strontium (Sr) | mg/L | - | - | - | 0.16 | 0.77 | 0.22 | 0.28 | 0.45 |
| | Total Thallium (Tl) | mg/L | 0.00080 | - | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Total Tin (Sn) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Total Titanium (Ti) | mg/L | - | - | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Total Uranium (U) | mg/L | 0.015 | 0.033 | - | 0.00054 | 0.0026 | 0.00081 | 0.0028 | 0.0017 | |
| Total Vanadium (V) | mg/L | - | - | - | 0.00056 | <0.00050 | 0.00091 | 0.00081 | 0.00060 | |
| Total Zinc (Zn) | mg/L | 0.030 | - | - | 0.0051 | <0.0030 | <0.0030 | <0.0030 | 0.0044 | |
| Dissolved Metals | Dissolved Aluminum (Al) | mg/L | - | - | 0.10 | 0.0056 | 0.0029 | 0.020 | 0.013 | 0.0050 |
| | Dissolved Antimony (Sb) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | 0.00012 | <0.00010 |
| | Dissolved Arsenic (As) | mg/L | - | - | 0.0050 | 0.00019 | 0.00024 | 0.00041 | 0.00067 | 0.00046 |
| | Dissolved Barium (Ba) | mg/L | - | - | - | 0.022 | 0.071 | 0.041 | 0.068 | 0.063 |
| | Dissolved Beryllium (Be) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Dissolved Bismuth (Bi) | mg/L | - | - | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Dissolved Boron (B) | mg/L | - | - | - | <0.010 | 0.021 | <0.010 | <0.010 | <0.010 |
| | Dissolved Cadmium (Cd) | mg/L | - | - | 0.00022 ^e | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Dissolved Calcium (Ca) | mg/L | - | - | - | 33 | 56 | 22 | 24 | 42 |
| | Dissolved Chromium (Cr) | mg/L | - | - | 0.0010 | 0.00015 | <0.00010 | 0.00041 | 0.00021 | 0.00019 |
| | Dissolved Cobalt (Co) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Dissolved Copper (Cu) | mg/L | - | - | 0.020/0.013 ^f | 0.00032 | 0.0025 | 0.0033 | 0.0017 | 0.0015 |
| | Dissolved Iron (Fe) | mg/L | - | - | 1.1 | 0.055 | 0.020 | 0.090 | 0.039 | 0.040 |
| | Dissolved Lead (Pb) | mg/L | - | - | 0.0040 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Dissolved Lithium (Li) | mg/L | - | - | - | <0.0010 | 0.0033 | 0.0019 | 0.0016 | 0.0017 |
| | Dissolved Magnesium (Mg) | mg/L | - | - | - | 9.2 | 29 | 13 | 10 | 17 |
| | Dissolved Manganese (Mn) | mg/L | - | - | - | 0.0060 | 0.047 | 0.0035 | 0.013 | 0.0022 |
| | Dissolved Mercury (Hg) | mg/L | - | - | - | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Dissolved Molybdenum (Mo) | mg/L | - | - | 0.073 | 0.0029 | 0.0041 | 0.00049 | 0.0011 | 0.0014 |
| | Dissolved Nickel (Ni) | mg/L | - | - | 0.11 | <0.00050 | 0.00081 | 0.0016 | 0.00090 | 0.00086 |
| | Dissolved Phosphorus (P) | mg/L | - | - | - | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Dissolved Potassium (K) | mg/L | - | - | - | 0.73 | 2.5 | 0.79 | 0.90 | 1.6 |
| | Dissolved Selenium (Se) | mg/L | - | - | 0.0020 | 0.00086 | 0.00032 | 0.00010 | <0.000050 | 0.00010 |
| | Dissolved Silicon (Si) | mg/L | - | - | - | 5.7 | 6.0 | 4.9 | 5.6 | 6.0 |
| | Dissolved Silver (Ag) | mg/L | - | - | 0.00010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Dissolved Sodium (Na) | mg/L | - | - | - | 6.5 | 19 | 8.6 | 7.8 | 11 |
| | Dissolved Strontium (Sr) | mg/L | - | - | - | 0.25 | 0.71 | 0.20 | 0.26 | 0.43 |
| | Dissolved Thallium (Tl) | mg/L | - | - | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Dissolved Tin (Sn) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Dissolved Titanium (Ti) | mg/L | - | - | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Dissolved Uranium (U) | mg/L | - | - | - | 0.0012 | 0.0023 | 0.00069 | 0.0025 | 0.0016 | |
| Dissolved Vanadium (V) | mg/L | - | - | - | 0.0011 | <0.00050 | 0.00086 | 0.00074 | 0.00057 | |
| Dissolved Zinc (Zn) | mg/L | - | - | 0.030 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0027 | |

Water use licence objectives not met.

Water quality guideline not met.

^a CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

^b Based on lowest guideline using highest temperature and pH

^c Based on lowest guideline using highest pH

^d Based on lowest guideline using lowest hardness

^e Dissolved Cadmium (µg/L) guidelines based on the following formula using the lowest hardness: $e(0.736(\ln(\text{Hardness})-4.943))$

^f Dissolved Copper water quality objective depends on concentration of dissolved organic carbon (DOC). If DOC is > 10 mg/L/ DOC is ≤ 10 mg/L.

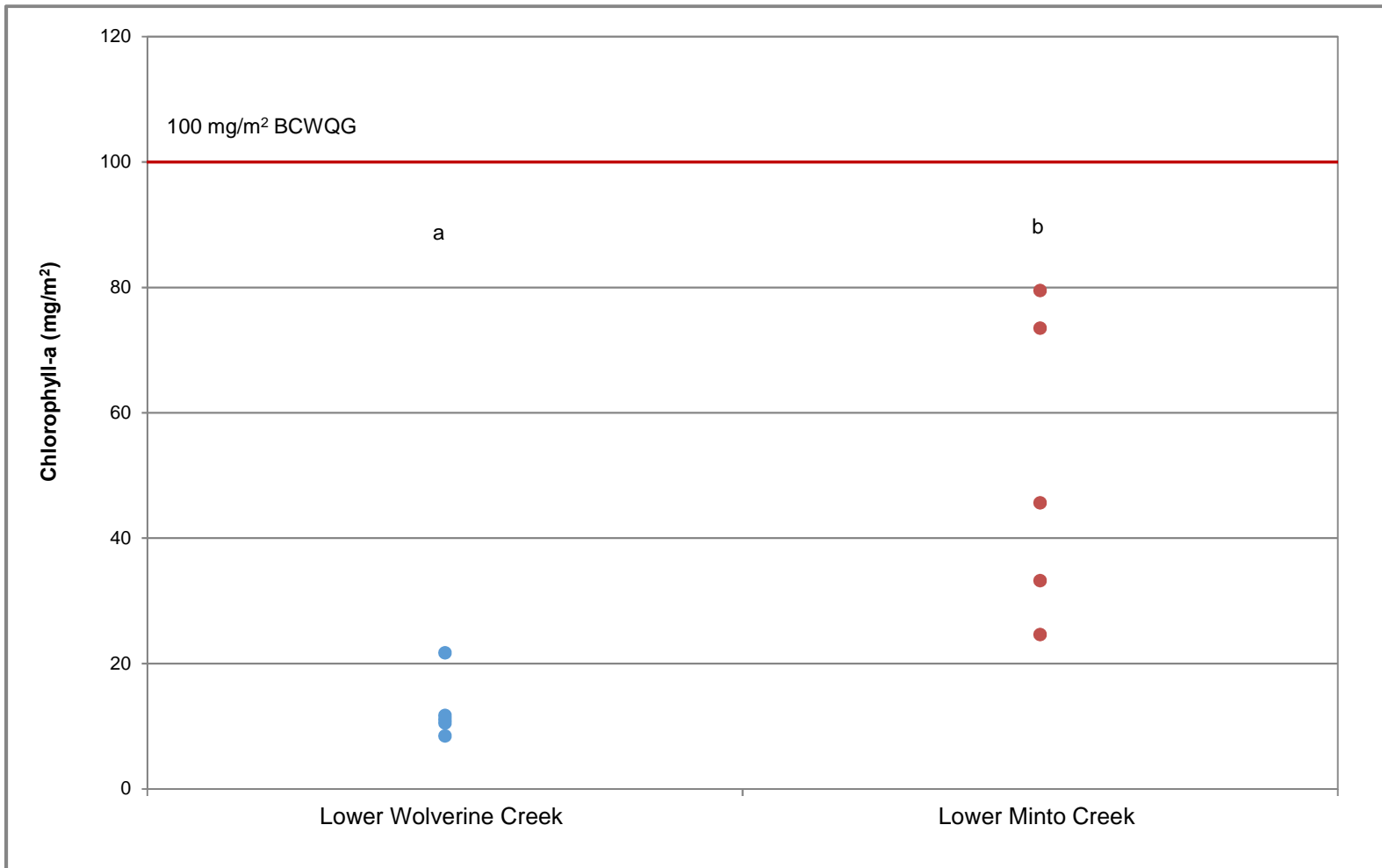


Figure 3.3: Concentrations of Chlorophyll-a in Periphyton Measured at Five Benthic Stations in Lower Wolverine and Lower Minto Creeks, Minto Mine WUL, 2017

Note: Different letters represent significant differences between areas.

Chlorophyll-a concentrations have been variable over time and between areas but concentrations are often higher (not always significantly different) and below BCWQG at lower Minto Creek (Appendix Figure B.1). Dodd's et al (1998) classification system sets the trophic status of lower Minto Creek (51 mg/m²) as mesotrophic and lower Wolverine Creek (13 mg/m²) as oligotrophic. Based on only total phosphorus, both creeks would be defined as oligotrophic as was observed in previous years (Dodds et al. 1998).

3.3 Summary

Supporting measures collected in September 2017 indicated good Minto Creek water quality. Influence of the Minto Mine was evident in higher specific conductance than in reference creeks, however, water quality parameter concentrations were lower than WUL water quality objectives. Concentration of total copper at upper Minto Creek was higher than CWQG and the reference area but dissolved copper was much lower than the WUL water quality objectives. Moving downstream, total copper concentrations were lower than CWQG at lower Minto Creek indicating natural elevation in upper Minto Creek. Mean concentrations of chlorophyll-a was significantly higher at lower Minto Creek compared to lower Wolverine Creek but were below BCWQG. Compared to 2016, production at the exposure and reference areas were different than in 2017; Minto Creek was defined as mesotrophic and lower Wolverine was oligotrophic.



4 SEDIMENT QUALITY

4.1 Sediment Particle Size and Chemistry

Sediment data quality were assessed prior to data analysis and interpretation, and were judged to be of good quality (Appendix A). Sediments collected in 2017 were largely composed of fine particles in the silt and sand size categories (Figure 4.1, Table 4.1, Appendix Table C.1). Mean total organic carbon (TOC) content of sediment collected from upper Minto Creek (2.8%) was slightly higher than at the upper McGinty Creek reference area (2.6%; Table 4.1). Lower Minto Creek (5.2%) had lower TOC than the lower Wolverine Creek reference area (6.5%; Table 4.1). Arsenic and copper were the only analytes with mean concentrations greater than Interim Sediment Quality Guidelines (ISQG) for the protection of aquatic life (CCME 1999) in an effluent-exposed area (Table 4.1, Appendix Table C.1). However, mean arsenic concentration in upper Minto Creek was below ISQG and lower than the reference area, upper McGinty Creek (which was greater than ISQG). This suggests that arsenic concentrations were unrelated to the mine. Mean copper concentrations in upper and lower Minto Creek were greater than the ISQG, and maximum copper concentration at upper Minto Creek was above the Probable Effect Level (PEL). Both areas had higher concentrations than the corresponding reference areas, which were lower than the ISQG (Figure 4.2, Table 4.1). With progression from upper to lower Minto Creek, sediment copper concentrations decreased from a mean of 155 to 49 mg/kg, respectively, indicating improvement with distance downstream.

Due to the predominantly erosional habitat in upper Minto Creek, relatively few areas had deposited sediment and even this only occurred in small quantities that likely wash away each year during freshet. Therefore, elevated copper in fine sediment in the upper reaches of Minto Creek may be of limited importance in terms of exposure and potential effects to biota. In lower Minto Creek, fine sediment deposits were somewhat more common and therefore more relevant to aquatic life.

4.2 Temporal Comparisons

Particle size distribution in 2017 was similar to distribution observed from 2010 to 2016 but was notably different from data collected prior to 2010, which employed different sampling methodology (Figure 4.1). Mean copper concentration at upper Minto Creek in 2017 was greater than the ISQG as was the case in all previous years, including the 1994 baseline (Figure 4.2). At lower Minto Creek, mean copper concentration in 2017 was greater than ISQG as was the case during most years, and was greater than 1994 baseline (Figure 4.2, Table 4.1, Appendix Table C.1). This does not necessarily indicate an influence of the Minto Mine as concentrations were within the historical range and sampling methodology applied in 1994 was



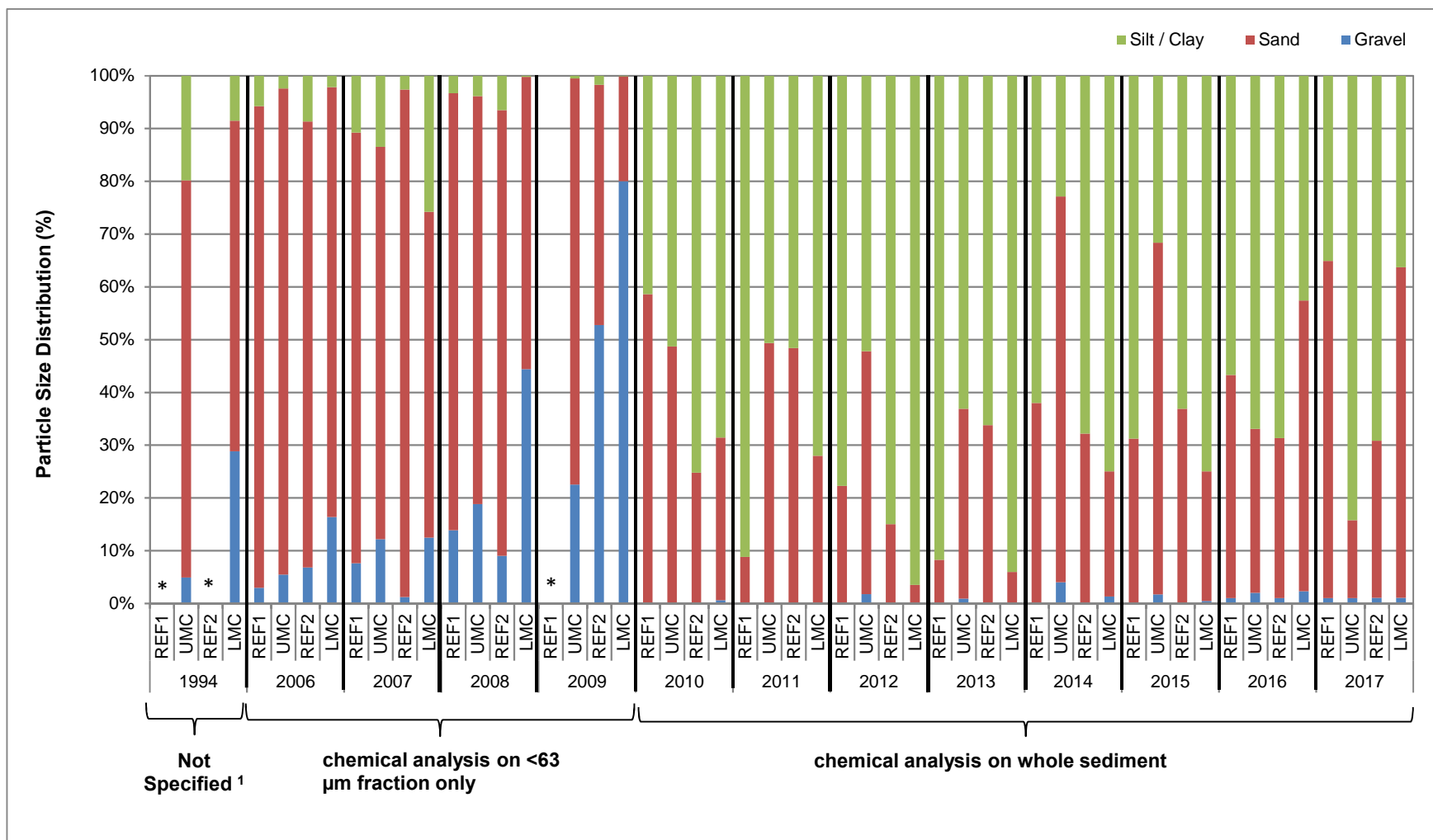


Figure 4.1: Particle Size Distribution of Sediment Collected in Minto Creek and Reference Locations, 1994 to 2017 ²




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

² REF1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2017; UMC = Upper Minto Creek; REF2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2017; LMC = Lower Minto Creek.

* No data.

Table 4.1: Summary of Sediment Chemistry Data Collected at Exposed and Reference Areas, Minto Mine WUL, 2017

| Analytes | Units | CSQG ^a | | Upper McGinty Creek (Reference) | | | | Upper Minto Creek (Exposed) | | | | Lower Wolverine Creek (Reference) | | | | Lower Minto Creek (Exposed) | | | | |
|--|--|-------------------|------|---------------------------------|--------------------|---------|---------|-----------------------------|--------------------|---------|---------|-----------------------------------|--------------------|---------|---------|-----------------------------|--------------------|---------|---------|--------|
| | | ISQG | PEL | Mean | Standard Deviation | Minimum | Maximum | Mean | Standard Deviation | Minimum | Maximum | Mean | Standard Deviation | Minimum | Maximum | Mean | Standard Deviation | Minimum | Maximum | |
| Particle size, TKN, carbon analytes and pH | Loss on Ignition | % | - | - | 5.8 | 2.5 | 4.0 | 10 | 5.6 | 2.6 | 2.0 | 9.0 | 14 | 2.8 | 10 | 17 | 10 | 2.3 | 8.0 | 14 |
| | pH (1:2 soil:water) | pH units | - | - | 7.09 | 0.45 | 6.63 | 7.69 | 7.88 | 0.26 | 7.46 | 8.16 | 6.92 | 0.19 | 6.69 | 7.18 | 7.86 | 0.12 | 7.70 | 8.02 |
| | % Gravel (>2mm) | % | - | - | - | - | - | - | - | - | - | - | <1.0 | - | <1.0 | <1.0 | 1.0 | - | <1.0 | 1.2 |
| | % Sand (2.0mm - 0.063mm) | % | - | - | - | - | - | - | - | - | - | - | 30 | 18 | 11 | 57 | 15 | 12 | 3.3 | 33 |
| | % Silt (0.063mm - 4µm) | % | - | - | - | - | - | - | - | - | - | - | 65 | 17 | 40 | 84 | 75 | 13 | 55 | 87 |
| | % Clay (<4µm) | % | - | - | - | - | - | - | - | - | - | - | 5.1 | 1.0 | 3.4 | 6.0 | 10 | 0.85 | 9.1 | 11 |
| | Total Kjeldahl Nitrogen | % | - | - | 0.13 | 0.042 | 0.096 | 0.20 | 0.13 | 0.058 | 0.049 | 0.19 | 0.31 | 0.073 | 0.21 | 0.39 | 0.26 | 0.044 | 0.22 | 0.33 |
| | Inorganic Carbon | % | - | - | 0.081 | 0.019 | 0.055 | 0.11 | 0.12 | 0.041 | 0.064 | 0.16 | 0.14 | 0.024 | 0.11 | 0.16 | 0.16 | 0.021 | 0.14 | 0.19 |
| | Inorganic Carbon (as CaCO ₃ Equivalent) | % | - | - | 0.68 | 0.16 | 0.46 | 0.91 | 1.0 | 0.34 | 0.54 | 1.3 | 1.1 | 0.20 | 0.93 | 1.4 | 1.4 | 0.17 | 1.2 | 1.6 |
| | Total Carbon by Combustion | % | - | - | 2.7 | 0.99 | 1.8 | 4.4 | 2.9 | 1.5 | 0.99 | 4.6 | 6.7 | 1.7 | 5.1 | 9.4 | 5.4 | 1.5 | 4.0 | 7.6 |
| | Total Organic Carbon | % | - | - | 2.6 | 0.97 | 1.8 | 4.3 | 2.8 | 1.5 | 0.93 | 4.4 | 6.5 | 1.7 | 5.0 | 9.2 | 5.2 | 1.5 | 3.9 | 7.4 |
| Total Metals | Aluminum (Al) | mg/kg | - | - | 8,100 | 1,733 | 6,050 | 10,700 | 10,658 | 1,133 | 9,060 | 11,800 | 15,540 | 1,989 | 13,000 | 18,500 | 13,820 | 1,152 | 12,300 | 15,200 |
| | Antimony (Sb) | mg/kg | - | - | 0.30 | 0.052 | 0.26 | 0.39 | 0.49 | 0.13 | 0.38 | 0.71 | 0.49 | 0.031 | 0.46 | 0.54 | 0.52 | 0.056 | 0.45 | 0.58 |
| | Arsenic (As) | mg/kg | 5.9 | 17 | 6.5 | 1.6 | 4.1 | 8.1 | 5.8 | 0.32 | 5.5 | 6.3 | 5.6 | 0.98 | 4.3 | 6.7 | 7.3 | 0.67 | 6.6 | 8.2 |
| | Barium (Ba) | mg/kg | - | - | 141 | 46 | 87 | 213 | 202 | 70 | 127 | 281 | 202 | 12 | 187 | 220 | 236 | 20 | 214 | 257 |
| | Beryllium (Be) | mg/kg | - | - | 0.26 | 0.049 | 0.21 | 0.34 | 0.41 | 0.037 | 0.36 | 0.45 | 0.80 | 0.031 | 0.77 | 0.85 | 0.48 | 0.049 | 0.41 | 0.53 |
| | Bismuth (Bi) | mg/kg | - | - | <0.20 | - | <0.20 | <0.20 | <0.20 | - | <0.20 | <0.20 | <0.20 | - | <0.20 | <0.20 | <0.20 | - | <0.20 | <0.20 |
| | Boron (B) | mg/kg | - | - | <5.0 | - | <5.0 | <5.0 | <5.0 | - | <5.0 | <5.0 | <5.0 | - | <5.0 | <5.0 | <5.0 | - | <5.0 | <5.0 |
| | Cadmium (Cd) | mg/kg | 0.60 | 3.5 | 0.11 | 0.056 | 0.076 | 0.21 | 0.20 | 0.086 | 0.10 | 0.30 | 0.26 | 0.036 | 0.23 | 0.31 | 0.22 | 0.036 | 0.17 | 0.25 |
| | Calcium (Ca) | mg/kg | - | - | 6,150 | 1,938 | 4,850 | 9,560 | 7,754 | 1,393 | 5,770 | 9,120 | 10,776 | 908 | 9,580 | 11,700 | 10,830 | 1,372 | 8,650 | 12,100 |
| | Chromium (Cr) | mg/kg | 37 | 90 | 16 | 3.2 | 12 | 21 | 26 | 1.9 | 25 | 29 | 48 | 4.7 | 42 | 55 | 32 | 2.2 | 29 | 34 |
| | Cobalt (Co) | mg/kg | - | - | 7.2 | 1.9 | 5.8 | 10 | 10 | 1.1 | 9.2 | 12 | 13 | 0.33 | 13 | 13 | 11 | 0.53 | 10 | 12 |
| | Copper (Cu) | mg/kg | 36 | 197 | 14 | 3.6 | 11 | 20 | 155 | 96 | 46 | 274 | 30 | 4.3 | 28 | 38 | 49 | 5.5 | 44 | 57 |
| | Iron (Fe) | mg/kg | - | - | 19,820 | 3,175 | 15,400 | 23,800 | 23,080 | 1,361 | 21,700 | 25,200 | 27,000 | 587 | 26,200 | 27,700 | 25,140 | 1,563 | 23,800 | 27,700 |
| | Lead (Pb) | mg/kg | 35 | 91 | 3.4 | 0.61 | 2.8 | 4.5 | 5.6 | 0.56 | 4.9 | 6.3 | 6.5 | 0.47 | 6.0 | 7.3 | 6.0 | 0.47 | 5.5 | 6.6 |
| | Lithium (Li) | mg/kg | - | - | 5.3 | 0.77 | 4.4 | 6.5 | 7.7 | 1.0 | 6.6 | 8.6 | 11 | 1.5 | 9.4 | 14 | 11 | 0.96 | 9.2 | 12 |
| | Magnesium (Mg) | mg/kg | - | - | 3,384 | 515 | 2,760 | 4,190 | 6,356 | 521 | 5,660 | 6,880 | 9,674 | 825 | 8,760 | 11,000 | 7,118 | 413 | 6,600 | 7,610 |
| | Manganese (Mn) | mg/kg | - | - | 519 | 312 | 245 | 1,050 | 2,085 | 1,506 | 491 | 3,690 | 410 | 174 | 204 | 549 | 975 | 140 | 813 | 1,120 |
| | Mercury (Hg) | mg/kg | 0.17 | 0.49 | 0.039 | 0.020 | 0.017 | 0.060 | 0.022 | 0.0064 | 0.012 | 0.028 | 0.044 | 0.0026 | 0.041 | 0.047 | 0.035 | 0.0058 | 0.028 | 0.041 |
| | Molybdenum (Mo) | mg/kg | - | - | 0.44 | 0.12 | 0.32 | 0.65 | 1.5 | 0.73 | 0.76 | 2.4 | 0.59 | 0.058 | 0.54 | 0.68 | 0.68 | 0.071 | 0.59 | 0.76 |
| | Nickel (Ni) | mg/kg | - | - | 13 | 2.0 | 11 | 16 | 26 | 2.3 | 24 | 29 | 38 | 2.5 | 35 | 42 | 28 | 1.3 | 28 | 30 |
| | Phosphorus (P) | mg/kg | - | - | 771 | 79 | 687 | 882 | 892 | 30 | 861 | 933 | 1,050 | 36 | 988 | 1,080 | 870 | 43 | 832 | 937 |
| | Potassium (K) | mg/kg | - | - | 548 | 97 | 440 | 690 | 1,298 | 147 | 1,140 | 1,510 | 1,134 | 110 | 1,020 | 1,300 | 1,196 | 86 | 1,100 | 1,330 |
| | Selenium (Se) | mg/kg | - | - | 0.35 | 0.078 | 0.24 | 0.45 | 0.51 | 0.24 | <0.20 | 0.78 | 0.39 | 0.044 | 0.34 | 0.44 | 0.57 | 0.11 | 0.44 | 0.70 |
| | Silver (Ag) | mg/kg | - | - | <0.10 | - | <0.10 | <0.10 | 0.13 | 0.063 | <0.10 | 0.24 | 0.10 | 0.0057 | <0.10 | 0.11 | 0.10 | 0.0057 | <0.10 | 0.11 |
| | Sodium (Na) | mg/kg | - | - | 173 | 20 | 147 | 198 | 326 | 18 | 308 | 350 | 458 | 33 | 417 | 500 | 317 | 22 | 281 | 335 |
| | Strontium (Sr) | mg/kg | - | - | 50 | 10 | 39 | 66 | 91 | 22 | 62 | 116 | 103 | 10 | 91 | 114 | 108 | 16 | 83 | 125 |
| | Thallium (Tl) | mg/kg | - | - | 0.053 | - | <0.05 | 0.063 | 0.082 | 0.010 | 0.071 | 0.10 | 0.093 | 0.012 | 0.080 | 0.11 | 0.10 | 0.010 | 0.087 | 0.11 |
| | Tin (Sn) | mg/kg | - | - | <2.0 | - | <2.0 | <2.0 | <2.0 | - | <2.0 | <2.0 | <2.0 | - | <2.0 | <2.0 | <2.0 | - | <2.0 | <2.0 |
| | Titanium (Ti) | mg/kg | - | - | 525 | 112 | 355 | 645 | 622 | 47 | 573 | 683 | 762 | 187 | 436 | 916 | 747 | 84 | 648 | 867 |
| | Uranium (U) | mg/kg | - | - | 0.87 | 0.33 | 0.56 | 1.4 | 0.89 | 0.25 | 0.54 | 1.2 | 3.2 | 0.44 | 2.7 | 3.8 | 1.2 | 0.25 | 0.94 | 1.5 |
| | Vanadium (V) | mg/kg | - | - | 37 | 6.3 | 31 | 48 | 52 | 4.0 | 50 | 59 | 70 | 2.1 | 67 | 73 | 54 | 3.6 | 51 | 60 |
| | Zinc (Zn) | mg/kg | 123 | 315 | 34 | 6.4 | 27 | 44 | 59 | 9.5 | 48 | 68 | 63 | 6.8 | 55 | 74 | 60 | 5.2 | 55 | 68 |

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

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

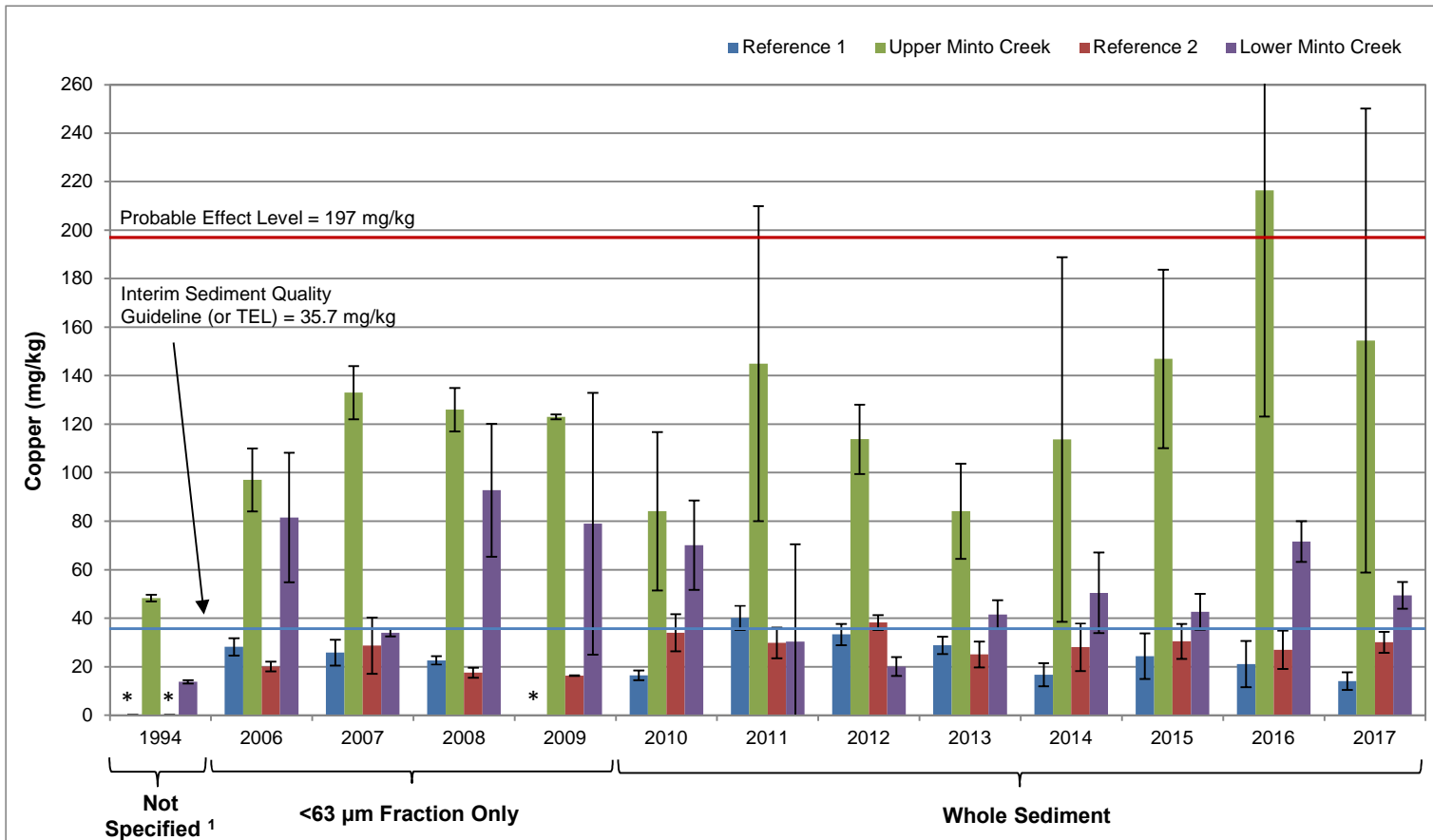


Figure 4.2: Copper Concentrations (Mean ± Standard Deviation) in Sediment Collected in Minto Creek and Reference Locations, 1994 to 2017²

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

² Reference 1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2017; Reference 2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2017.

* = no data.

TEL = Threshold Effect Level.

unspecified.

4.3 Sediment Toxicity

Sediment toxicity test conditions and associated supporting water quality parameters were all within the range outlined in the test protocols, and testing was judged to be acceptable (Appendix A). Survival and growth were evaluated using the 10-day test of *C. dilutus* (midge) and the 14-day test of *H. azteca* (amphipod).

No effects to *H. azteca* survival or growth were observed (Table 4.2). Survival of *C. dilutus* was significantly lower in sediment collected from lower Minto Creek than in laboratory control sediment (sand) and field reference sediment (lower Wolverine Creek) (Table 4.2). Growth of *C. dilutus* was significantly greater in lower Minto Creek sediment compared to the reference sediment. In 2016, growth of *C. dilutus* was greater at lower Minto Creek but not significantly so. *H. azteca* results (no effects in 2017) were similar to those of 2011, 2015, and 2016 (Minnow 2012, 2016, 2017). Differences from previous years observed at lower Minto Creek in *C. dilutus* survival and growth suggest a possible adverse effect, but are not consistent with the results of previous years despite similar sediment chemistry.

4.4 Summary

Overall, concentrations of metals in Minto Creek sediments were similar to reference and lower than sediment quality guidelines with the exception of copper. Concentrations of copper in Minto Creek (both upper and lower) were greater than the sediment quality guideline and reference. Copper concentrations in sediment were similar to results seen after the methodology change and lower than concentrations in 2008. Sediment toxicity testing of *C. dilutus* suggested adverse effects to survival or growth in lower Minto Creek sediment when compared to the laboratory control (no significant difference for growth) and the field reference (lower Wolverine Creek). No effects to *H. azteca* were observed.



Table 4.2: Minto Mine Effluent Sediment Toxicity Test Results Collected for Lower Wolverine and Lower Minto Creeks, September 2017

| Area | <i>Hyalella azteca</i> | | <i>Chironomus dilutus</i> | |
|-----------------------------------|------------------------|-----------------|---------------------------|-----------------|
| | Survival (%) | Dry Weight (mg) | Survival (%) | Dry Weight (mg) |
| Control Sediment | 96 ± 5.5 | 0.11 ± 0.020 | 86 ± 8.9 | 1.2 ± 0.25 |
| Lower Wolverine Creek (Reference) | 94 ± 5.5 | 0.13 ± 0.030 | 90 ± 17 | 2.0 ± 0.24 |
| Lower Minto Creek (Exposed) | 92 ± 13 | 0.11 ± 0.020 | 48 ± 38 | 1.6 ± 0.32 |

- Significantly different than control sediment.
- Significantly different than reference sediment.
- Significantly different than reference and control sediment.

Note: Data presented as mean ± standard deviation.

5 PERIPHYTON COMMUNITY

5.1 Primary Metrics and Community Composition

Quality of periphyton community data was assessed prior to data analysis and interpretation, and close agreement was shown between field duplicate samples except for Rhodophyta, due to low abundance of this group (Appendix A). Analysis of periphyton community density (cells/cm²) indicated that four of the five periphyton community metrics (density, Simpson's Diversity, Simpson's Evenness and Bray-Curtis index) were significantly higher at lower Minto Creek than at lower Wolverine Creek (Table 5.1a, Appendix Table D.1, D.3). Only taxon richness was not significantly different between areas. This indicates that the lower Minto Creek benthic invertebrate community had higher density and a different community structure than the reference areas.

Analysis of periphyton community biomass (µg/cm²) indicated that one out of five metrics (Bray-Curtis index) was significantly higher at lower Minto Creek compared to lower Wolverine Creek, both areas had similar density, taxon richness, and Simpson's diversity and evenness (Table 5.1b, Appendix Table D.2, D.4).

Dominant phyla in lower Minto and Wolverine creeks were Bacillariophyceae and Cyanophyta (blue-green algae). Cyanophyta were dominant at lower Minto Creek (51% of community) and Bacillariophyceae (95% of the community; Figure 5.1) dominated lower Wolverine Creek. Little information is available regarding specific periphyton taxon group sensitivities and tolerances to mining activities to assist in interpretation (Deniseger et al. 1986, De Jonge et al. 2008).

5.2 Temporal Comparisons

Substantial temporal variability in periphyton community composition was evident among samples taken in Minto Creek and reference since 1994 (Figure 5.1). For example, at lower Minto Creek, Bacillariophyceae (diatoms) were dominant in 1994, 2013, 2014, and 2016, Rhodophyta (red algae) in 2012, and Cyanophyta (blue-green algae) in 2011, 2015, and 2017 (Figure 5.1). This lack of temporal consistency was also observed at lower Wolverine Creek, with Cyanophyta dominant in 2011 and 2013 and Bacillariophyceae in 2012 and 2014 to 2017 (Minnow 2013a, 2014, 2015, 2016, 2017).

5.3 Summary

Evaluation of periphyton community density (cells/cm²) and biomass (µg/cm²) indicated significant differences in a number of metrics in lower Minto Creek relative to the lower Wolverine Creek reference. In general, the periphyton community of lower Minto Creek and lower Wolverine Creek had different community structures. However, differences in periphyton community summary




Table 5.1: Statistical Contrasts of Periphyton Density (cells/cm²) and Biomass (µg/cm²) Community Metrics between Lower Wolverine Creek and Lower Minto Creek Areas, Minto Mine WUL, 2017


A) Density (cells/cm²)

| Endpoint | Data Transformation | Test | Test P-value | Mean or Median ^a | | Observed Effect Size (LMC - LWC)/SD |
|---------------------|---------------------|------|--------------|-----------------------------|--------|-------------------------------------|
| | | | | LMC | LWC | |
| Density | log | T | 0.046 | 83,619 | 51,274 | 1.6 |
| Taxon Richness | none | T | 0.178 | 14 | 12 | 0.99 |
| Simpson's Evenness | none | T | 0.001 | 0.36 | 0.25 | 3.3 |
| Simpson's Diversity | rank | MW | 0.009 | 0.82 | 0.67 | - |
| Bray-Curtis Index | square root | T | <0.001 | 0.84 | 0.12 | 11 |

B) Biomass (µg/cm²)

| Endpoint | Data Transformation | Test | Test P-value | Mean or Median ^a | | Observed Effect Size (LMC - LWC)/SD |
|---------------------|---------------------|------|--------------|-----------------------------|------|-------------------------------------|
| | | | | LMC | LWC | |
| Density | square root | T | 0.228 | 33 | 45 | -0.88 |
| Taxon Richness | none | T | 0.178 | 14 | 12 | 0.99 |
| Simpson's Evenness | none | T | 0.156 | 0.39 | 0.32 | 1.0 |
| Simpson's Diversity | rank | MW | 0.117 | 0.82 | 0.75 | - |
| Bray-Curtis Index | none | T | <0.001 | 0.76 | 0.35 | 3.6 |

 P-value < 0.10.

 Effect size magnitude > 2.

Notes: Observed effect size = (exposure mean - reference mean)/pooled standard deviation.

T = Two-sample t-test.

MW = Mann Whitney test.

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

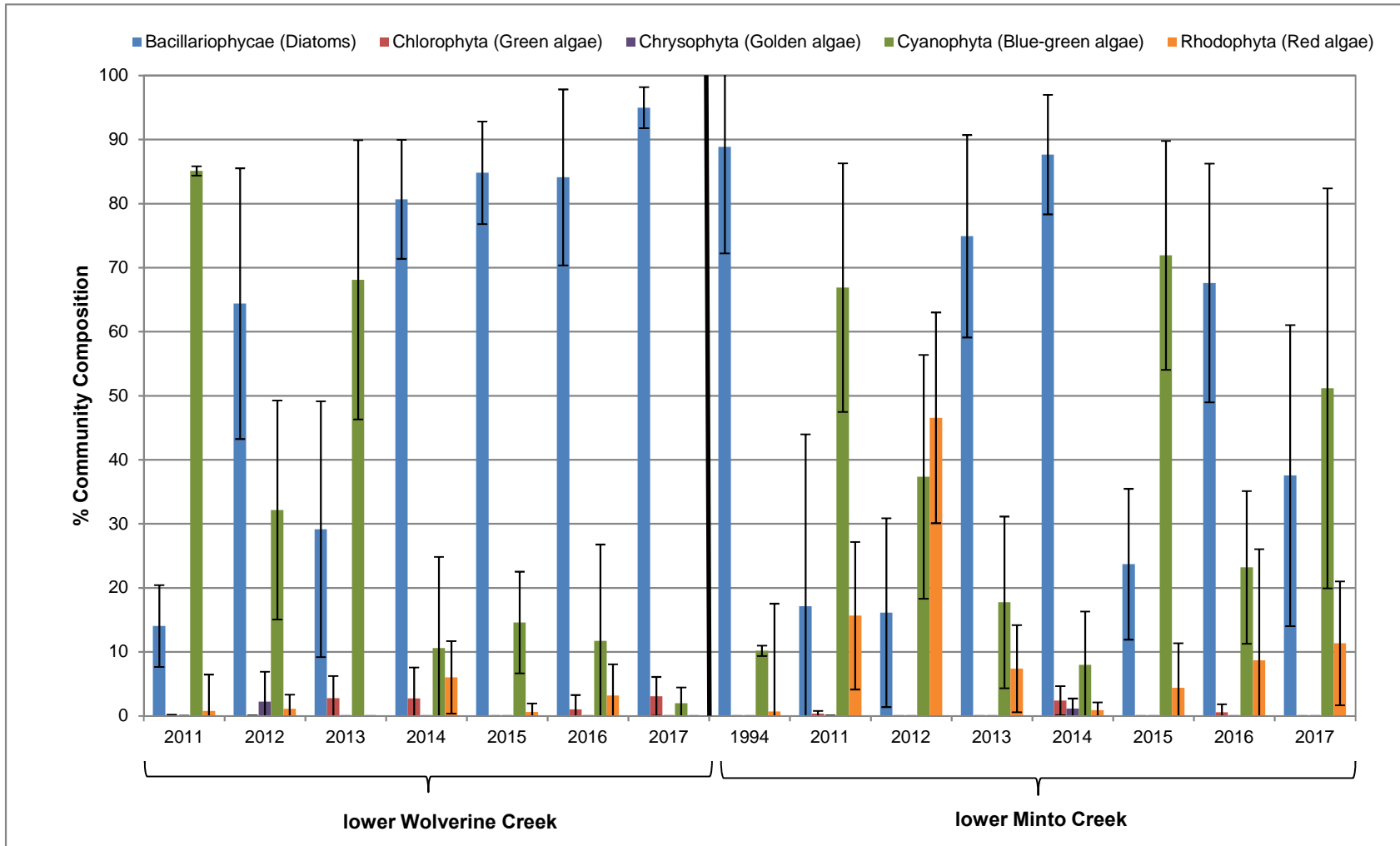


Figure 5.1: Periphyton Community (cells/cm²) Composition in Lower Minto Creek (1994, 2011 to 2017) and Lower Wolverine Creek (2011 to 2017)

Note: Data presented as mean ± standard deviation.

metrics and community composition were apparent among years at both lower Minto Creek and lower Wolverine Creek, indicating substantial temporal variability. The differences observed in the periphyton communities of lower Minto Creek and lower Wolverine Creek in 2017 were within natural temporal variability and do not provide any resolution of potential mine influence.



6 BENTHIC INVERTEBRATE COMMUNITY

6.1 Primary Metrics and Community Composition

Benthic invertebrate community data quality were assessed prior to data analysis and interpretation, and were judged to be of good quality (Appendix A). Benthic invertebrate community metrics of density, Simpson's diversity, and Simpson's evenness were not significantly different among areas (Table 6.1, Appendix Table E.3). Number of taxa and Bray-Curtis index showed significant differences among areas, but lower Minto Creek was intermediate between the reference areas (Table 6.1, Figure 6.1). This suggests a limited mine influence (Table 6.1, Appendix Table E.3).

Dominant taxonomic groups in lower Minto, lower Wolverine and lower Big creeks included EPT taxa, chironomids (non-biting midges) and oligochaetes (worms; only dominant at reference areas). Percent EPT did not differ significantly among areas, but there were differences in the abundances of chironomids and oligochaetes (Figure 6.2, Table 6.1, Appendix Table E.1 to E.3). The relative abundance of chironomids was significantly greater at lower Minto Creek (31%) compared to lower Wolverine Creek (4.7%; Figure 6.2, Table 6.1, Appendix Table E.1 to E.3). Oligochaetes were a small proportion of the community at lower Minto Creek (6.8%) compared to higher proportions at lower Wolverine (68%; significantly higher) and lower Big creeks (15%; not significantly higher). The higher proportion of chironomids suggests a potential mine influence, but in combination with the lower proportion of oligochaetes together with similar percent EPT taxa between areas, suggests a limited influence of the mine on benthic invertebrate community (Chapman et al. 1982a,b, Rosenberg and Resh 1993, Taylor and Bailey 1997).

Correspondence Analysis (CA) explained 63.7 percent of the total community variance in the first two CA axes (Appendix Table E.5). The first CA axis explained 34.8 percent of the total variation in the original benthic abundance data, and significantly separated lower Minto Creek from lower Wolverine and lower Big creeks (Table 6.1, Figure 6.3). Lower Minto Creek had strong positive CA Axis-1 scores and were separated from lower Wolverine and lower Big creeks by high relative abundance of the Plecoptera (stonefly) *Nemoura*, chironomids *Eukiefferiella*, the mite *Sperchon*, and the crane fly *Antocha* (Figure 6.3, Appendix Table E.4, E.5). The reference areas had strong negative CA Axis-1 scores and was dominated by the Ephemeroptera (mayflies) Family Heptageiidae (Figure 6.3, Appendix Table E.4, E.5). The reference areas were separated on CA Axis-2 (which explained 28.9% of the total variation) and lower Minto Creek was significantly different and intermediate between both reference areas. (Table 6.1, Figure 6.3).



Table 6.1: Statistical Comparisons of Benthic Invertebrate Community Metrics, Minto Mine WUL, 2017

| Metric | Comparison | | Area Means | | Statistical Contrasts | | |
|---------------------------------------|-------------------|-----------------------|------------|------|---------------------------------------|-------------------|----------------------|
| | Exposure Site | Reference Site | | | Significant Difference between areas? | Direction | P-value ^a |
| Density (organisms/m ²) | lower Minto Creek | lower Wolverine Creek | 345 | 174 | NO | - | 0.208 |
| | | lower Big Creek | | 229 | NO | - | |
| Number of Taxa | lower Minto Creek | lower Wolverine Creek | 18 | 16 | NO | - | 0.813 |
| | | lower Big Creek | | 24 | NO | - | 0.213 |
| Simpson's Diversity ^b | lower Minto Creek | lower Wolverine Creek | 0.70 | 0.48 | NO | - | 0.105 |
| | | lower Big Creek | | 0.78 | NO | - | |
| Simpson's Evenness ^b | lower Minto Creek | lower Wolverine Creek | 0.22 | 0.18 | NO | - | 0.555 |
| | | lower Big Creek | | 0.20 | NO | - | |
| BC Index to Combined Reference Median | lower Minto Creek | lower Wolverine Creek | 0.79 | 0.82 | NO | - | 0.847 |
| | | lower Big Creek | | 0.67 | NO | - | 0.192 |
| EPT (%) ^c | lower Minto Creek | lower Wolverine Creek | 48 | 25 | NO | - | 0.161 |
| | | lower Big Creek | | 47 | NO | - | |
| Chironomids (%) | lower Minto Creek | lower Wolverine Creek | 31 | 4.7 | YES | Minto > Wolverine | 0.004 |
| | | lower Big Creek | | 27 | NO | - | 0.800 |
| Oligochaetes (%) | lower Minto Creek | lower Wolverine Creek | 6.8 | 65 | YES | Minto < Wolverine | 0.001 |
| | | lower Big Creek | | 15 | NO | - | 0.389 |
| CA Axis-1 (34.8%) | lower Minto Creek | lower Wolverine Creek | 224 | -212 | YES | Minto > Wolverine | 0.011 |
| | | lower Big Creek | | -214 | YES | Minto > Wolverine | 0.006 |
| CA Axis-2 (28.9%) | lower Minto Creek | lower Wolverine Creek | 10 | 190 | YES | Minto < Wolverine | 0.007 |
| | | lower Big Creek | | -169 | YES | Minto < Wolverine | 0.007 |

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

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

^b Calculated as recommended by Environment Canada 2012.

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

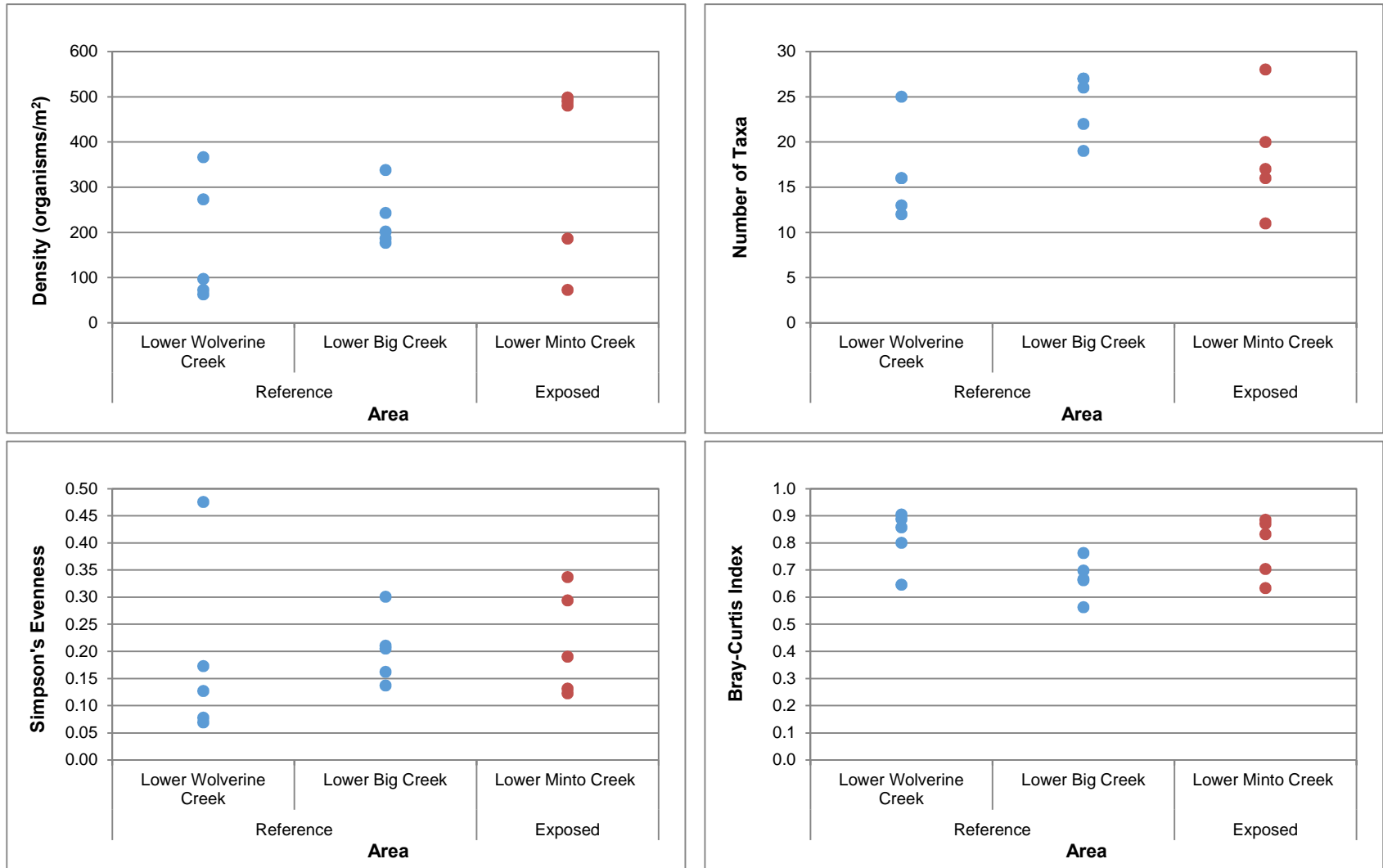


Figure 6.1: Comparison of Benthic Invertebrate Primary Metrics, Minto Mine, 2017

Notes: An Asterisk (*) above lower Minto Creek indicates exposed area was significantly different ($p < 0.10$) from both reference areas.

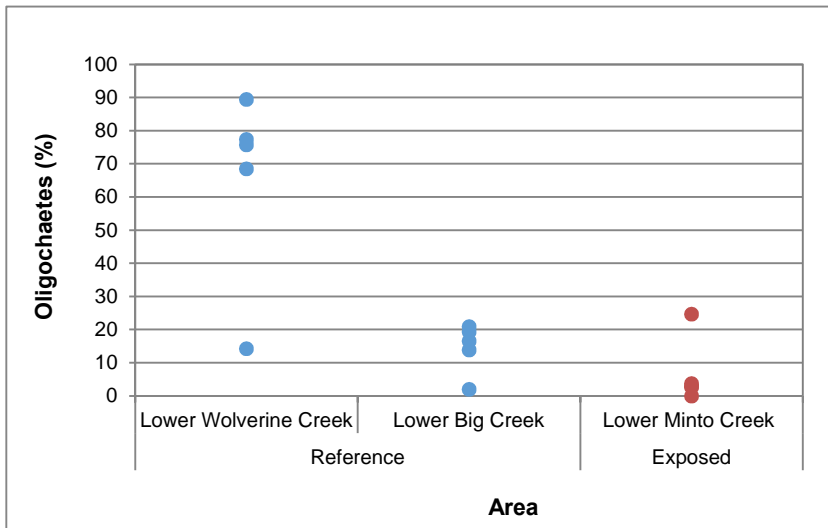
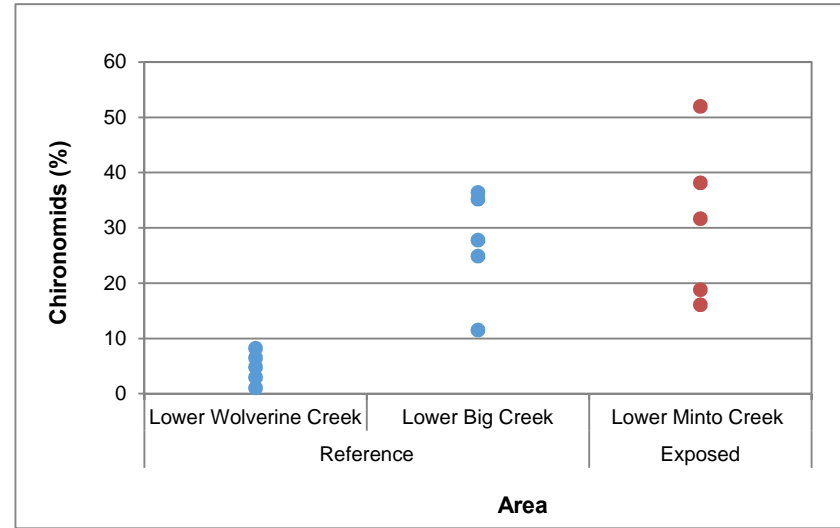
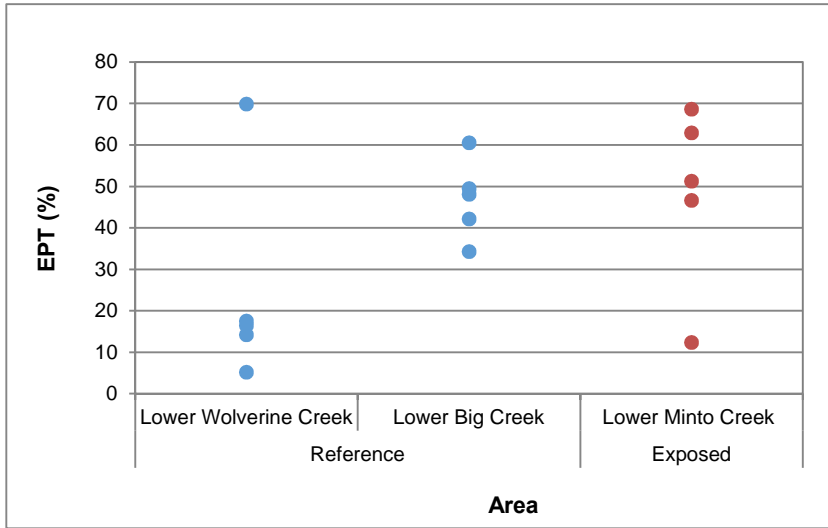


Figure 6.2: Comparison of Benthic Invertebrate Supporting Metrics, Minto Mine, 2017

Notes: An Asterisk (*) above lower Minto Creek indicates exposed area was significantly different ($p < 0.10$) from both reference areas.

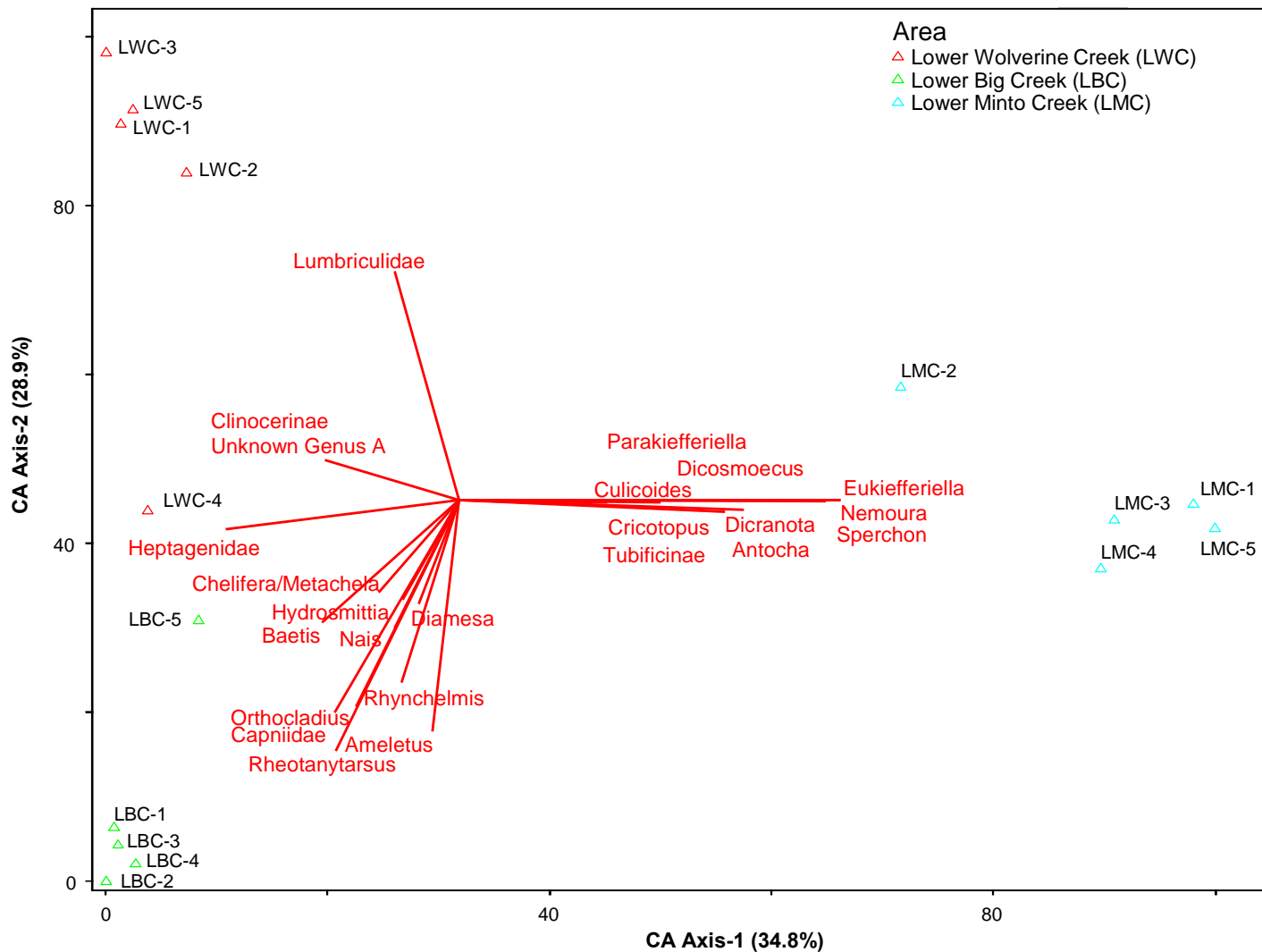


Figure 6.3: Correspondence Analysis (CA) Ordination Biplot Displaying CA Axis-1 and CA Axis-2 of Benthic Invertebrate Community Lower Minto Creek and Associated Reference Areas, Minto Mine, 2017

6.2 Correlation Analysis

Correlation analysis between eight benthic indices and six supporting measurements resulted in 16 significant correlations at a p-level of 0.050, of which four were significant at the Bonferroni-corrected p-level of 0.0010 (Table 6.2). It is important to consider that illustration of a significant or suggestive degree of correlation between two variables does not necessarily imply a cause-and-effect relationship, although it is cause to investigate further and to consider known biological responses to environmental differences.

Of the four correlations significant at the Bonferroni-corrected p-level, two were with specific conductance (Table 6.2, Figure 6.4). Percent Ephemeroptera was positively correlated and CA Axis-1 was negatively correlated with specific conductance (Table 6.2, Figure 6.4). CA Axis-1 scores were negatively correlated with depth and percent oligochaetes were negatively correlated with average depth Hess was pushed into the substrate (Table 6.2, Figure 6.4). High specific conductance is a mine influence but the CA Axis-1 score indicates a high proportion of the chironomid *Eukiefferiella*. Chironomid taxa are typically tolerant, but this taxon can be associated with very good to fair water quality in terms of organic pollution (Mandeville 2002).

6.3 Temporal Comparisons

Temporal comparisons of the benthic invertebrate community condition of lower Minto Creek were made in order to augment data interpretation, but their power was tempered by temporal changes in sampling location, sampling methodology, level of replication and analytical processing techniques. Baseline data (1994) were collected near the mouth of Minto Creek as three single grab samples, 2006 data were collected at Station W2 in the same manner, 2008 and 2010 data were collected at Station W2 as three-grab composites whereas 2011 to 2017 data were collected as five replicate three-grab samples from a large area upstream of Station W2. Only in the later years (2011 to 2017) do data represent an area (i.e., lower Minto Creek) rather than a station. In addition, data collected in 2013 to 2017 were sieved using 500 µm mesh as recommended for federal EEM (Environment Canada 2012), whereas all years prior to 2011 used 250 µm (both mesh sizes were used in 2012 to assist in transition). This was expected to result in lower densities in 2013 and later.

Benthic invertebrate density at lower Minto Creek in 2017 was lower than or similar to densities in 2012 (500 µm) and 2014 to 2016 but higher than in 2013 (Figure 6.5). Number of taxa at lower Minto Creek in 2017 was lower than in 1994 and within the historical range from 2006 onwards (Figure 6.5). Simpson's Evenness was within the historical range documented after methodological change in 2011 (Figure 6.5). Over the 2012 to 2017 period, benthic invertebrate community metrics were stable.



Table 6.2: Correlations between Benthic Invertebrate Metrics and Supporting Environmental Measurements at Minto Mine WUL, 2017

| | | Depth (m) | Water Velocity (m/s) | Temperature (°C) | Specific Conductivity (µS/cm) | pH | Average Depth HESS into substrate (cm) |
|--|---------------------|-----------|----------------------|------------------|-------------------------------|--------|--|
| Number of Taxa | Pearson Correlation | 0.019 | 0.45 | 0.38 | -0.22 | -0.065 | 0.28 |
| | Sig. (2-tailed) | 0.945 | 0.094 | 0.167 | 0.427 | 0.819 | 0.313 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 |
| BC Distance to Combined Reference Median | Pearson Correlation | 0.056 | -0.50 | -0.41 | 0.18 | -0.22 | -0.38 |
| | Sig. (2-tailed) | 0.843 | 0.056 | 0.129 | 0.515 | 0.437 | 0.160 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 |
| Ephemeroptera (%) | Pearson Correlation | 0.64 | 0.27 | 0.59 | -0.85 | -0.20 | -0.51 |
| | Sig. (2-tailed) | 0.011 | 0.324 | 0.021 | 0.000 | 0.467 | 0.053 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 |
| Trichoptera (%) | Pearson Correlation | -0.49 | -0.45 | -0.43 | 0.58 | 0.020 | 0.43 |
| | Sig. (2-tailed) | 0.063 | 0.094 | 0.106 | 0.024 | 0.944 | 0.112 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 |
| Chironomids (%) | Pearson Correlation | -0.50 | 0.46 | -0.057 | 0.50 | 0.50 | 0.61 |
| | Sig. (2-tailed) | 0.056 | 0.084 | 0.841 | 0.056 | 0.056 | 0.016 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 |
| Oligochaeta (%) | Pearson Correlation | 0.57 | -0.21 | 0.024 | -0.56 | -0.50 | -0.80 |
| | Sig. (2-tailed) | 0.026 | 0.448 | 0.933 | 0.029 | 0.060 | 0.000 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 |
| CA Axis-1 (34.8%) | Pearson Correlation | -0.80 | -0.36 | -0.69 | 0.95 | 0.30 | 0.59 |
| | Sig. (2-tailed) | 0.000 | 0.192 | 0.005 | 0.000 | 0.283 | 0.021 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 |
| CA Axis-2 (28.9%) | Pearson Correlation | 0.24 | -0.63 | -0.53 | 0.059 | -0.52 | -0.58 |
| | Sig. (2-tailed) | 0.396 | 0.011 | 0.040 | 0.835 | 0.044 | 0.024 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 |

Correlation scatterplot inspected: $p < 0.050$.

Significant after Bonferroni correction; $p < 0.0010$ ($p = 0.050$ adjusted for 48 comparisons).

Note: Correlations only conducted with endpoints that were significantly different between areas.

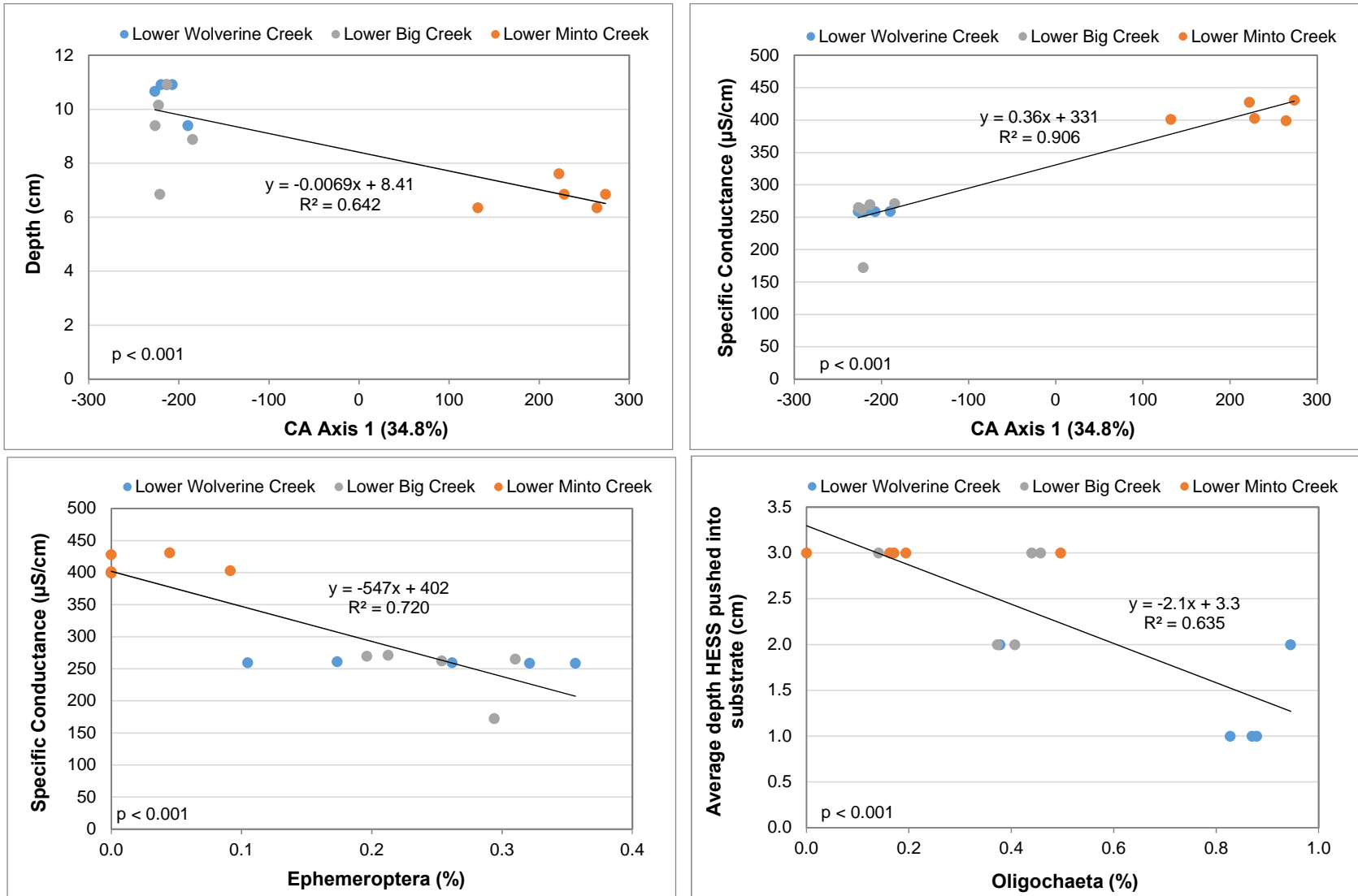


Figure 6.4: Scatterplots of Significant Relationships (Bonferroni Corrected; $p < 0.0010$), Minto Mine WUL, 2017

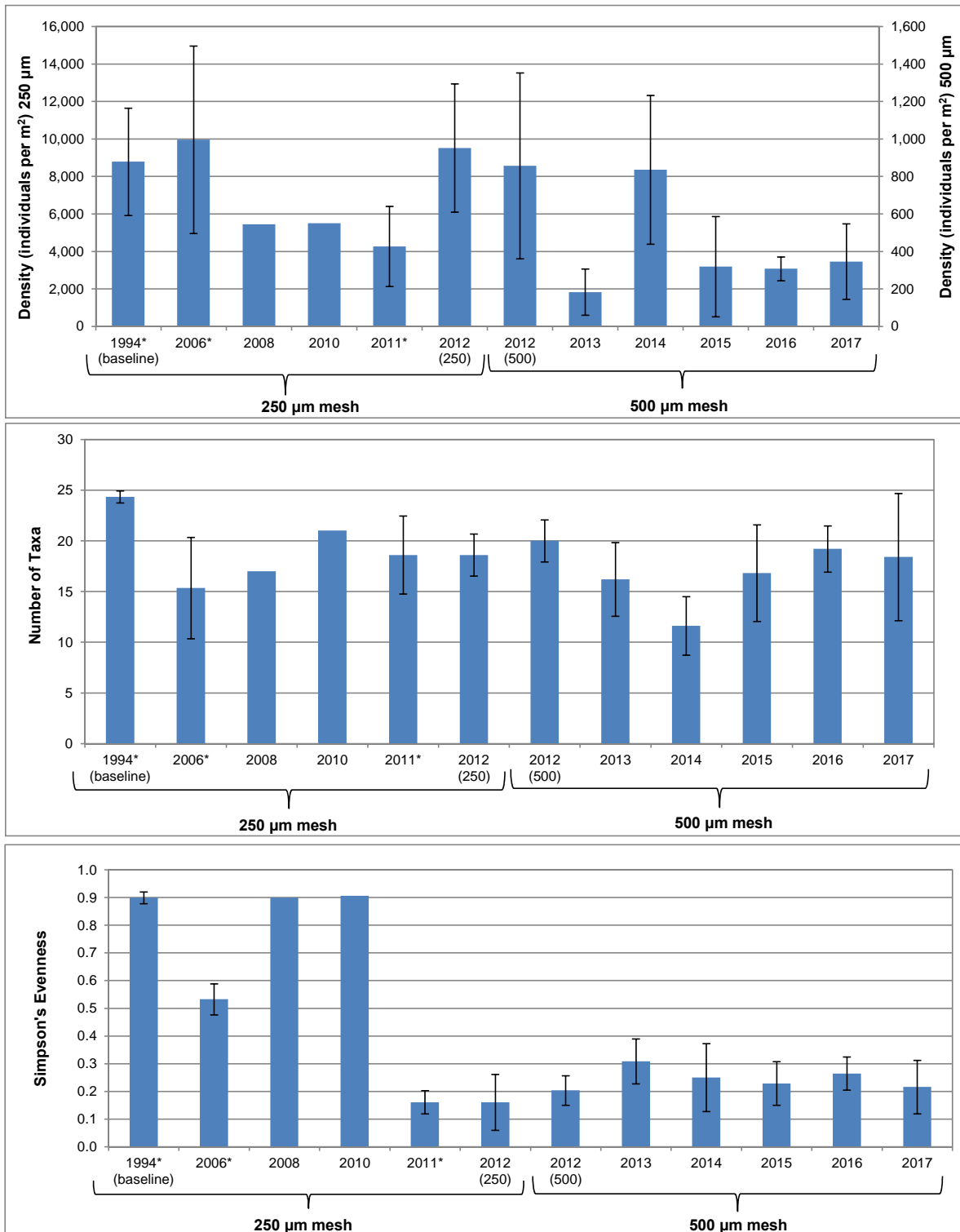


Figure 6.5: Primary Benthic Invertebrate Community Metrics at Lower Minto Creek, 1994 to 2017

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

6.4 Summary

The erosional benthic invertebrate community of lower Minto Creek did not differ from reference communities, or was intermediate between reference communities, for all metrics. A potential decrease in number of taxa from 2012 to 2014 identified in previous reporting (Minnow 2015) was not supported by the higher number of taxa in 2015 to 2017 and appears to represent natural variability (Minnow 2015, 2016, 2017). The similarity of the benthic community of lower Minto Creek to reference communities and the temporal stability in the benthic community of lower Minto Creek suggest limited mine influence.



7 TISSUE CHEMISTRY

As indicated in Section 2.5, tissue chemistry data are provided here simply to report the ancillary data collected along with the selenium data reported separately. Data interpretation were therefore limited to basic comparisons of metal concentrations in tissue collected at the exposure area (lower Minto Creek) to those collected at reference creeks (lower Wolverine and lower Big creeks).

7.1 Periphyton Tissue

Periphyton tissue data quality were assessed prior to data analysis and interpretation, and field duplicates showed poor agreement for seven analytes (Appendix A). However, none of these seven analytes differed between lower Minto Creek and both reference areas (Table 7.1, Appendix A).

Periphyton tissue concentrations were significantly greater at lower Minto Creek than at both reference areas for eight analytes (Table 7.1, Appendix Table C.2). Analytes of concern such as copper were significantly different from both reference areas whereas selenium was only significantly different from lower Minto Creek and lower Big Creek (Table 7.1). No significant differences were observed between areas for selenium in 2013 (Figure 7.1), whereas from 2014 to 2017, periphyton selenium concentrations were significantly greater at lower Minto Creek than at the reference areas (only between lower Big Creek in 2017; Figure 7.1). Significantly higher concentrations of selenium at lower Minto Creek compared to reference areas over the last three years suggest an influence of the mine on Minto Creek.

7.2 Benthic Invertebrate Tissue

Benthic invertebrate tissue data quality were assessed prior to data analysis and interpretation, and were judged to be of good quality, with the exception that field duplicate samples lacked close agreement for several analytes (Appendix A). Of the analytes that lacked close agreement, only eight analytes differed significantly at lower Minto Creek compared to both reference areas (Figure 7.1, Appendix A).

Benthic invertebrate tissue concentrations were significantly higher at lower Minto Creek compared to both reference areas for ten analytes, significantly lower for sodium, and intermediate between reference for two analytes (Table 7.1, Appendix Table C.3). Only selenium has been identified as strongly mine-related (Sections 3.0 and 4.0) and was significantly higher at lower Minto Creek than at lower Wolverine and lower Big creeks (Table 7.1, Appendix Table C.3). Concentration of copper at lower Minto Creek was also significantly higher than at lower Wolverine and lower Big creeks. Variability in concentrations of copper in benthic invertebrate



Table 7.1: Periphyton and Benthic Invertebrate Tissue Chemistry Results, Minto Mine WUL, September 2017

| Analyte | Units | Periphyton | | | | | | Benthic Invertebrates | | | | | |
|-------------------------------|-----------|-----------------------------------|--------------------|-----------------------------|--------------------|-----------------------------|--------------------|-----------------------------------|--------------------|-----------------------------|--------------------|-----------------------------|--------------------|
| | | Lower Wolverine Creek (Reference) | | Lower Big Creek (Reference) | | Lower Minto Creek (Exposed) | | Lower Wolverine Creek (Reference) | | Lower Big Creek (Reference) | | Lower Minto Creek (Exposed) | |
| | | n = 5 | | n = 5 | | n = 5 | | n = 5 | | n = 5 | | n = 5 | |
| | | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation |
| Aluminum (Al) | mg/kg dwt | 2,021 | 733 | 2,870 | 664 | 1,963 | 838 | 12,631 | 2,189 | 11,077 | 2,921 | 9,823 | 4,699 |
| Antimony (Sb) ^a | mg/kg dwt | 0.059 | 0.0056 | 0.12 | 0.031 | 0.087 | 0.010 | 0.039 | 0.0084 | 0.13 | 0.045 | 0.13 | 0.089 |
| Arsenic (As) | mg/kg dwt | 1.7 | 0.71 | 5.5 | 1.8 | 2.0 | 0.68 | 4.7 | 0.65 | 12 | 2.7 | 8.9 | 1.8 |
| Barium (Ba) ^b | mg/kg dwt | 58 | 22 | 78 | 20 | 135 | 30 | 166 | 29 | 208 | 31 | 537 | 245 |
| Beryllium (Be) ^b | mg/kg dwt | 0.16 | 0.064 | 0.16 | 0.037 | 0.089 | 0.034 | 0.62 | 0.11 | 0.48 | 0.10 | 0.38 | 0.13 |
| Bismuth (Bi) ^{a,c} | mg/kg dwt | 0.017 | 0.0048 | 0.17 | 0.030 | 0.023 | 0.0081 | 0.074 | 0.015 | 0.62 | 0.38 | 0.11 | 0.031 |
| Boron (B) ^{a,d} | mg/kg dwt | 1.2 | 0.18 | 1.4 | 0.29 | 6.4 | 3.9 | 3.1 | 0.92 | 3.5 | 1.2 | 17 | 13 |
| Cadmium (Cd) ^{b,e} | mg/kg dwt | 0.43 | 0.28 | 0.96 | 0.63 | 0.33 | 0.099 | 0.14 | 0.031 | 0.17 | 0.042 | 0.41 | 0.18 |
| Calcium (Ca) | mg/kg dwt | 2,195 | 585 | 3,277 | 795 | 2,673 | 348 | 7,634 | 1,080 | 7,329 | 1,528 | 11,392 | 2,303 |
| Cesium (Cs) | mg/kg dwt | 0.26 | 0.087 | 0.63 | 0.13 | 0.19 | 0.084 | 1.5 | 0.29 | 2.2 | 0.68 | 0.82 | 0.36 |
| Chromium (Cr) | mg/kg dwt | 12 | 5.5 | 11 | 3.6 | 10 | 4.9 | 38 | 4.7 | 27 | 5.2 | 23 | 9.7 |
| Cobalt (Co) | mg/kg dwt | 2.9 | 1.1 | 3.0 | 0.66 | 2.2 | 0.58 | 12 | 1.3 | 8.5 | 1.3 | 17 | 6.0 |
| Copper (Cu) | mg/kg dwt | 19 | 3.8 | 21 | 5.9 | 30 | 2.4 | 17 | 2.8 | 21 | 5.3 | 45 | 5.3 |
| Iron (Fe) | mg/kg dwt | 4,768 | 1,944 | 5,773 | 1,138 | 4,266 | 1,742 | 23,905 | 2,467 | 21,898 | 2,250 | 20,520 | 6,022 |
| Lead (Pb) | mg/kg dwt | 1.2 | 0.47 | 2.6 | 0.34 | 1.3 | 0.22 | 5.4 | 0.75 | 7.7 | 1.6 | 5.2 | 1.5 |
| Lithium (Li) ^a | mg/kg dwt | 1.9 | 0.82 | 3.0 | 0.84 | 1.8 | 0.84 | 11 | 2.0 | 8.7 | 1.8 | 8.4 | 3.7 |
| Magnesium (Mg) | mg/kg dwt | 2,268 | 826 | 2,479 | 541 | 1,917 | 291 | 8,644 | 1,076 | 6,186 | 1,241 | 5,631 | 1,592 |
| Manganese (Mn) ^f | mg/kg dwt | 330 | 141 | 433 | 136 | 580 | 142 | 686 | 150 | 698 | 225 | 8,671 | 6,089 |
| Mercury (Hg) ^{b,d} | mg/kg dwt | 0.026 | 0.014 | 0.035 | 0.014 | 0.022 | 0.0092 | 0.021 | 0.0054 | 0.028 | 0.013 | 0.032 | 0.019 |
| Molybdenum (Mo) ^f | mg/kg dwt | 0.74 | 0.18 | 0.61 | 0.13 | 0.94 | 0.25 | 0.53 | 0.39 | 0.71 | 0.14 | 1.1 | 0.47 |
| Nickel (Ni) | mg/kg dwt | 11 | 5.5 | 8.0 | 2.2 | 7.8 | 1.9 | 35 | 3.9 | 22 | 4.5 | 29 | 4.4 |
| Phosphorus (P) | mg/kg dwt | 5,340 | 1,419 | 4,550 | 1,587 | 6,552 | 684 | 1,218 | 86 | 1,188 | 177 | 1,545 | 457 |
| Potassium (K) | mg/kg dwt | 5,307 | 2,547 | 4,395 | 1,481 | 10,176 | 2,783 | 1,121 | 138 | 1,428 | 434 | 2,400 | 963 |
| Rubidium (Rb) ^e | mg/kg dwt | 4.1 | 0.82 | 5.5 | 2.4 | 3.5 | 0.17 | 12 | 2.1 | 11 | 3.3 | 10 | 3.6 |
| Selenium (Se) ^a | mg/kg dwt | 1.2 | 0.43 | 0.90 | 0.42 | 1.7 | 0.31 | 0.28 | 0.054 | 0.21 | 0.086 | 1.8 | 0.73 |
| Sodium (Na) ^a | mg/kg dwt | 1,798 | 453 | 1,644 | 736 | 2,286 | 163 | 386 | 41 | 395 | 78 | 255 | 7.1 |
| Strontium (Sr) ^g | mg/kg dwt | 23 | 6.5 | 33 | 11 | 29 | 4.9 | 70 | 13 | 64 | 16 | 125 | 24 |
| Tellurium (Te) ^{a,d} | mg/kg dwt | <0.014 | - | 0.011 | 0.00042 | <0.016 | - | 0.017 | 0.0021 | 0.036 | 0.011 | 0.030 | 0.00043 |
| Thallium (Tl) ^b | mg/kg dwt | 0.018 | 0.0036 | 0.033 | 0.0082 | 0.018 | 0.0070 | 0.077 | 0.015 | 0.11 | 0.029 | 0.092 | 0.031 |
| Tin (Sn) ^{a,d} | mg/kg dwt | 0.26 | 0.091 | 0.33 | 0.28 | 0.12 | 0.028 | 0.33 | 0.034 | 0.34 | 0.075 | 0.38 | 0.038 |
| Uranium (U) | mg/kg dwt | 0.60 | 0.29 | 0.86 | 0.38 | 0.48 | 0.079 | 0.98 | 0.13 | 1.4 | 0.30 | 0.71 | 0.18 |
| Vanadium (V) | mg/kg dwt | 12 | 4.5 | 14 | 2.0 | 10 | 4.4 | 55 | 4.9 | 53 | 6.5 | 44 | 11 |
| Zinc (Zn) | mg/kg dwt | 88 | 23 | 78 | 24 | 144 | 48 | 59 | 7.7 | 56 | 11 | 64 | 9.4 |
| Zirconium (Zr) | mg/kg dwt | 3.1 | 1.4 | 3.3 | 0.53 | 2.5 | 1.2 | 11 | 1.4 | 8.0 | 1.8 | 6.7 | 4.0 |

Indicates a mean concentration in lower Minto Creek that is significantly different than the mean concentration in lower Wolverine Creek (ANOVA; p = 0.050).
 Indicates a mean concentration in lower Minto Creek that is significantly different than the mean concentration in lower Big Creek (ANOVA; p = 0.050).
 Indicates a mean concentration in lower Minto Creek that is significantly different than the mean concentration in lower Wolverine and lower Big creeks (ANOVA; p = 0.050).

Note: Standard deviation was not calculated if all samples are < MDL.

^a Benthic invertebrate tissue data were analyzed using a non-parametric Wilcoxon Score Test (p = 0.050)

^b Benthic invertebrate tissue data were normalized by log transformation (ANOVA, p = 0.050)

^c Periphyton tissue data were normalized by square root transformation (ANOVA, p = 0.050)

^d Periphyton tissue data were analyzed using a non-parametric Wilcoxon Score Test (p = 0.050)

^e Periphyton tissue data were normalized by log transformation (ANOVA, p = 0.050)

^f Benthic invertebrate tissue data were analyzed using a non-parametric Mann-Whitney U-test (p = 0.050)

^g Benthic invertebrate tissue data were normalized by fourth root transformation (ANOVA, p = 0.050)

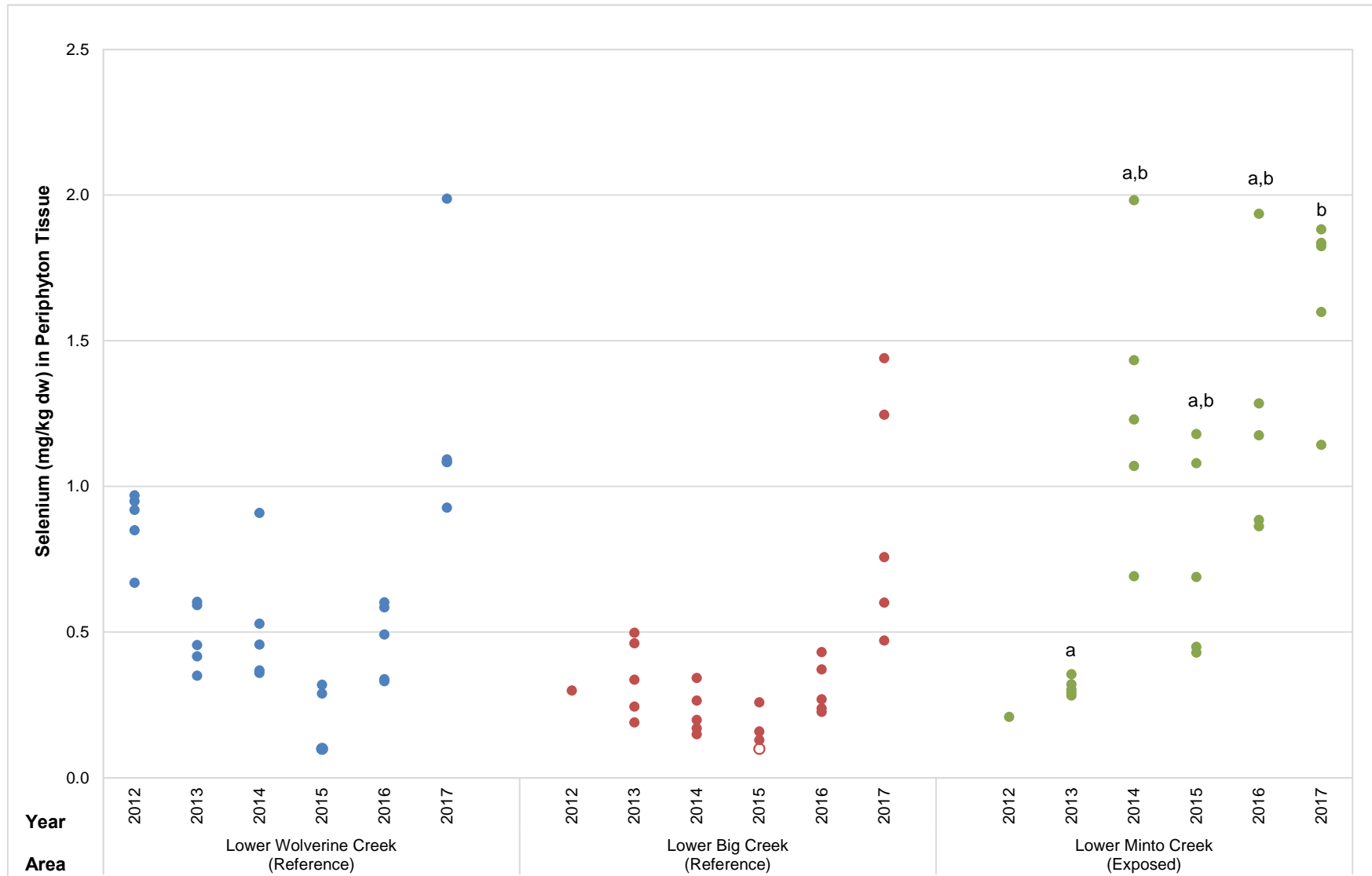


Figure 7.1: Periphyton Tissue Selenium Concentrations, 2012 to 2017

Notes: Mean concentrations at exposure areas that differ significantly ($p < 0.05$) within year from a reference area are marked with an "a" for differences between lower Wolverine Creek and "b" for differences between lower Big Creek, $n = 5$, except in lower Minto and lower Big creeks in 2012 ($n = 1$). Unfilled circles represents samples < method detection limits.

tissue has been high among years. In 2013, 2016, and 2017 copper was significantly higher in benthic invertebrates from lower Minto Creek compared to lower Wolverine Creek, but in 2014 copper was non-significantly different among areas (Figure 7.2). In 2015, copper was significantly lower at lower Minto Creek compared to lower Big Creek (Figure 7.2). This lack of consistency suggests observed differences likely represent natural variability.



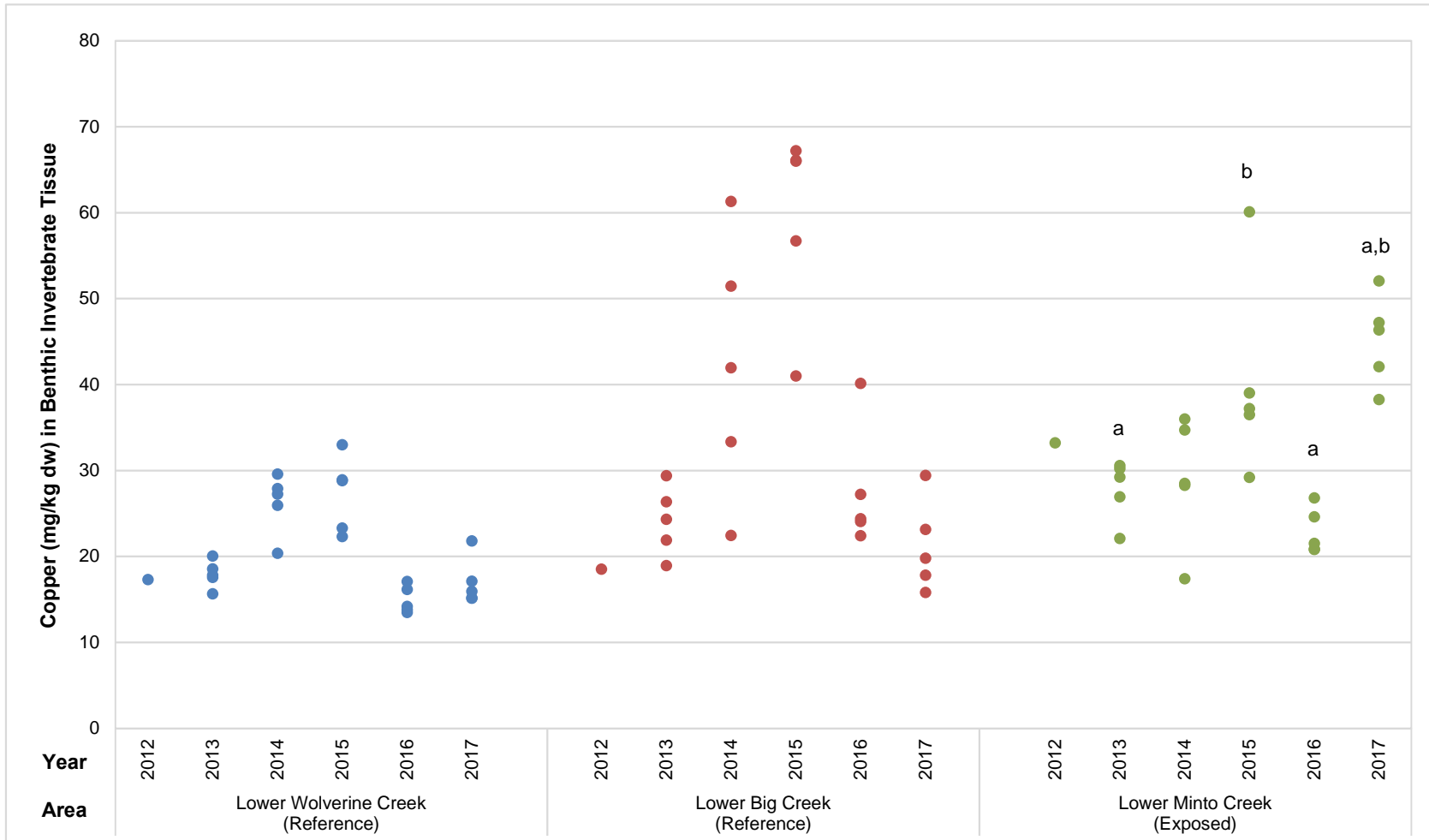


Figure 7.2: Benthic Invertebrate Tissue Copper Concentrations, 2012 to 2017

Notes: Mean concentrations at exposure areas that differ significantly ($p < 0.05$) within year from a reference area are marked with an "a" for differences between lower Wolverine Creek and "b" for differences between lower Big Creek, $n = 5$, except in 2012 ($n = 1$). Statistics not conducted in 2012 due to low sample size. Unfilled circles represents samples $<$ method detection limits.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

The Minto Mine sediment, periphyton, and benthic assessment undertaken from September 20th to 26th, 2017 serves to quantitatively compare water quality (field measures and chemistry), sediment quality, periphyton and benthic invertebrate community, and tissue quality of Minto Creek to reference creeks and previous data.

Supporting measures collected in September 2017 indicated good Minto Creek water quality. The influence of the Minto Mine was evident in higher specific conductance than in reference creeks; however, water quality met WUL water quality objectives. Concentration of total copper at upper Minto Creek was above CWQG and reference areas but dissolved copper was below the WUL water quality objective. Moving downstream, copper concentration at lower Minto Creek and associated reference areas were below CWQG. Mean concentrations of chlorophyll-a at lower Minto and lower Wolverine creeks were significantly different but were below BCWQG. Trophic status in 2017 was different from previous years since lower Minto Creek was classified as mesotrophic (Dodds et al. 1998).

Concentrations of metals in Minto Creek sediments were similar to reference and lower than sediment quality guidelines with the exception of arsenic and/or copper. Concentrations of copper in Minto Creek (both upper and lower) were greater than the sediment quality guideline and reference, but were similar to concentrations observed in previous years. Sediment toxicity testing of *C. dilutus* indicated adverse effects to survival and growth in lower Minto Creek sediment when compared to the laboratory control and the field reference (lower Wolverine Creek) sediment. However, no effects on survival or growth occurred in tests of *H. azteca*.

Periphyton community density (cells/cm²) and biomass (µg/cm²) indicated significant differences in a number of metrics in lower Minto Creek relative to the lower Wolverine Creek reference. In general, lower Minto Creek had a different community structure compared to lower Wolverine Creek. However, differences in periphyton community summary metrics and community composition were apparent among years at both lower Minto Creek and lower Wolverine Creek, indicating substantial temporal variability. The differences observed in the periphyton communities of lower Minto Creek and lower Wolverine Creek in 2017 were within natural temporal variability and do not provide any resolution of potential mine influence.

The erosional benthic invertebrate community of lower Minto Creek did not differ from both references, or was intermediate between references, for all community metrics. High temporal variability has been observed at the exposure and reference areas (Minnow 2009b, 2011, 2012,



2013b, 2014, 2015, 2016, 2017), presumably due to inter-annual variability in environmental conditions (e.g., flow, ice scour).

The chemical quality of biological tissues (periphyton and benthic invertebrates) collected at mine-exposed lower Minto Creek and reference areas indicated selenium concentrations were significantly different between areas. Significantly higher concentrations of selenium at lower Minto Creek compared to either reference areas over the last three years could indicate an influence of the mine on Minto Creek. Copper concentration in benthic invertebrate tissue was significantly higher at lower Minto Creek than at lower Wolverine and lower Big creeks.

8.2 Recommendations

Based on results and conclusions of the 2017 Minto Mine sediment, periphyton, and benthic assessment, it is recommended the program be repeated in 2018. It is recommended that both lower Wolverine Creek and lower Big Creek continue to be sampled as reference areas for the benthic invertebrate community assessment to provide better perspective on whether any of the observed differences are actually due to mine influence or simply due to natural differences among creeks. It is also recommended that periphyton community monitoring be removed from the WUL monitoring program as results are highly variable and are not effective in determining potential mine-related effects.



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APPENDIX A
DATA QUALITY REPORT

APPENDIX A DATA QUALITY REPORT

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A1 INTRODUCTION

This Data Quality Report (DQR) provides an evaluation of data collected as part of the 2017 Minto Creek Sediment, Periphyton, and Benthic Invertebrate Community Assessment Report. The objective of the DQR is to define the overall quality of the data presented in the report, and, by extension, the confidence with which the data can be used to derive conclusions.

A1.1 Background

A variety of factors can influence the chemical and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Inconsistencies in sampling or laboratory methods, use of instruments that are inadequately calibrated or which cannot measure to the desired level of accuracy or precision, and contamination of samples in the field or laboratory are just some of the potential factors that can lead to the reporting of data that do not accurately reflect actual environmental conditions. Depending on the magnitude of the problem, inaccuracy or imprecision have the potential to affect the reliability of any conclusions made from the data. Therefore, it is important to ensure that monitoring programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize the variability that does not reflect natural spatial and temporal variability in the environment) and thus assure the quality of the data.

Data quality as a concept is meaningful only when it relates to the intended use of the data. That is, one must know the context in which the data will be interpreted in order to establish a relevant basis for judging whether or not the data set is adequate. The DQR involves comparison of actual field and laboratory measurement performance to data quality objectives (DQOs) established for a particular study, such as evaluation of method detection limits, blank sample data, data precision (based on field and laboratory duplicate samples), and data accuracy (based on matrix spike recoveries and/or analysis of standards or certified reference materials). A trusted analytical laboratory certified by Canadian Association for Laboratory Accreditation (CALA) with a rigorous internal quality assurance program was selected to ensure the highest possible quality.

DQOs were established either at the outset of the field program or by the laboratory (e.g., ALS Environmental) and reflect reasonable and achievable performance expectations. The method detection limit (MDL) was set at the outset of the field program for water, sediment, and tissue quality. Only samples that were below the laboratory detection limits were evaluated against target detection limits. Target detection limits should be at least as low as applicable guidelines, ideally $\leq 1/10$ th guideline values. Tissue samples are compared to the detection limit the laboratory quoted they could achieve. Programs involving a large number of samples



and analytes usually result in some analytes that exceed the DQOs. This is particularly so for multi-element scans (e.g., ICP scans for metals) since the analytical conditions are not necessarily optimal for every element included in the scan. Generally, scan results may be considered acceptable if no more than 20% of the parameters fail to meet the DQOs. Overall, the intent of comparing data to DQOs was not to reject any measurement that did not meet the DQO, but to ensure that any questionable data received more scrutiny to determine what effect, if any, this had on interpretation of results within the context of this project.

A1.2 Types of Quality Control Samples

Several types of quality control (QC) samples were assessed based on samples collected (or prepared) in the field and laboratory. These samples include the following:

- **Blanks** are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed the same way as regular samples. These samples will reflect any contamination that occurred in the field (in the case of field or travel blanks) or the laboratory (in the case of laboratory or method blanks). Analyte concentrations should be non-detectable although a DQO of twice the method detection limit allows for slight “noise” around the detection limit.
- **Field Duplicates** are sub-sample pairs collected from a randomly selected field station using identical collection and handling methods that are then analyzed separately in the laboratory. The duplicate samples are handled and analyzed in an identical manner in the laboratory. The data from field duplicate samples reflect natural variability, as well as the variability associated with sample collection methods, and therefore provide a measure of field precision.
- **Laboratory Duplicates** are sub-sample pairs created in the laboratory from randomly selected field samples which are sub-sampled and then analyzed independently using identical analytical methods. The laboratory duplicate sample results reflect any variability introduced during laboratory sample handling and analysis and thus provide a measure of laboratory precision.
- **Spike Recovery Samples** are created in the laboratory by adding a known amount/concentration of a given analyte (or mixture of analytes) to a randomly selected test sample previously divided to create two sub-samples. The spiked and regular sub-samples are then analyzed in an identical manner. The spike recovery represents the difference between the measured spike amount (total amount in spiked sample minus amount in original sample) relative to the known spike amount (as a percentage). Two types of spike recovery samples are commonly analyzed. Spiked blanks (or blank spikes) are created using laboratory control materials whereas matrix spikes are



created using field-collected samples. The analysis of spiked samples provides an indication of the accuracy of analytical results.

- **Certified Reference Materials** are samples containing known chemical concentrations that are processed and analyzed along with batches of environmental samples. The sample results are then compared to target results to provide a measure of analytical accuracy. The results are reported as the percent of the known amount that was recovered in the analysis.

The following QC was applied to benthic invertebrate community samples as follows:

- **Organism Recovery Checks** for benthic invertebrate community samples involve the re-processing of previously sorted material from a randomly selected sample to determine the number of invertebrates that were not recovered during the original sample processing. The reprocessing is conducted by an analyst not involved during the original processing to reduce any bias. This check allows the determination of accuracy through assessment of recovery efficiency.



A2 WATER SAMPLES

A2.1 Method Detection Limits

The MDL for total mercury was higher than targeted detection limits but was lower than guideline levels (Table A.1). Therefore, data for this project can be reliably interpreted relative to guidelines.

A2.2 Laboratory Blank Samples Analysis

All blank samples contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Appendix B).

A2.3 Data Precision

Relative percent differences (RPDs) between field duplicate samples were greater than 25% for five analytes: total suspended solids, total phosphorus, total cadmium, total mercury, and dissolved zinc (Table A.2). Fewer than 20% of the field duplicate samples failed the DQO, therefore the samples were associated with good field precision.

Agreement was achieved between all laboratory duplicate samples (Appendix B). This indicates that samples were associated with good analytical precision.

A2.4 Data Accuracy

Analyte recoveries for spiked blanks all met the DQO indicating excellent analytical accuracy for the water sample analyses (Appendix B).

The analyte recoveries for matrix spiked samples met the DQO for all analytes except for dissolved organic carbon, total inorganic carbon and total organic carbon. Recovery of these analytes could not be accurately calculated due to high analyte background in the samples. The matrix spiked samples indicate good analytical accuracy for the water sample analyses (Appendix B).

Recoveries of certified reference materials all met the DQO indicating excellent analytical accuracy (Appendix B).



Table A.1: Laboratory Method Detection Limits (MDLs) Relative to Targets and Water Quality Guidelines, Minto Mine, 2017^a

| | Analyte | Units | Method Detection Limit | | Water Use Licence Objectives | CCME Water Quality Guidelines ^b | |
|------------------------|--------------------------|--------|------------------------|-------------------------|------------------------------|--|---------------------|
| | | | Target | Achieved | | 30 Day | Max |
| Physical Tests | Total Suspended Solids | mg/L | - | 3.0 | - | - | - |
| Anions and Nutrients | Total Ammonia (as N) | mg/L | 0.025 | 0.0050 | 0.25 | 0.41 ^c | - |
| | Nitrate (as N) | mg/L | 0.30 | 0.0050 | 9.1 | 3.0 | 124 |
| | Nitrite (as N) | mg/L | 0.0060 | 0.0010 | 0.060 | 0.060 | - |
| Cyanides | Total Cyanide | mg/L | - | 0.0050 | - | - | - |
| Total Metals | Total Antimony (Sb) | mg/L | - | 0.00010 | - | - | - |
| | Total Beryllium (Be) | mg/L | - | 0.00010 | - | - | - |
| | Total Bismuth (Bi) | mg/L | - | 0.000050 | - | - | - |
| | Total Boron (B) | mg/L | 0.15 | 0.010 | - | 1.5 | 29 |
| | Total Cadmium (Cd) | mg/L | 0.000016 | 0.0000050 | - | 0.00016 ^d | 0.0022 ^d |
| | Total Chromium (Cr) | mg/L | 0.00010 | 0.00010 | - | 0.0010 ^e | - |
| | Total Cobalt (Co) | mg/L | - | 0.00010 | - | - | - |
| | Total Lead (Pb) | mg/L | 0.00033 | 0.000050 | - | 0.0033 ^d | - |
| | Total Lithium (Li) | mg/L | - | 0.0010 | - | - | - |
| | Total Mercury (Hg) | mg/L | 0.0000026 | 0.0000050 - 0.000025 | - | 0.000026 | - |
| | Total Phosphorus (P) | mg/L | - | 0.30 | - | - | - |
| | Total Silver (Ag) | mg/L | 0.000025 | 0.000010 | - | 0.00025 | - |
| | Total Thallium (Tl) | mg/L | 0.000080 | 0.000010 | - | 0.00080 | - |
| | Total Tin (Sn) | mg/L | - | 0.00010 | - | - | - |
| | Total Titanium (Ti) | mg/L | - | 0.010 | - | - | - |
| Total Vanadium (V) | mg/L | - | 0.00050 | - | - | - | |
| Total Zinc (Zn) | mg/L | 0.0030 | 0.0030 | - | 0.030 | - | |
| Dissolved Metals | Dissolved Antimony (Sb) | mg/L | - | 0.00010 | - | - | - |
| | Dissolved Beryllium (Be) | mg/L | - | 0.00010 | - | - | - |
| | Dissolved Bismuth (Bi) | mg/L | - | 0.000050 | - | - | - |
| | Dissolved Boron (B) | mg/L | - | 0.010 | - | - | - |
| | Dissolved Cadmium (Cd) | mg/L | 0.000022 | 0.0000050 | 0.00022 ^f | - | - |
| | Dissolved Chromium (Cr) | mg/L | 0.00010 | 0.00010 | 0.0010 | - | - |
| | Dissolved Cobalt (Co) | mg/L | - | 0.00010 | - | - | - |
| | Dissolved Lead (Pb) | mg/L | 0.00040 | 0.000050 | 0.0040 | - | - |
| | Dissolved Lithium (Li) | mg/L | - | 0.0010 | - | - | - |
| | Dissolved Mercury (Hg) | mg/L | - | 0.0000050 | - | - | - |
| | Dissolved Nickel (Ni) | mg/L | 0.011 | 0.00050 | 0.11 | - | - |
| | Dissolved Phosphorus (P) | mg/L | - | 0.30 | - | - | - |
| | Dissolved Selenium (Se) | mg/L | 0.00020 | 0.000050 | 0.002 | - | - |
| | Dissolved Silver (Ag) | mg/L | 0.000010 | 0.000010 | 0.00010 | - | - |
| | Dissolved Thallium (Tl) | mg/L | - | 0.000010 | - | - | - |
| | Dissolved Tin (Sn) | mg/L | - | 0.00010 | - | - | - |
| | Dissolved Titanium (Ti) | mg/L | - | 0.010 | - | - | - |
| Dissolved Vanadium (V) | mg/L | - | 0.00050 | - | - | - | |
| Dissolved Zinc (Zn) | mg/L | 0.0030 | 0.0010 | 0.030 | - | - | |

Value greater than target.

^a Only analytes with any reported values less than MDL were presented.

^b CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

^c Based on lowest guideline using highest temperature and pH.


^d Based on lowest guideline using lowest hardness.

^e Based on hexavalent Chromium (Cr VI).

^f Dissolved Cadmium ($\mu\text{g/L}$) calculations based on the following formula using the lowest hardness: $e^{(0.736(\ln(\text{Hardness})-4.943))}$.

Table A.2: Field Duplicate Results for Analysis of Water Quality, Minto Mine, 2017

| Analytes | Units | Lab Report L1998329 | | | |
|------------------------|--|---------------------|-------------|------------|------|
| | | LBC | LBCX | RPD (%) | |
| | | 26-Sep-2017 | 26-Sep-2017 | | |
| Physical Tests | Conductivity | µS/cm | 217 | 214 | 1.4 |
| | Hardness (as CaCO ₃) | mg/L | 103 | 103 | 0 |
| | pH | pH Units | 8.18 | 8.16 | 0.24 |
| | Total Suspended Solids | mg/L | <3.0 | 4.1 | 31 |
| | Total Dissolved Solids | mg/L | 152 | 150 | 1.3 |
| | Turbidity | NTU | 0.89 | 0.87 | 2.3 |
| Anions and Nutrients | Total Alkalinity (as CaCO ₃) | mg/L | 105 | 98 | 6.7 |
| | Total Ammonia (as N) | mg/L | <0.0050 | <0.0050 | 0 |
| | Chloride (Cl) | mg/L | 0.59 | 0.59 | 0 |
| | Fluoride (F) | mg/L | 0.13 | 0.14 | 3.0 |
| | Nitrate (as N) | mg/L | 0.0053 | 0.0055 | 3.7 |
| | Nitrite (as N) | mg/L | <0.0010 | <0.0010 | 0 |
| | Total dissolved Phosphorus (P) | mg/L | 0.0023 | 0.0023 | 0 |
| | Total Phosphorus (P) | mg/L | 0.0037 | 0.0022 | 51 |
| | Sulfate (SO ₄) | mg/L | 16 | 16 | 0 |
| Other | Total Cyanide | mg/L | <0.0050 | <0.0050 | 0 |
| | Dissolved Organic Carbon | mg/L | 7.6 | 7.7 | 0.52 |
| | Total Inorganic Carbon | mg/L | 22 | 22 | 0 |
| | Total Organic Carbon | mg/L | 7.5 | 7.6 | 0.93 |
| Total Metals | Total Aluminum (Al) | mg/L | 0.038 | 0.041 | 8.4 |
| | Total Antimony (Sb) | mg/L | 0.00014 | 0.00015 | 6.9 |
| | Total Arsenic (As) | mg/L | 0.00081 | 0.00079 | 2.5 |
| | Total Barium (Ba) | mg/L | 0.0664 | 0.0661 | 0.45 |
| | Total Beryllium (Be) | mg/L | <0.00010 | <0.00010 | 0 |
| | Total Bismuth (Bi) | mg/L | <0.000050 | <0.000050 | 0 |
| | Total Boron (B) | mg/L | <0.010 | <0.010 | 0 |
| | Total Cadmium (Cd) | mg/L | 0.0000078 | 0.0000051 | 42 |
| | Total Calcium (Ca) | mg/L | 26 | 25 | 2.0 |
| | Total Chromium (Cr) | mg/L | 0.00030 | 0.00025 | 18 |
| | Total Cobalt (Co) | mg/L | <0.00010 | <0.00010 | 0 |
| | Total Copper (Cu) | mg/L | 0.0019 | 0.0020 | 3.6 |
| | Total Iron (Fe) | mg/L | 0.079 | 0.087 | 9.6 |
| | Total Lead (Pb) | mg/L | <0.000050 | <0.000050 | 0 |
| | Total Lithium (Li) | mg/L | 0.0012 | 0.0014 | 15 |
| | Total Magnesium (Mg) | mg/L | 10.2 | 10.3 | 0.98 |
| | Total Manganese (Mn) | mg/L | 0.015 | 0.014 | 0.69 |
| | Total Mercury (Hg) | mg/L | <0.000025 | <0.0000050 | 133 |
| | Total Molybdenum (Mo) | mg/L | 0.0013 | 0.0012 | 4.0 |
| | Total Nickel (Ni) | mg/L | 0.0011 | 0.0010 | 1.9 |
| | Total Phosphorus (P) | mg/L | <0.30 | <0.30 | 0 |
| | Total Potassium (K) | mg/L | 0.865 | 0.869 | 0.46 |
| | Total Selenium (Se) | mg/L | 0.000072 | 0.000076 | 5.4 |
| | Total Silicon (Si) | mg/L | 5.86 | 5.85 | 0.17 |
| | Total Silver (Ag) | mg/L | <0.000010 | <0.000010 | 0 |
| | Total Sodium (Na) | mg/L | 7.8 | 8.0 | 2.2 |
| | Total Strontium (Sr) | mg/L | 0.28 | 0.28 | 0 |
| | Total Thallium (Tl) | mg/L | <0.000010 | <0.000010 | 0 |
| | Total Tin (Sn) | mg/L | <0.00010 | <0.00010 | 0 |
| | Total Titanium (Ti) | mg/L | <0.010 | <0.010 | 0 |
| Total Uranium (U) | mg/L | 0.00279 | 0.00276 | 1.1 | |
| Total Vanadium (V) | mg/L | 0.00081 | 0.00081 | 0 | |
| Total Zinc (Zn) | mg/L | <0.0030 | <0.0030 | 0 | |
| Dissolved Metals | Dissolved Aluminum (Al) | mg/L | 0.013 | 0.013 | 0 |
| | Dissolved Antimony (Sb) | mg/L | 0.00012 | 0.00012 | 0 |
| | Dissolved Arsenic (As) | mg/L | 0.00067 | 0.00066 | 1.5 |
| | Dissolved Barium (Ba) | mg/L | 0.068 | 0.067 | 1.3 |
| | Dissolved Beryllium (Be) | mg/L | <0.00010 | <0.00010 | 0 |
| | Dissolved Bismuth (Bi) | mg/L | <0.000050 | <0.000050 | 0 |
| | Dissolved Boron (B) | mg/L | <0.010 | <0.010 | 0 |
| | Dissolved Cadmium (Cd) | mg/L | <0.0000050 | <0.0000050 | 0 |
| | Dissolved Calcium (Ca) | mg/L | 24 | 24 | 0 |
| | Dissolved Chromium (Cr) | mg/L | 0.00021 | 0.00021 | 0 |
| | Dissolved Cobalt (Co) | mg/L | <0.00010 | <0.00010 | 0 |
| | Dissolved Copper (Cu) | mg/L | 0.00174 | 0.00173 | 0.58 |
| | Dissolved Iron (Fe) | mg/L | 0.039 | 0.041 | 5.0 |
| | Dissolved Lead (Pb) | mg/L | <0.000050 | <0.000050 | 0 |
| | Dissolved Lithium (Li) | mg/L | 0.0016 | 0.0015 | 6.5 |
| | Dissolved Magnesium (Mg) | mg/L | 10 | 10 | 0 |
| | Dissolved Manganese (Mn) | mg/L | 0.0128 | 0.0129 | 0.78 |
| | Dissolved Mercury (Hg) | mg/L | <0.0000050 | <0.0000050 | 0 |
| | Dissolved Molybdenum (Mo) | mg/L | 0.0011 | 0.0011 | 0 |
| | Dissolved Nickel (Ni) | mg/L | 0.00090 | 0.00088 | 2.2 |
| | Dissolved Phosphorus (P) | mg/L | <0.30 | <0.30 | 0 |
| | Dissolved Potassium (K) | mg/L | 0.897 | 0.900 | 0.33 |
| | Dissolved Selenium (Se) | mg/L | <0.000050 | 0.000051 | 2.0 |
| | Dissolved Silicon (Si) | mg/L | 5.63 | 5.60 | 0.53 |
| | Dissolved Silver (Ag) | mg/L | <0.000010 | <0.000010 | 0 |
| | Dissolved Sodium (Na) | mg/L | 7.8 | 7.7 | 0.52 |
| | Dissolved Strontium (Sr) | mg/L | 0.262 | 0.259 | 1.2 |
| | Dissolved Thallium (Tl) | mg/L | <0.000010 | <0.000010 | 0 |
| | Dissolved Tin (Sn) | mg/L | <0.00010 | <0.00010 | 0 |
| | Dissolved Titanium (Ti) | mg/L | <0.010 | <0.010 | 0 |
| Dissolved Uranium (U) | mg/L | 0.00248 | 0.00246 | 0.81 | |
| Dissolved Vanadium (V) | mg/L | 0.00074 | 0.00074 | 0 | |
| Dissolved Zinc (Zn) | mg/L | <0.0010 | 0.0013 | 26 | |

 > 25% Relative Percent Difference (RPD).

A3 SEDIMENT SAMPLES

A3.1 Method Detection Limits

Results for seven analytes were reported as <MDL but did not have any guidelines associated with them. Analytes with guidelines were all detectable indicating that the data can be reliably interpreted.

A3.2 Laboratory Blank Samples Analysis

All blank samples contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Appendix C).

A3.3 Data Precision

The RPD between field duplicate samples all showed close agreement, as they were lower than the DQO (40% RPD; Table A.3). This indicates that the results were associated with excellent field precision.

Agreement was achieved between all laboratory duplicate samples as the RPD were lower than the laboratory set DQO (Appendix C). This indicates that reported sample results were associated with excellent analytical precision.

A3.4 Data Accuracy

Analyte recoveries for spiked blanks all met the DQO indicating excellent analytical accuracy for the sediment sample analyses (Appendix C).

Recoveries of all analytes in certified reference materials met the DQO (Appendix C). These data indicated excellent analytical accuracy associated with the analysis of sediment samples.



Table A.3: Field Duplicate Results for Analysis of Sediment Quality, Minto Mine, 2017

| Analytes | | Units | Lab Report L1998308 | | |
|--------------------|--|-------|---------------------|-------------|---------|
| | | | LWC-5 | LWC-5X | RPD (%) |
| | | | 24-Sep-2017 | 24-Sep-2017 | |
| Physical Tests | Loss on Ignition | % | 15 | 16 | 6.5 |
| | pH (1:2 soil:water) | pH | 6.92 | 6.77 | 2.2 |
| Particle Size | Gravel (> 2 mm) | % | <1.0 | <1.0 | 0 |
| | Sand (2.0 mm - 0.063 mm) | % | 17 | 21 | 18 |
| | Silt (0.063 mm - 4 µm) | % | 77 | 74 | 4.0 |
| | Clay (< 4 µm) | % | 5.7 | 5.4 | 5.4 |
| Other | Total Kjeldahl Nitrogen | % | 0.35 | 0.34 | 4.0 |
| | Inorganic Carbon | % | 0.141 | 0.137 | 2.9 |
| | Inorganic Carbon (as CaCO ₃ Equivalent) | % | 1.2 | 1.1 | 2.6 |
| | Total Carbon by Combustion | % | 7.2 | 5.4 | 28 |
| | Total Organic Carbon | % | 7.0 | 5.2 | 29 |
| Total Metals | Total Aluminum (Al) | mg/kg | 16,000 | 15,900 | 0.63 |
| | Total Antimony (Sb) | mg/kg | 0.46 | 0.48 | 4.3 |
| | Total Arsenic (As) | mg/kg | 4.9 | 5.7 | 15 |
| | Total Barium (Ba) | mg/kg | 200 | 221 | 10 |
| | Total Beryllium (Be) | mg/kg | 0.78 | 0.83 | 6.2 |
| | Total Bismuth (Bi) | mg/kg | <0.20 | <0.20 | 0 |
| | Total Boron (B) | mg/kg | <5.0 | <5.0 | 0 |
| | Total Cadmium (Cd) | mg/kg | 0.23 | 0.26 | 14 |
| | Total Calcium (Ca) | mg/kg | 10,200 | 11,100 | 8.5 |
| | Total Chromium (Cr) | mg/kg | 48 | 49 | 1.7 |
| | Total Cobalt (Co) | mg/kg | 12.8 | 13.1 | 2.3 |
| | Total Copper (Cu) | mg/kg | 28 | 30 | 6.3 |
| | Total Iron (Fe) | mg/kg | 26,700 | 28,400 | 6.2 |
| | Total Lead (Pb) | mg/kg | 6.5 | 6.6 | 1.8 |
| | Total Lithium (Li) | mg/kg | 11.7 | 11.6 | 0.86 |
| | Total Magnesium (Mg) | mg/kg | 9,760 | 9,730 | 0.31 |
| | Total Manganese (Mn) | mg/kg | 236 | 259 | 9.3 |
| | Total Mercury (Hg) | mg/kg | 0.041 | 0.047 | 13 |
| | Total Molybdenum (Mo) | mg/kg | 0.56 | 0.52 | 7.4 |
| | Total Nickel (Ni) | mg/kg | 37 | 38 | 2.4 |
| | Total Phosphorus (P) | mg/kg | 1,070 | 1,120 | 4.6 |
| | Total Potassium (K) | mg/kg | 1,140 | 1,130 | 0.88 |
| | Total Selenium (Se) | mg/kg | 0.34 | 0.43 | 23 |
| | Total Silver (Ag) | mg/kg | 0.10 | 0.12 | 18 |
| | Total Sodium (Na) | mg/kg | 458 | 456 | 0.44 |
| | Total Strontium (Sr) | mg/kg | 93 | 103 | 9.9 |
| | Total Thallium (Tl) | mg/kg | 0.095 | 0.099 | 4.1 |
| | Total Tin (Sn) | mg/kg | <2.0 | <2.0 | 0 |
| | Total Titanium (Ti) | mg/kg | 841 | 908 | 7.7 |
| | Total Uranium (U) | mg/kg | 2.7 | 3.2 | 14 |
| Total Vanadium (V) | mg/kg | 69 | 68 | 0.58 | |
| Total Zinc (Zn) | mg/kg | 63.5 | 64.4 | 1.4 | |

 > 40% Relative Percent Difference (RPD).

A4 SEDIMENT TOXICITY TESTING

Results for the reference toxicant tests for both the 10-day *Chironomus dilutus* and the 14-day *Hyalella azteca* tests were within the acceptability range for organism performance of mean and two standard deviations (Appendix C – Nautilus Environmental Report). Water quality parameters remained within the acceptability criteria throughout testing. The sensitivity of the organisms was deemed to be appropriate when compared to historical results obtained by the laboratory (Appendix C – Nautilus Environmental Report).



A5 PERIPHYTON COMMUNITY

Close agreement was achieved between laboratory duplicate samples for both density (cells/cm²; Table A.4) and biomass (µg/cm²; Table A.5), except for Rhodophyta. The RPD between duplicate samples and Rhodophyta (density and biomass) was 46% (Tables A.4 and A.5). The higher magnitude of difference between the duplicate samples could be due to the low abundance of Rhodophyta present. Data can be reliably interpreted.



Table A.4: Laboratory Duplicate Results for Analysis of Periphyton Group Density (cells/cm²)

| Algal Density (cells/cm²) | LMC-5 | LMC-5R | RPD (%) |
|---|--------------|---------------|----------------|
| Cyanobacteria | 76,371 | 79,242 | 3.7 |
| Bacillariophyceae | 29,859 | 28,424 | 4.9 |
| Rhodophyta | 2,871 | 4,594 | 46 |
| Total | 109,101 | 112,260 | 2.9 |

 > 30% Relative Percent Difference (RPD).

Table A.5: Laboratory Duplicate Results for Analysis of Periphyton Group Biomass (µg/cm²)

| Algal Biomass (µg/cm²) | LMC-4 | LMC-4R | RPD (%) |
|--|--------------|---------------|----------------|
| Cyanobacteria | 12 | 15 | 22 |
| Bacillariophyceae | 18.6 | 19.0 | 2.0 |
| Rhodophyta | 2.1 | 3.4 | 46 |
| Total | 32 | 37 | 13 |

 > 30% Relative Percent Difference (RPD).

A6 BENTHIC INVERTEBRATE COMMUNITY

Two re-sorted samples met the objective for percent organism recovery, with a percent recovery of 99% and 100% (Table A.6). All benthic invertebrate samples were analyzed whole (Table A.7), and therefore no analysis of sub-sampling variability was required. This indicates that the data can be reliably interpreted.



Table A.6: Percent Sorting Efficiency of Benthic Invertebrates, Minto Mine, 2017

| Station | Initial Sort | Re-sort | Percent sorting efficiency ^a |
|---------|--------------|---------|---|
| LMC-4 | 186 | 1 | 99% |
| LWC-2 | 73 | 0 | 100% |

^a Percent sorting efficiency = $(1 - (\# \text{ in QA/AC re-sort} / (\# \text{ sorted originally} + \# \text{ in QA/QC re-sort}))) * 100$.

■ Sorting efficiency < 90%.

Table A.7: Percent of Benthic Invertebrate Sample Analyzed for Each Station

| Area | Station | | | | |
|------|---------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 |
| LWC | 100% | 100% | 100% | 100% | 100% |
| LBC | 100% | 100% | 100% | 100% | 100% |
| LMC | 100% | 100% | 100% | 100% | 100% |

A7 TISSUE SAMPLES

A7.1 Method Detection Limits

For periphyton tissue samples, only one analyte (total mercury) was below laboratory detection limits and greater than the targeted detection limit (Table A.8). Target concentrations are not based on guidelines; rather represent detection limits the laboratory quoted were achievable.

Eight benthic invertebrate tissue analytes were below the laboratory detection limits and did not meet targets: total antimony, bismuth, boron, lithium, selenium, sodium, tellurium, and tin. For each analyte only 3 out of 16 samples exceeded targets (Table A.9). Target concentrations are not guidelines but represent detection limits quoted by the laboratory. Data for this project can be reliably interpreted.

All chlorophyll-a periphyton samples were detectable and interpretable.

A7.2 Laboratory Blank Samples Analysis

Periphyton (chlorophyll-a, tissue) and benthic invertebrate tissue blank samples contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Appendix C).

A7.3 Data Precision

Periphyton field duplicate samples showed close agreement among analytes except for seven analytes: Calcium, magnesium, manganese, mercury, nickel, selenium, and uranium. This represents 20% of the analytes measured and will be considered when interpreting the results (Table A.10).

Laboratory duplicate periphyton tissue samples showed good agreement among all duplicate analyte concentrations (Appendix C). Periphyton samples were associated with good analytical precision.

Benthic invertebrate field duplicate samples did not meet the DQO for most analytes (Table A.11). Tissue samples can be highly variable and this will be considered when analyzing the data.

Laboratory benthic invertebrate duplicate samples showed good agreement among all comparisons as they were all below the DQO set out by the laboratory (Appendix C). Benthic invertebrate samples were associated with good analytical precision.

The RPD between the field duplicate periphyton chlorophyll-a samples was 14%, indicating that the data was associated with good laboratory precision (Table A.12).



Table A.8: Laboratory Method Detection Limits (MDL) for Periphyton Tissue Samples Relative to Targets, Minto Mine, 2017 ^a

| Analyte | Units | Method Detection Limits | |
|----------------------|-----------|-------------------------|----------------|
| | | Target | Achieved |
| Total Boron (B) | mg/kg wwt | 0.20 | 0.20 |
| Total Mercury (Hg) | mg/kg wwt | 0.0010 | 0.0010 - 0.014 |
| Total Tellurium (Te) | mg/kg wwt | 0.0040 | 0.0040 |
| Total Tin (Sn) | mg/kg wwt | 0.020 | 0.020 |

 Target MDL were exceeded.

^a Only analytes with any reported values less than MDL were presented.

Table A.9: Laboratory Method Detection Limits (MDL) for Benthic Invertebrate Tissue Samples Relative to Targets, Minto Mine, 2017 ^a

| Analyte | Units | Method Detection Limits | |
|----------------------|-----------|-------------------------|----------------|
| | | Target | Achieved |
| Total Antimony (Sb) | mg/kg wwt | 0.0020 | 0.0020 - 0.050 |
| Total Bismuth (Bi) | mg/kg wwt | 0.0020 | 0.0020 - 0.050 |
| Total Boron (B) | mg/kg wwt | 0.20 | 0.20 - 5.0 |
| Total Lithium (Li) | mg/kg wwt | 0.10 | 0.10 - 2.5 |
| Total Selenium (Se) | mg/kg wwt | 0.010 | 0.010 - 0.50 |
| Total Sodium (Na) | mg/kg wwt | 4.0 | 4.0 - 100 |
| Total Tellurium (Te) | mg/kg wwt | 0.0040 | 0.0040 - 0.10 |
| Total Tin (Sn) | mg/kg wwt | 0.020 | 0.020 - 0.50 |

 Target MDL were exceeded.

^a Only analytes with any reported values less than MDL were presented.

Table A.10: Field Duplicate Results for Analysis of Periphyton Tissue Quality, Minto Mine, 2017

| Analyte | Units | Lab Report L1998303 | | | |
|-----------------------|-----------------------|---------------------|-------------|---------|------|
| | | LWC-3 | LWC-3X | RPD (%) | |
| | | 23-Sep-2017 | 23-Sep-2017 | | |
| Physical Tests | % Moisture | % | 71 | 62 | 14 |
| Metals | Total Aluminum (Al) | mg/kg wwt | 852 | 862 | 1.2 |
| | Total Antimony (Sb) | mg/kg wwt | 0.018 | 0.019 | 4.9 |
| | Total Arsenic (As) | mg/kg wwt | 0.46 | 0.53 | 13 |
| | Total Barium (Ba) | mg/kg wwt | 18 | 24 | 29 |
| | Total Beryllium (Be) | mg/kg wwt | 0.066 | 0.081 | 21 |
| | Total Bismuth (Bi) | mg/kg wwt | 0.0057 | 0.0072 | 23 |
| | Total Boron (B) | mg/kg wwt | 0.38 | 0.41 | 7.6 |
| | Total Cadmium (Cd) | mg/kg wwt | 0.17 | 0.16 | 3.7 |
| | Total Calcium (Ca) | mg/kg wwt | 813 | 985 | 19 |
| | Total Cesium (Cs) | mg/kg wwt | 0.086 | 0.12 | 33 |
| | Total Chromium (Cr) | mg/kg wwt | 5.9 | 5.1 | 15 |
| | Total Cobalt (Co) | mg/kg wwt | 1.3 | 1.1 | 17 |
| | Total Copper (Cu) | mg/kg wwt | 6.6 | 5.8 | 13 |
| | Total Iron (Fe) | mg/kg wwt | 1,990 | 1,990 | 0 |
| | Total Lead (Pb) | mg/kg wwt | 0.42 | 0.51 | 19 |
| | Total Lithium (Li) | mg/kg wwt | 0.67 | 0.84 | 23 |
| | Total Magnesium (Mg) | mg/kg wwt | 1,040 | 766 | 30.3 |
| | Total Manganese (Mn) | mg/kg wwt | 110 | 161 | 38 |
| | Total Mercury (Hg) | mg/kg wwt | <0.010 | <0.014 | 33 |
| | Total Molybdenum (Mo) | mg/kg wwt | 0.22 | 0.27 | 21 |
| | Total Nickel (Ni) | mg/kg wwt | 5.7 | 3.6 | 45 |
| | Total Phosphorus (P) | mg/kg wwt | 1,280 | 1,390 | 8.2 |
| | Total Potassium (K) | mg/kg wwt | 982 | 986 | 0.41 |
| | Total Rubidium (Rb) | mg/kg wwt | 1.4 | 1.6 | 15 |
| | Total Selenium (Se) | mg/kg wwt | 0.32 | 0.48 | 41 |
| | Total Sodium (Na) | mg/kg wwt | 495 | 382 | 26 |
| | Total Strontium (Sr) | mg/kg wwt | 8.8 | 9.8 | 11 |
| | Total Tellurium (Te) | mg/kg wwt | <0.0040 | <0.0040 | 0 |
| | Total Thallium (Tl) | mg/kg wwt | 0.0062 | 0.0071 | 15 |
| | Total Tin (Sn) | mg/kg wwt | 0.080 | 0.082 | 2.5 |
| Total Uranium (U) | mg/kg wwt | 0.23 | 0.50 | 76 | |
| Total Vanadium (V) | mg/kg wwt | 4.4 | 5.1 | 16 | |
| Total Zinc (Zn) | mg/kg wwt | 23 | 29 | 25 | |
| Total Zirconium (Zr) | mg/kg wwt | 1.5 | 1.3 | 18 | |

 > 30% Relative Percent Differences (RPD).

Table A.11: Field Duplicate Results for Analysis of Benthic Invertebrate Tissue Quality, Minto Mine, 2017

| Analyte | | Units | Lab Report L1998305 | | |
|-----------------------|-----------------------|-----------|---------------------|-------------|---------|
| | | | LWC-3 | LWC-3X | RPD (%) |
| | | | 23-Sep-2017 | 23-Sep-2017 | |
| Physical Tests | % Moisture | % | 60 | 72 | 19 |
| Metals | Total Aluminum (Al) | mg/kg wwt | 5,350 | 3,630 | 38 |
| | Total Antimony (Sb) | mg/kg wwt | 0.0153 | 0.0147 | 4.0 |
| | Total Arsenic (As) | mg/kg wwt | 1.9 | 1.3 | 37 |
| | Total Barium (Ba) | mg/kg wwt | 69 | 50 | 33 |
| | Total Beryllium (Be) | mg/kg wwt | 0.26 | 0.17 | 42 |
| | Total Bismuth (Bi) | mg/kg wwt | 0.029 | 0.021 | 34 |
| | Total Boron (B) | mg/kg wwt | 1.2 | 1.1 | 6.1 |
| | Total Cadmium (Cd) | mg/kg wwt | 0.055 | 0.041 | 28 |
| | Total Calcium (Ca) | mg/kg wwt | 3,240 | 2,250 | 36 |
| | Total Cesium (Cs) | mg/kg wwt | 0.59 | 0.45 | 26 |
| | Total Chromium (Cr) | mg/kg wwt | 16 | 11 | 38 |
| | Total Cobalt (Co) | mg/kg wwt | 4.9 | 3.1 | 44 |
| | Total Copper (Cu) | mg/kg wwt | 6.9 | 5.0 | 31 |
| | Total Iron (Fe) | mg/kg wwt | 9,550 | 6,280 | 41 |
| | Total Lead (Pb) | mg/kg wwt | 2.2 | 1.5 | 37 |
| | Total Lithium (Li) | mg/kg wwt | 4.4 | 3.0 | 40 |
| | Total Magnesium (Mg) | mg/kg wwt | 3,560 | 2,270 | 44 |
| | Total Manganese (Mn) | mg/kg wwt | 262 | 222 | 17 |
| | Total Mercury (Hg) | mg/kg wwt | 0.0086 | 0.0063 | 31 |
| | Total Molybdenum (Mo) | mg/kg wwt | 0.15 | 0.10 | 35 |
| | Total Nickel (Ni) | mg/kg wwt | 14 | 8.9 | 43 |
| | Total Phosphorus (P) | mg/kg wwt | 501 | 359 | 33 |
| | Total Potassium (K) | mg/kg wwt | 443 | 344 | 25 |
| | Total Rubidium (Rb) | mg/kg wwt | 4.9 | 3.5 | 33 |
| | Total Selenium (Se) | mg/kg wwt | 0.12 | 0.11 | 4.4 |
| | Total Sodium (Na) | mg/kg wwt | 162 | 108 | 40 |
| | Total Strontium (Sr) | mg/kg wwt | 30 | 21 | 35 |
| | Total Tellurium (Te) | mg/kg wwt | 0.0071 | <0.0040 | 56 |
| Total Thallium (Tl) | mg/kg wwt | 0.031 | 0.024 | 27 | |
| Total Tin (Sn) | mg/kg wwt | 0.13 | 0.10 | 24 | |
| Total Uranium (U) | mg/kg wwt | 0.42 | 0.27 | 44 | |
| Total Vanadium (V) | mg/kg wwt | 22 | 15 | 40 | |
| Total Zinc (Zn) | mg/kg wwt | 23 | 15 | 40 | |
| Total Zirconium (Zr) | mg/kg wwt | 4.6 | 3.2 | 37 | |

 > 30% Relative Percent Differences (RPD).

Table A.12: Field Duplicate Results for Analysis of Chlorophyll-a Quality, Minto Mine, 2017

| Analytes | Units | Lab Report L1998299 | | |
|---------------|-------------------|---------------------|-------------|---------|
| | | LWC-3 | LWC-3X | RPD (%) |
| | | 23-Sep-2017 | 23-Sep-2017 | |
| Chlorophyll-a | mg/m ² | 22 | 19 | 14 |

 > 30% Relative Percent Difference (RPD).

A7.4 Data Accuracy

Analyte recoveries for spiked blanks all met the DQO indicating excellent analytical accuracy for periphyton (chlorophyll-a, tissue) and benthic invertebrate tissue (Appendix C).

Certified reference material met the DQO for periphyton and benthic invertebrate tissue indicating good analytical accuracy (Appendix C).



A8 DATA QUALITY STATEMENT

Water, sediment, and benthic community data were all of good quality compared to DQO indicating that they can be reliably interpreted. Periphyton community showed close agreement between duplicate samples except for Rhodophyta samples. The RPD was 46% and differences could be due to the low abundance of Rhodophyta. Lack of agreement between duplicate tissue samples (periphyton, benthic invertebrate) were observed. Over 20% of the analytes measured for periphyton and benthic invertebrate duplicate tissue samples had RPDs that were greater than 30%, failing the DQO. This will be considered when analyzing the data. The overall quality of data for this project was good to serve the project objectives.



APPENDIX B
SUPPORTING INFORMATION AND DATA

Figures and Tables

Laboratory Reports

APPENDIX B
SUPPORTING INFORMATION AND DATA

Figures and Tables

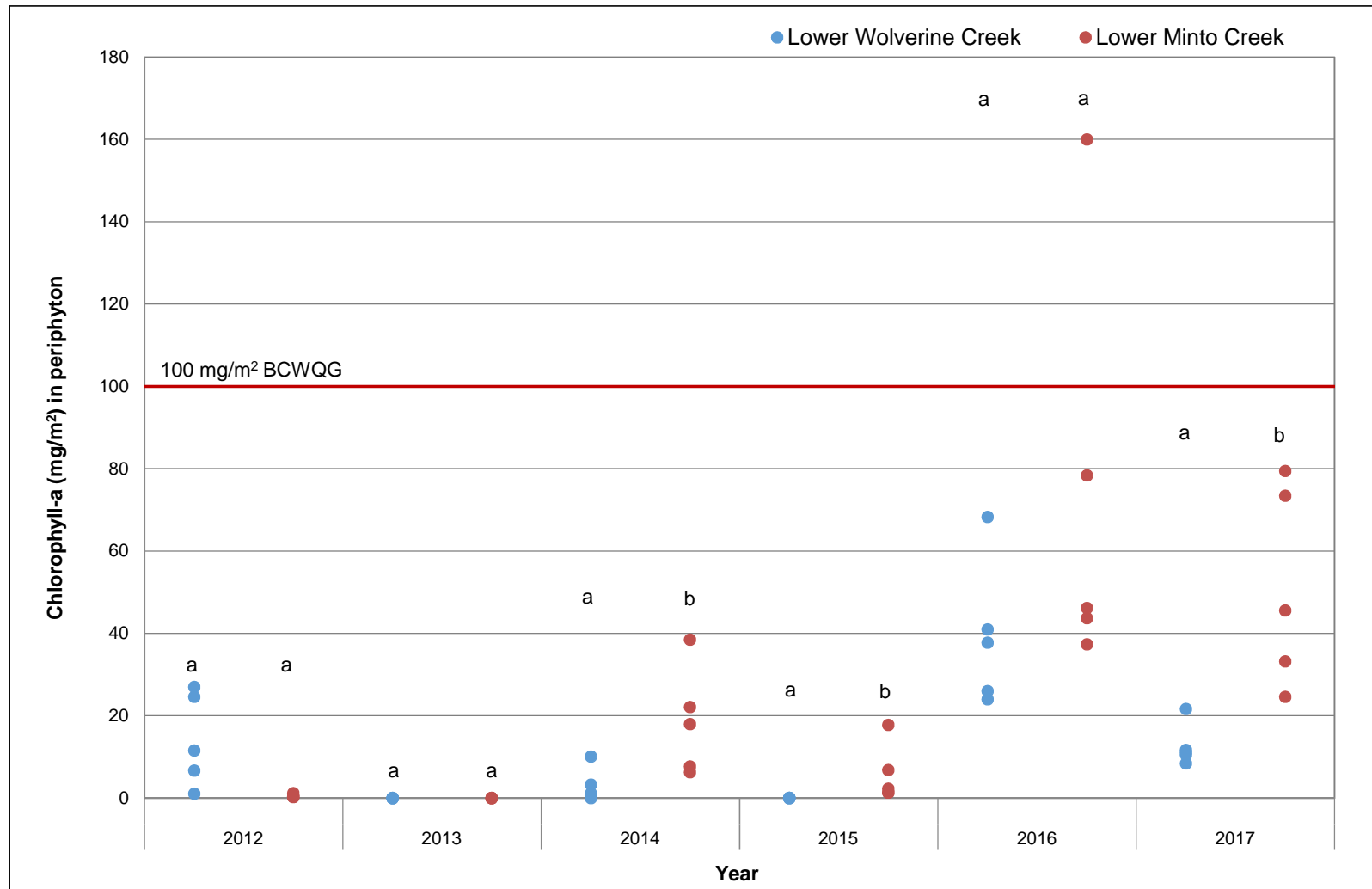


Figure B.1: Concentrations of Chlorophyll-a in Periphyton Measured in Lower Wolverine and Lower Minto Creeks, Minto Mine WUL, 2012 - 2017

Note: Different letters represent significant differences between sites within years.

Table B.1: Habitat Characteristics for Benthic Invertebrate Areas, Minto Mine, September 2017

| Characteristics | | Lower Wolverine Creek (Reference) | Lower Big Creek (Reference) | Lower Minto Creek (Exposed) |
|--|------------------|---|---------------------------------|--|
| UTM (NAD83, Zone 8V) | Easting | 382472 | 396627 | 392236 |
| | Northing | 6954814 | 694270 | 6948025 |
| Approximate Length of Reach Assessed (m) | | 200 | 150 | 20 |
| Gradient (%) | | 2 | 1 | 1 |
| Velocity (m/s) | Mean (min-max) | 0.28 (0.26 - 0.29) | 0.32 (0.29 - 0.35) | 0.28 (0.26 - 0.30) |
| Depth (cm) | Mean | 35 | 70 | 13 |
| | Maximum | 83 | 106 | 16.5 |
| Width (m) | Wetted | 8.0 | 32 | 1.8 |
| | Bankfull | 25 | 49 | 2.6 |
| General Morphology | % pool | 5 | 10 | 10 |
| | % riffle | 85 | 60 | 60 |
| | % run | 10 | 30 | 30 |
| Bank Condition | | Moderate (some undercut banks) | Moderate (some undercut banks) | Moderate (some undercut banks) |
| Substrate Coverage | % bedrock | 0 | 0 | 0 |
| | % boulder | 5 | 10 | 5 |
| | % cobble | 85 | 80 | 80 |
| | % gravel | 5 | 5 | 5 |
| | % sand and finer | 5 | 5 | 10 |
| Instream Cover (% total Surface) | undercut banks | 10 | 5 | 10 |
| | boulder | 5 | 10 | 5 |
| | woody debris | 5 | 5 | 20 |
| | deep pool | 5 | 10 | 1 |
| | macrophytes | 0 | 0 | 0 |
| | other | - | - | - |
| Overhead Canopy (%Surface) | Dense | 0 | 10 | 40 |
| | Partially Open | 0 | 0 | 40 |
| | Open | 100 | 90 | 20 |
| Aquatic Vegetation (% areal coverage) | Emergent | 0 | 0 | 0 |
| | Submergent | 0 | 0 | 0 |
| | Floating | 0 | 0 | 0 |
| | Attached Algae | 0 | 80 (brown filamentous) | 0 |
| Riparian vegetation | | willow, alder, birch, fir, rose bush, grasses | willows, alders, birch, spruce | willow, alder, grasses |
| Surrounding Land Use | | forested | forested | mine upstream, forested, previous forest fires |
| Evidence of Anthropogenic Disturbance | | none | bridge downstream / access road | mine |

Table B.2: Supporting Information for Erosional Benthic Invertebrate Grab Sample Collections, Minto Mine, September 2017

| Characteristics | | Lower Wolverine Creek (Reference) | | | | |
|---|------------------|-----------------------------------|--------------|--------------|------------------------|-------------------|
| | | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 |
| Date | | 24-Sep-17 | 24-Sep-17 | 23-Sep-17 | 23-Sep-17 | 23-Sep-17 |
| Time | | 10:32 | 8:39 | 14:59 | 12:11 | 9:35 |
| UTM (NAD83, Zone 8V) | Easting | 382419 | 382422 | 382472 | 382546 | 382561 |
| | Northing | 6954622 | 6954726 | 6954814 | 6955032 | 6955149 |
| Sampling Device | | Hess Sampler | Hess Sampler | Hess Sampler | Hess Sampler | Hess Sampler |
| Sampler Size (m ²) | | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Mesh Size (µm) | | 500 | 500 | 500 | 500 | 500 |
| Grabs in Composite | | 3 | 3 | 3 | 3 | 3 |
| Water Velocity (m/s) | | 0.27 | 0.26 | 0.29 | 0.29 | 0.29 |
| Depth (m) | | 11 | 9 | 11 | 11 | 11 |
| Number of Jars | | 1 | 1 | 1 | 1 | 1 |
| Average Depth (cm) (Sampler pushed into substrate) | | 1 | 1 | 2 | 2 | 1 |
| Average Depth (cm) (Substrate is sampled/cleaned) | | 2 | 3 | 3 | 3 | 3 |
| Average Sampling Time per Grab (min) | | 5 | 5 | 5 | 4 | 5 |
| Macrophytes (in sample) | | sparse (bryophytes) | none | none | sparse (bryophytes) | none |
| Algae (in sample) | | none | none | none | none | sparse (brown) |
| Sample Texture | % cobble | 90 | 90 | 92.5 | 95 | 95 |
| | % gravel | 5 | 5 | 2.5 | 2.5 | 2.5 |
| | % sand and finer | 5 | 5 | 5 | 2.5 | 2.5 |
| | % organic | 0 | 0 | 0 | 0 | 0 |

Table B.2: Supporting Information for Erosional Benthic Invertebrate Grab Sample Collections, Minto Mine, September 2017

| Characteristics | | Lower Big Creek (Reference) | | | | |
|---|------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| | | LBC-1 | LBC-2 | LBC-3 | LBC-4 | LBC-5 |
| Date | | 22-Sep-17 | 22-Sep-17 | 22-Sep-17 | 22-Sep-17 | 22-Sep-17 |
| Time | | 16:48 | 15:53 | 13:42 | 11:15 | 8:50 |
| UTM (NAD83, Zone 8V) | Easting | 396397 | 396499 | 396627 | 396623 | 396493 |
| | Northing | 6942238 | 6942203 | 694270 | 6942519 | 6942694 |
| Sampling Device | | Hess Sampler | Hess Sampler | Hess Sampler | Hess Sampler | Hess Sampler |
| Sampler Size (m ²) | | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Mesh Size (µm) | | 500 | 500 | 500 | 500 | 500 |
| Grabs in Composite | | 3 | 3 | 3 | 3 | 3 |
| Water Velocity (m/s) | | 0.34 | 0.35 | 0.29 | 0.32 | 0.31 |
| Depth (m) | | 10 | 9 | 7 | 11 | 9 |
| Number of Jars | | 1 | 1 | 1 | 1 | 1 |
| Average Depth (cm) (Sampler pushed into substrate) | | 3 | 2 | 3 | 2 | 3 |
| Average Depth (cm) (Substrate is sampled/cleaned) | | 3 | 3 | 2 | 3 | 3 |
| Average Sampling Time per Grab (min) | | 5 | 5 | 5 | 5 | 5 |
| Macrophytes (in sample) | | none | none | none | none | none |
| Algae (in sample) | | common (brown filamentous) | common (brown filamentous) | common (brown filamentous) | common (brown filamentous) | sparse (brown filamentous) |
| Sample Texture | % cobble | 90 | 90 | 85 | 90 | 92.5 |
| | % gravel | 5 | 5 | 10 | 5 | 2.5 |
| | % sand and finer | 5 | 5 | 5 | 5 | 5 |
| | % organic | 0 | 0 | 0 | 0 | 0 |

Table B.2: Supporting Information for Erosional Benthic Invertebrate Grab Sample Collections, Minto Mine, September 2017

| Characteristics | | Lower Minto Creek (Exposed) | | | | |
|---|------------------|-----------------------------|--------------|----------------------------|----------------------------|----------------------------|
| | | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 |
| Date | | 26-Sep-17 | 26-Sep-17 | 26-Sep-17 | 21-Sep-17 | 21-Sep-17 |
| Time | | 13:46 | 11:35 | 8:58 | 15:07 | 12:26 |
| UTM (NAD83, Zone 8V) | Easting | 392102 | 392131 | 392216 | 392236 | 392263 |
| | Northing | 6948052 | 6948044 | 6948009 | 6948025 | 6948077 |
| Sampling Device | | Hess sampler | Hess Sampler | Hess Sampler | Hess Sampler | Hess Sampler |
| Sampler Size (m ²) | | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Mesh Size (µm) | | 500 | 500 | 500 | 500 | 500 |
| Grabs in Composite | | 3 | 3 | 3 | 3 | 3 |
| Water Velocity (m/s) | | 0.29 | 0.30 | 0.30 | 0.27 | 0.26 |
| Depth (m) | | 6 | 6 | 7 | 8 | 7 |
| Number of Jars | | 1 | 1 | 1 | 1 | 1 |
| Average Depth (cm) (Sampler pushed into substrate) | | 3 | 3 | 3 | 3 | 3 |
| Average Depth (cm) (Substrate is sampled/cleaned) | | 2 | 3 | 3 | 3 | 3 |
| Average Sampling Time per Grab (min) | | 5 | 5 | 5 | 5 | 7 |
| Macrophytes (in sample) | | none | none | sparse (roots) | none | sparse (roots) |
| Algae (in sample) | | none | none | sparse (brown on rocks) | sparse (brown on rocks) | sparse (brown on rocks) |
| Sample Texture | % cobble | 90 | 95 | 90 | 80 | 90 |
| | % gravel | 5 | 2.5 | 5 | 5 | 5 |
| | % sand and finer | 5 | 2.5 | 5 | 15 | 5 |
| | % organic | 0 | 0 | 0 | 0 | 0 |

Table B.3: *In situ* Water Quality Measures at Sediment Sampling Stations, Minto Mine WUL, September 2017

| Area | Variable | Temperature | Specific Conductance | Dissolved Oxygen | Dissolved Oxygen | pH |
|-----------------------------------|-------------------------------|-------------|----------------------|------------------|------------------|------------------------|
| | Unit | °C | µS/cm | mg/L | % | pH units |
| | CCME Water Quality Guidelines | - | - | 6.5 - 9.5 | 54 | 6.5 - 9.0 ^a |
| Upper McGinty Creek (Reference) | URC-1 | 1.7 | 170.0 | 11.86 | 83.8 | 7.66 |
| | URC-2 | 1.7 | 171.4 | 11.43 | 82.0 | 7.63 |
| | URC-3 | 1.7 | 170.6 | 11.22 | 80.5 | 7.67 |
| | URC-4 | 1.6 | 177.0 | 11.24 | 80.1 | 7.74 |
| | URC-5 | 1.5 | 182.4 | 12.82 | 90.8 | 7.99 |
| | Mean | 1.6 | 174.3 | 11.71 | 83.4 | 7.74 |
| | Standard Deviation | 0.089 | 5.3 | 0.67 | 4.4 | 0.15 |
| Upper Minto Creek (Exposed) | UMC-1 | 2.8 | 605.7 | 11.35 | 82.4 | 7.76 |
| | UMC-2 | 2.6 | 601.5 | 10.48 | 76.9 | 7.76 |
| | UMC-3 | 2.5 | 604.0 | 10.80 | 78.6 | 7.77 |
| | UMC-4 | 2.5 | 603.2 | 10.40 | 76.1 | 7.76 |
| | UMC-5 | 3.0 | 594.0 | 13.49 | 92.1 | - |
| | Mean | 2.7 | 601.7 | 11.30 | 81.2 | 7.76 |
| | Standard Deviation | 0.22 | 4.6 | 1.3 | 6.5 | 0.0050 |
| Lower Wolverine Creek (Reference) | LWC-1 | 5.1 | 258.4 | 6.08 | 44.2 | 7.47 |
| | LWC-2 | 6.2 | 253.3 | 3.86 | 32.2 | 7.35 |
| | LWC-3 | 6.2 | 218.8 | 4.55 | 34.3 | 7.56 |
| | LWC-4 | 6.8 | 252.6 | 5.09 | 43.6 | 7.41 |
| | LWC-5 | 6.9 | 251.9 | 3.43 | 28.5 | 7.55 |
| | Mean | 6.2 | 247.0 | 4.60 | 36.6 | 7.47 |
| | Standard Deviation | 0.72 | 16 | 1.0 | 7.0 | 0.090 |
| Lower Minto Creek (Exposed) | LMC-1 | 3.5 | 433.0 | 8.82 | 66.1 | 8.00 |
| | LMC-2 | 3.4 | 430.5 | 8.97 | 67.3 | 7.99 |
| | LMC-3 | 3.5 | 425.0 | 9.08 | 66.2 | 8.34 |
| | LMC-4 | 4.6 | 415.2 | 9.26 | 70.9 | 7.32 |
| | LMC-5 | 4.7 | 446.9 | 9.63 | 70.2 | 6.51 |
| | Mean | 3.9 | 430.1 | 9.15 | 68.1 | 7.63 |
| | Standard Deviation | 0.65 | 12 | 0.31 | 2.3 | 0.73 |

 Value does not meet the water quality objective.

^a Range for the Water Use Licence is 6.0 - 9.0.

Table B.4: *In situ* Water Quality Measures at Benthic Invertebrate Sampling Stations, Minto Mine WUL, September 2017

| Area | Variable | Temperature | Specific Conductance | Dissolved Oxygen | Dissolved Oxygen | pH | Mean Depth | Mean Velocity |
|--------------------------------------|-------------------------------|-------------|----------------------|------------------|------------------|------------------------|------------|---------------|
| | Unit | °C | µS/cm | mg/L | % | pH units | m | m/s |
| | CCME Water Quality Guidelines | - | - | 6.5 - 9.5 | 54 | 6.5 - 9.0 ^a | - | - |
| Lower Wolverine Creek (Reference) | LWC-1 | 3.1 | 258.7 | 11.73 | 87.4 | 7.98 | 11 | 0.27 |
| | LWC-2 | 3.4 | 259.3 | 12.10 | 90.2 | 7.98 | 9 | 0.26 |
| | LWC-3 | 4.6 | 259.3 | 12.15 | 94.7 | 8.06 | 11 | 0.29 |
| | LWC-4 | 3.9 | 258.6 | 11.51 | 87.0 | 7.63 | 11 | 0.29 |
| | LWC-5 | 3.8 | 261.0 | 11.02 | 83.7 | 7.24 | 11 | 0.29 |
| | Mean | 3.8 | 259.4 | 11.70 | 88.6 | 7.78 | 11 | 0.28 |
| | Standard Deviation | 0.57 | 1.0 | 0.46 | 4.1 | 0.34 | 0.66 | 0.014 |
| Lower Big Creek (Reference) | LBC-1 | 7.0 | 262.2 | 10.72 | 88.3 | 8.47 | 10 | 0.34 |
| | LBC-2 | 7.2 | 265.0 | 10.63 | 88.2 | 8.43 | 9 | 0.35 |
| | LBC-3 | 6.3 | 172.3 | 10.60 | 85.7 | 8.27 | 7 | 0.29 |
| | LBC-4 | 5.8 | 269.6 | 9.56 | 76.3 | 7.93 | 11 | 0.32 |
| | LBC-5 | 5.5 | 271.0 | 10.33 | 81.9 | 7.94 | 9 | 0.31 |
| | Mean | 6.4 | 248.0 | 10.37 | 84.1 | 8.21 | 9 | 0.32 |
| | Standard Deviation | 0.74 | 42 | 0.47 | 5.1 | 0.26 | 1.5 | 0.024 |
| Lower Minto Creek (Exposed) | LMC-1 | 1.3 | 399.3 | 13.25 | 93.2 | 8.28 | 6 | 0.29 |
| | LMC-2 | 0.8 | 401.2 | 13.10 | 91.5 | 8.22 | 6 | 0.30 |
| | LMC-3 | 0.6 | 402.8 | 12.85 | 89.6 | 8.08 | 7 | 0.30 |
| | LMC-4 | 4.1 | 427.9 | 9.20 | 71.4 | 8.30 | 8 | 0.27 |
| | LMC-5 | 3.4 | 430.9 | 9.27 | 69.5 | 8.12 | 7 | 0.26 |
| | Mean | 2.0 | 412.4 | 11.53 | 83.0 | 8.20 | 7 | 0.28 |
| | Standard Deviation | 1.6 | 16 | 2.10 | 12 | 0.10 | 0.52 | 0.018 |

 Value does not meet the water quality objective.

^a Range for the Water Use Licence is 6.0 - 9.0.

Table B.5: Water Quality Results at Reference and Exposed Areas, Minto Mine WUL, September 2017

| Analyte | | Units | URC (Reference) | UMC (Exposed) | LWC (Reference) | LBC (Reference) | LMC (Exposed) |
|----------------------------|----------------------------------|----------|--------------------|------------------|--------------------|--------------------|------------------|
| Sampling Dates: | | | 25-Sep-17 | 26-Sep-17 | 25-Sep-17 | 26-Sep-17 | 26-Sep-17 |
| Physical Tests | Conductivity | µS/cm | 164 | 523 | 219 | 217 | 340 |
| | Hardness (as CaCO ₃) | mg/L | 113 | 260 | 107 | 103 | 175 |
| | pH | pH Units | 7.82 | 8.08 | 8.03 | 8.18 | 8.22 |
| | Total Suspended Solids | mg/L | <3.0 | <3.0 | 3.1 | <3.0 | 3.5 |
| | Total Dissolved Solids | mg/L | 163 | 317 | 165 | 152 | 225 |
| | Turbidity | NTU | 0.87 | 0.20 | 0.87 | 0.89 | 0.75 |
| Anions and Nutrients | Total Alkalinity | mg/L | 77 | 234 | 105 | 105 | 172 |
| | Total Ammonia (as N) | mg/L | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| | Chloride (Cl) | mg/L | 0.27 | 4.4 | 0.45 | 0.59 | 1.7 |
| | Fluoride (F) | mg/L | 0.33 | 0.58 | 0.13 | 0.13 | 0.44 |
| | Nitrate (as N) | mg/L | 0.069 | 0.16 | <0.0050 | 0.0053 | 0.042 |
| | Nitrite (as N) | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Phosphorus (P)-Total dissolved | mg/L | 0.011 | 0.0056 | 0.0055 | 0.0023 | 0.0038 |
| | Phosphorus (P)-Total | mg/L | 0.0089 | 0.0053 | 0.0063 | 0.0037 | 0.0050 |
| Sulfate (SO ₄) | mg/L | 14 | 55 | 21 | 16 | 20 | |
| Cyanides | Total Cyanide | mg/L | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| Organic/inorganic carbon | Dissolved Organic Carbon | mg/L | 10 | 5.8 | 14 | 7.6 | 9.0 |
| | Total Inorganic Carbon | mg/L | 16 | 54 | 22 | 22 | 38 |
| | Total Organic Carbon | mg/L | 12 | 5.5 | 14 | 7.5 | 9.0 |
| Total Metals | Total Aluminum (Al) | mg/L | 0.022 | 0.0055 | 0.038 | 0.038 | 0.018 |
| | Total Antimony (Sb) | mg/L | <0.00010 | <0.00010 | <0.00010 | 0.00014 | <0.00010 |
| | Total Arsenic (As) | mg/L | 0.00042 | 0.00025 | 0.00045 | 0.00081 | 0.00048 |
| | Total Barium (Ba) | mg/L | 0.032 | 0.068 | 0.041 | 0.066 | 0.060 |
| | Total Beryllium (Be) | mg/L | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Total Bismuth (Bi) | mg/L | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Total Boron (B) | mg/L | <0.010 | 0.025 | <0.010 | <0.010 | <0.010 |
| | Total Cadmium (Cd) | mg/L | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000078 | <0.0000050 |
| | Total Calcium (Ca) | mg/L | 24 | 59 | 24 | 26 | 45 |
| | Total Chromium (Cr) | mg/L | 0.00034 | <0.00010 | 0.00052 | 0.00030 | 0.00024 |
| | Total Cobalt (Co) | mg/L | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Total Copper (Cu) | mg/L | 0.0012 | 0.0025 | 0.0019 | 0.0019 | 0.0016 |
| | Total Iron (Fe) | mg/L | 0.26 | 0.025 | 0.13 | 0.079 | 0.067 |
| | Total Lead (Pb) | mg/L | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Total Lithium (Li) | mg/L | <0.0010 | 0.0032 | 0.0016 | 0.0012 | 0.0014 |
| | Total Magnesium (Mg) | mg/L | 6.6 | 29 | 13 | 10 | 16 |
| | Total Manganese (Mn) | mg/L | 0.021 | 0.047 | 0.0058 | 0.015 | 0.0034 |
| | Total Mercury (Hg) | mg/L | <0.0000050 | <0.0000050 | <0.0000050 | <0.000025 | <0.0000050 |
| | Total Molybdenum (Mo) | mg/L | 0.0013 | 0.0048 | 0.00057 | 0.0013 | 0.0016 |
| | Total Nickel (Ni) | mg/L | 0.00091 | 0.00092 | 0.0017 | 0.0011 | 0.00097 |
| | Total Phosphorus (P) | mg/L | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Total Potassium (K) | mg/L | 0.59 | 2.4 | 0.76 | 0.87 | 1.5 |
| | Total Selenium (Se) | mg/L | 0.00036 | 0.00031 | 0.00011 | 0.000072 | 0.000081 |
| | Total Silicon (Si) | mg/L | 6.4 | 6.3 | 5.2 | 5.9 | 6.2 |
| | Total Silver (Ag) | mg/L | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Total Sodium (Na) | mg/L | 4.4 | 19 | 8.5 | 7.8 | 10 |
| | Total Strontium (Sr) | mg/L | 0.16 | 0.77 | 0.22 | 0.28 | 0.45 |
| | Total Thallium (Tl) | mg/L | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Total Tin (Sn) | mg/L | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Total Titanium (Ti) | mg/L | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Total Uranium (U) | mg/L | 0.00054 | 0.0026 | 0.00081 | 0.0028 | 0.0017 |
| Total Vanadium (V) | mg/L | 0.00056 | <0.00050 | 0.00091 | 0.00081 | 0.00060 | |
| Total Zinc (Zn) | mg/L | 0.0051 | <0.0030 | <0.0030 | <0.0030 | 0.0044 | |
| Dissolved Metals | Dissolved Aluminum (Al) | mg/L | 0.0056 | 0.0029 | 0.020 | 0.013 | 0.0050 |
| | Dissolved Antimony (Sb) | mg/L | <0.00010 | <0.00010 | <0.00010 | 0.00012 | <0.00010 |
| | Dissolved Arsenic (As) | mg/L | 0.00019 | 0.00024 | 0.00041 | 0.00067 | 0.00046 |
| | Dissolved Barium (Ba) | mg/L | 0.022 | 0.071 | 0.041 | 0.068 | 0.063 |
| | Dissolved Beryllium (Be) | mg/L | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Dissolved Bismuth (Bi) | mg/L | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Dissolved Boron (B) | mg/L | <0.010 | 0.021 | <0.010 | <0.010 | <0.010 |
| | Dissolved Cadmium (Cd) | mg/L | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Dissolved Calcium (Ca) | mg/L | 33 | 56 | 22 | 24 | 42 |
| | Dissolved Chromium (Cr) | mg/L | 0.00015 | <0.00010 | 0.00041 | 0.00021 | 0.00019 |
| | Dissolved Cobalt (Co) | mg/L | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Dissolved Copper (Cu) | mg/L | 0.00032 | 0.0025 | 0.0033 | 0.0017 | 0.0015 |
| | Dissolved Iron (Fe) | mg/L | 0.055 | 0.020 | 0.090 | 0.039 | 0.040 |
| | Dissolved Lead (Pb) | mg/L | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Dissolved Lithium (Li) | mg/L | <0.0010 | 0.0033 | 0.0019 | 0.0016 | 0.0017 |
| | Dissolved Magnesium (Mg) | mg/L | 9.2 | 29 | 13 | 10 | 17 |
| | Dissolved Manganese (Mn) | mg/L | 0.0060 | 0.047 | 0.0035 | 0.013 | 0.0022 |
| | Dissolved Mercury (Hg) | mg/L | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Dissolved Molybdenum (Mo) | mg/L | 0.0029 | 0.0041 | 0.00049 | 0.0011 | 0.0014 |
| | Dissolved Nickel (Ni) | mg/L | <0.00050 | 0.00081 | 0.0016 | 0.00090 | 0.00086 |
| | Dissolved Phosphorus (P) | mg/L | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Dissolved Potassium (K) | mg/L | 0.73 | 2.5 | 0.79 | 0.90 | 1.6 |
| | Dissolved Selenium (Se) | mg/L | 0.00086 | 0.00032 | 0.00010 | <0.000050 | 0.00010 |
| | Dissolved Silicon (Si) | mg/L | 5.7 | 6.0 | 4.9 | 5.6 | 6.0 |
| | Dissolved Silver (Ag) | mg/L | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Dissolved Sodium (Na) | mg/L | 6.5 | 19 | 8.6 | 7.8 | 11 |
| | Dissolved Strontium (Sr) | mg/L | 0.25 | 0.71 | 0.20 | 0.26 | 0.43 |
| | Dissolved Thallium (Tl) | mg/L | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Dissolved Tin (Sn) | mg/L | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Dissolved Titanium (Ti) | mg/L | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Dissolved Uranium (U) | mg/L | 0.0012 | 0.0023 | 0.00069 | 0.0025 | 0.0016 |
| Dissolved Vanadium (V) | mg/L | 0.0011 | <0.00050 | 0.00086 | 0.00074 | 0.00057 | |
| Dissolved Zinc (Zn) | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0027 | |

Table B.6: Explanatory Notes for Selected Water Quality Guidelines, Minto Mine WUL, 2017

| Analyte | | Water Quality Guidelines | Unit | CCME ^a |
|---------------------------------------|---------------|--------------------------------------|------|---|
| Physical, anion and nutrient analytes | Total Ammonia | 0.41 | mg/L | Ammonia guideline is based on highest field pH of 8.27 and highest temperature of 6.3°C |
| | Fluoride | 0.12 | mg/L | Guideline is an interim level |
| Total Metals | Aluminum | 0.10 | mg/L | Guideline is based on pH of > 6.5 |
| | Cadmium | 0.00016 / 0.0022 ^b | mg/L | Guideline is based on lowest hardness of 103 mg/L |
| | Chromium | 0.0010 | mg/L | Guideline is based hexavalent chromium (Cr VI) |
| | Copper | 0.0024 | mg/L | Guideline is based on lowest hardness of 103 mg/L |
| | Lead | 0.0033 | mg/L | Guideline is based on lowest hardness of 103 mg/L |
| | Nickel | 0.098 | mg/L | Guideline is based on lowest hardness of 103 mg/L |

^a CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg.

^b 30 day guideline / Max guideline.

Table B.7: Comparison of Water Quality Results at Reference and Exposed Areas in 2016 and 2017, Minto Mine WUL

| Analyte | Units | CCME Water Quality Guidelines ^a | | WUL Objectives at W2 | 2016 | | | | | 2017 | | | | | |
|----------------------|------------------------|--|----------------------|----------------------|---------------------------------|-----------------------------|-----------------------------------|------------------------------|-----------------------------|---------------------------------|-----------------------------|-----------------------------------|------------------------------|-----------------------------|------------|
| | | 30 Day | Max | | Upper McGinty Creek (Reference) | Upper Minto Creek (Exposed) | Lower Wolverine Creek (Reference) | Little Big Creek (Reference) | Lower Minto Creek (Exposed) | Upper McGinty Creek (Reference) | Upper Minto Creek (Exposed) | Lower Wolverine Creek (Reference) | Little Big Creek (Reference) | Lower Minto Creek (Exposed) | |
| Physical Tests | Total Suspended Solids | mg/L | - | - | - | <3.0 | <3.0 | <3.0 | <3.0 | 3.9 | <3.0 | <3.0 | 3.1 | <3.0 | 3.5 |
| Total Metals | Total Aluminum (Al) | mg/L | 0.10 ^b | - | - | 0.095 | 0.023 | 0.060 | 0.059 | 0.041 | 0.022 | 0.0055 | 0.038 | 0.038 | 0.018 |
| | Total Antimony (Sb) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | 0.00018 | 0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00014 | <0.00010 |
| | Total Arsenic (As) | mg/L | 0.0050 | - | - | 0.00065 | 0.00021 | 0.00052 | 0.00095 | 0.00051 | 0.00042 | 0.00025 | 0.00045 | 0.00081 | 0.00048 |
| | Total Barium (Ba) | mg/L | - | - | - | 0.034 | 0.039 | 0.035 | 0.066 | 0.058 | 0.032 | 0.068 | 0.041 | 0.066 | 0.060 |
| | Total Beryllium (Be) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Total Bismuth (Bi) | mg/L | - | - | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Total Boron (B) | mg/L | 1.5 | 2.9 | - | <0.010 | 0.028 | <0.010 | <0.010 | 0.012 | <0.010 | 0.025 | <0.010 | <0.010 | <0.010 |
| | Total Cadmium (Cd) | mg/L | 0.00016 ^c | 0.0022 ^c | - | 0.0000051 | 0.000015 | <0.0000050 | 0.0000066 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000078 | <0.0000050 |
| | Total Calcium (Ca) | mg/L | - | - | - | 21 | 32 | 21 | 25 | 43 | 24 | 59 | 24 | 26 | 45 |
| | Total Chromium (Cr) | mg/L | 0.0010 Cr(VI) | - | - | 0.00058 | 0.00010 | 0.00063 | 0.00031 | 0.00025 | 0.00034 | <0.00010 | 0.00052 | 0.00030 | 0.00024 |
| | Total Cobalt (Co) | mg/L | - | - | - | 0.00019 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Total Copper (Cu) | mg/L | 0.0024 ^c | - | - | 0.0017 | 0.0066 | 0.0022 | 0.0023 | 0.0023 | 0.0012 | 0.0025 | 0.0019 | 0.0019 | 0.0016 |
| | Total Iron (Fe) | mg/L | 0.30 | - | - | 0.69 | 0.046 | 0.22 | 0.12 | 0.20 | 0.26 | 0.025 | 0.13 | 0.079 | 0.067 |
| | Total Lead (Pb) | mg/L | 0.0033 ^c | - | - | <0.000050 | <0.000050 | <0.000050 | 0.000071 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Total Lithium (Li) | mg/L | - | - | - | <0.0010 | 0.0010 | 0.0016 | 0.0014 | 0.0014 | <0.0010 | 0.0032 | 0.0016 | 0.0012 | 0.0014 |
| | Total Magnesium (Mg) | mg/L | - | - | - | 6.1 | 10 | 11 | 10 | 14 | 6.6 | 29 | 13 | 10 | 16 |
| | Total Manganese (Mn) | mg/L | - | - | - | 0.050 | 0.039 | 0.015 | 0.017 | 0.013 | 0.021 | 0.047 | 0.0058 | 0.015 | 0.0034 |
| | Total Mercury (Hg) | mg/L | 0.000026 | - | - | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.000025 | <0.0000050 |
| | Total Molybdenum (Mo) | mg/L | 0.073 | - | - | 0.0010 | 0.0024 | 0.00057 | 0.0014 | 0.0016 | 0.0013 | 0.0048 | 0.00057 | 0.0013 | 0.0016 |
| | Total Nickel (Ni) | mg/L | 0.098 ^c | - | - | 0.0014 | 0.00053 | 0.0021 | 0.0013 | 0.0011 | 0.00091 | 0.00092 | 0.0017 | 0.0011 | 0.0010 |
| | Total Phosphorus (P) | mg/L | - | - | - | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Total Potassium (K) | mg/L | - | - | - | 0.47 | 1.8 | 0.63 | 0.86 | 1.4 | 0.59 | 2.4 | 0.76 | 0.87 | 1.5 |
| | Total Selenium (Se) | mg/L | 0.0010 | - | - | 0.00027 | 0.00059 | 0.00011 | 0.00055 | 0.00022 | 0.00036 | 0.00031 | 0.00011 | 0.00072 | 0.00081 |
| | Total Silicon (Si) | mg/L | - | - | - | 7.1 | 2.3 | 6.0 | 6.5 | 5.4 | 6.4 | 6.3 | 5.2 | 5.9 | 6.2 |
| | Total Silver (Ag) | mg/L | 0.00025 | - | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Total Sodium (Na) | mg/L | - | - | - | 4.2 | 12 | 7.3 | 7.9 | 9.9 | 4.4 | 19 | 8.5 | 7.8 | 10 | |
| Total Strontium (Sr) | mg/L | - | - | - | 0.13 | 0.33 | 0.19 | 0.27 | 0.36 | 0.16 | 0.77 | 0.22 | 0.28 | 0.45 | |
| Total Thallium (Tl) | mg/L | 0.00080 | - | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| Total Tin (Sn) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| Total Titanium (Ti) | mg/L | - | - | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | |
| Total Uranium (U) | mg/L | 0.015 | 0.033 | - | 0.00043 | 0.00074 | 0.00068 | 0.0027 | 0.0010 | 0.00054 | 0.0026 | 0.00081 | 0.0028 | 0.0017 | |
| Total Vanadium (V) | mg/L | - | - | - | 0.0011 | <0.00050 | 0.0012 | 0.0011 | 0.00075 | 0.00056 | <0.00050 | 0.00091 | 0.00081 | 0.00060 | |
| Total Zinc (Zn) | mg/L | 0.030 | - | - | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0051 | <0.0030 | <0.0030 | <0.0030 | 0.0044 | |

Water use licence objectives not met.
 Water quality guideline not met.

^a CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

^b Based on lowest guideline using highest pH.


^c Based on lowest guideline using lowest hardness.


^d Dissolved Cadmium (µg/L) guidelines based on the following formula using the lowest hardness: $e^{(0.736(\ln(\text{Hardness})-4.943)}$.

^e Dissolved copper water quality objective depends on concentration of dissolved organic carbon (DOC). If DOC is > 10 mg/L/ DOC is ≤ 10 mg/L.

Table B.7: Comparison of Water Quality Results at Reference and Exposed Areas in 2016 and 2017, Minto Mine WUL

| Analyte | Units | CCME Water Quality Guidelines ^a | | WUL Objectives at W2 | 2016 | | | | | 2017 | | | | |
|---------------------------|-------|--|-----|--------------------------|---------------------------------|-----------------------------|-----------------------------------|------------------------------|-----------------------------|---------------------------------|-----------------------------|-----------------------------------|------------------------------|-----------------------------|
| | | 30 Day | Max | | Upper McGinty Creek (Reference) | Upper Minto Creek (Exposed) | Lower Wolverine Creek (Reference) | Little Big Creek (Reference) | Lower Minto Creek (Exposed) | Upper McGinty Creek (Reference) | Upper Minto Creek (Exposed) | Lower Wolverine Creek (Reference) | Little Big Creek (Reference) | Lower Minto Creek (Exposed) |
| Dissolved Aluminum (Al) | mg/L | - | - | 0.10 | 0.029 | 0.0017 | 0.027 | 0.017 | 0.0052 | 0.0056 | 0.0029 | 0.020 | 0.013 | 0.0050 |
| Dissolved Antimony (Sb) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | 0.00014 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00012 | <0.00010 |
| Dissolved Arsenic (As) | mg/L | - | - | 0.0050 | 0.00053 | 0.00018 | 0.00046 | 0.00075 | 0.00047 | 0.00019 | 0.00024 | 0.00041 | 0.00067 | 0.00046 |
| Dissolved Barium (Ba) | mg/L | - | - | - | 0.032 | 0.038 | 0.036 | 0.066 | 0.058 | 0.022 | 0.071 | 0.041 | 0.068 | 0.063 |
| Dissolved Beryllium (Be) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Dissolved Bismuth (Bi) | mg/L | - | - | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Dissolved Boron (B) | mg/L | - | - | - | <0.010 | 0.027 | <0.010 | <0.010 | 0.012 | <0.010 | 0.021 | <0.010 | <0.010 | <0.010 |
| Dissolved Cadmium (Cd) | mg/L | - | - | 0.00022 ^d | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| Dissolved Calcium (Ca) | mg/L | - | - | - | 20 | 32 | 21 | 25 | 42 | 33 | 56 | 22 | 24 | 42 |
| Dissolved Chromium (Cr) | mg/L | - | - | 0.0010 | 0.00037 | <0.00010 | 0.00049 | 0.00021 | 0.00016 | 0.00015 | <0.00010 | 0.00041 | 0.00021 | 0.00019 |
| Dissolved Cobalt (Co) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Dissolved Copper (Cu) | mg/L | - | - | 0.020/0.013 ^e | 0.0013 | 0.0057 | 0.0020 | 0.0019 | 0.0021 | 0.00032 | 0.0025 | 0.0033 | 0.0017 | 0.0015 |
| Dissolved Iron (Fe) | mg/L | - | - | 1.1 | 0.35 | <0.010 | 0.17 | 0.047 | 0.10 | 0.055 | 0.020 | 0.090 | 0.039 | 0.040 |
| Dissolved Lead (Pb) | mg/L | - | - | 0.0040 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Dissolved Lithium (Li) | mg/L | - | - | - | <0.0010 | <0.0010 | 0.0015 | 0.0014 | 0.0014 | <0.0010 | 0.0033 | 0.0019 | 0.0016 | 0.0017 |
| Dissolved Magnesium (Mg) | mg/L | - | - | - | 6.0 | 10 | 11 | 10 | 13 | 9.2 | 29 | 13 | 10 | 17 |
| Dissolved Manganese (Mn) | mg/L | - | - | - | 0.029 | 0.015 | 0.012 | 0.015 | 0.0051 | 0.0060 | 0.047 | 0.0035 | 0.013 | 0.0022 |
| Dissolved Mercury (Hg) | mg/L | - | - | - | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| Dissolved Molybdenum (Mo) | mg/L | - | - | 0.073 | 0.00080 | 0.0021 | 0.00044 | 0.0012 | 0.0015 | 0.0029 | 0.0041 | 0.00049 | 0.0011 | 0.0014 |
| Dissolved Nickel (Ni) | mg/L | - | - | 0.11 | 0.0012 | <0.00050 | 0.0019 | 0.0011 | 0.0010 | <0.00050 | 0.00081 | 0.0016 | 0.00090 | 0.00086 |
| Dissolved Phosphorus (P) | mg/L | - | - | - | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| Dissolved Potassium (K) | mg/L | - | - | - | 0.47 | 1.8 | 0.65 | 0.85 | 1.4 | 0.73 | 2.5 | 0.79 | 0.90 | 1.6 |
| Dissolved Selenium (Se) | mg/L | - | - | 0.0020 | 0.00030 | 0.00069 | 0.00013 | 0.00073 | 0.00023 | 0.00086 | 0.00032 | 0.00010 | <0.000050 | 0.00010 |
| Dissolved Silicon (Si) | mg/L | - | - | - | 6.8 | 2.2 | 5.8 | 6.3 | 5.1 | 5.7 | 6.0 | 4.9 | 5.6 | 6.0 |
| Dissolved Silver (Ag) | mg/L | - | - | 0.00010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Dissolved Sodium (Na) | mg/L | - | - | - | 4.1 | 11 | 7.3 | 7.7 | 9.7 | 6.5 | 19 | 8.6 | 7.8 | 11 |
| Dissolved Strontium (Sr) | mg/L | - | - | - | 0.12 | 0.32 | 0.18 | 0.26 | 0.36 | 0.25 | 0.71 | 0.20 | 0.26 | 0.43 |
| Dissolved Thallium (Tl) | mg/L | - | - | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Dissolved Tin (Sn) | mg/L | - | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Dissolved Titanium (Ti) | mg/L | - | - | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Dissolved Uranium (U) | mg/L | - | - | - | 0.00036 | 0.00065 | 0.00061 | 0.0025 | 0.00090 | 0.0012 | 0.0023 | 0.00069 | 0.0025 | 0.0016 |
| Dissolved Vanadium (V) | mg/L | - | - | - | 0.00050 | <0.00050 | 0.00092 | 0.00080 | <0.00050 | 0.0011 | <0.00050 | 0.00086 | 0.00074 | 0.00057 |
| Dissolved Zinc (Zn) | mg/L | - | - | 0.030 | <0.0010 | 0.0036 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0027 |

 Water use licence objectives not met.

 Water quality guideline not met.

^a CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

^b Based on lowest guideline using highest pH.


^c Based on lowest guideline using lowest hardness.

^d Dissolved Cadmium (µg/L) guidelines based on the following formula using the lowest hardness: $e^{(0.736(\ln(\text{Hardness})-4.943))}$.

^e Dissolved copper water quality objective depends on concentration of dissolved organic carbon (DOC). If DOC is > 10 mg/L/ DOC is ≤ 10 mg/L.

Table B.8: Concentration of Chlorophyll-a Measured at Five Benthic Stations in Lower Wolverine and Lower Minto Creeks, Minto Mine WUL, 2017

| Lower Wolverine Creek (Reference) | | Lower Minto Creek (Exposed) | |
|--------------------------------------|-------------------|--------------------------------|-------------------|
| Station | mg/m ² | Station | mg/m ² |
| LWC-1 | 8.4 | LMC-1 | 25 |
| LWC-2 | 11 | LMC-2 | 80 |
| LWC-3 | 22 | LMC-3 | 46 |
| LWC-4 | 11 | LMC-4 | 33 |
| LWC-5 | 12 | LMC-5 | 74 |
| Mean | 13 | Mean | 51 |
| Standard Deviation | 5.2 | Standard Deviation | 24 |

 Chlorophyll-a exceeded the BCWQG of 100 mg/m².

APPENDIX B
SUPPORTING INFORMATION AND DATA

Laboratory Reports



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 27-SEP-17
Report Date: 03-OCT-17 18:08 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1998023
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT
C of C Numbers: 1 of 1
Legal Site Desc:

Can Dang
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1998023-1 Water 25-SEP-17 URC | L1998023-2 Water 25-SEP-17 LWC | | |
|-----------------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Physical Tests | Conductivity (uS/cm) | 164 | 219 | | |
| | Hardness (as CaCO3) (mg/L) | 113 | 107 | | |
| | pH (pH) | 7.82 | 8.03 | | |
| | Total Suspended Solids (mg/L) | <3.0 | 3.1 | | |
| | Total Dissolved Solids (mg/L) | 163 | 165 | | |
| | Turbidity (NTU) | 0.87 | 0.87 | | |
| Anions and Nutrients | Alkalinity, Total (as CaCO3) (mg/L) | 77.3 | 105 | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | <0.0050 | | |
| | Chloride (Cl) (mg/L) | 0.27 | 0.45 | | |
| | Fluoride (F) (mg/L) | 0.326 | 0.134 | | |
| | Nitrate (as N) (mg/L) | 0.0688 | <0.0050 | | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | | |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0106 | 0.0055 | | |
| | Phosphorus (P)-Total (mg/L) | 0.0089 | 0.0063 | | |
| | Sulfate (SO4) (mg/L) | 13.7 | 20.6 | | |
| Cyanides | Cyanide, Total (mg/L) | <0.0050 | <0.0050 | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | 10.3 | 13.6 | | |
| | Total Inorganic Carbon (mg/L) | 15.9 | 21.5 | | |
| | Total Organic Carbon (mg/L) | 11.5 | 13.5 | | |
| Total Metals | Aluminum (Al)-Total (mg/L) | 0.0219 | 0.0379 | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Total (mg/L) | 0.00042 | 0.00045 | | |
| | Barium (Ba)-Total (mg/L) | 0.0318 | 0.0413 | | |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | | |
| | Bismuth (Bi)-Total (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Total (mg/L) | <0.010 | <0.010 | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0000050 | <0.0000050 | | |
| | Calcium (Ca)-Total (mg/L) | 23.8 | 23.8 | | |
| | Chromium (Cr)-Total (mg/L) | 0.00034 | 0.00052 | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Total (mg/L) | 0.00118 | 0.00185 | | |
| | Iron (Fe)-Total (mg/L) | 0.263 | 0.130 | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Total (mg/L) | <0.0010 | 0.0016 | | |
| | Magnesium (Mg)-Total (mg/L) | 6.62 | 12.6 | | |
| | Manganese (Mn)-Total (mg/L) | 0.0208 | 0.00582 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1998023-1 Water 25-SEP-17 URC | L1998023-2 Water 25-SEP-17 LWC | | |
|-------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00127 | 0.000570 | | |
| | Nickel (Ni)-Total (mg/L) | 0.00091 | 0.00174 | | |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | | |
| | Potassium (K)-Total (mg/L) | 0.591 | 0.757 | | |
| | Selenium (Se)-Total (mg/L) | 0.000356 | 0.000109 | | |
| | Silicon (Si)-Total (mg/L) | 6.38 | 5.20 | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Total (mg/L) | 4.44 | 8.53 | | |
| | Strontium (Sr)-Total (mg/L) | 0.164 | 0.220 | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Total (mg/L) | <0.010 | <0.010 | | |
| | Uranium (U)-Total (mg/L) | 0.000537 | 0.000812 | | |
| | Vanadium (V)-Total (mg/L) | 0.00056 | 0.00091 | | |
| | Zinc (Zn)-Total (mg/L) | 0.0051 | <0.0030 | | |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0056 | 0.0199 | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00019 | 0.00041 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0221 | 0.0408 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 32.7 ^{DTC} | 21.8 | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00015 | 0.00041 | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00032 | 0.00332 | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.055 | 0.090 | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | <0.0010 | 0.0019 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 9.23 ^{DTC} | 12.7 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00604 | 0.00347 | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00293 ^{DTC} | 0.000489 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1998023-1 Water 25-SEP-17 URC | L1998023-2 Water 25-SEP-17 LWC | | |
|-------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Dissolved Metals | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | 0.00156 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | | |
| | Potassium (K)-Dissolved (mg/L) | 0.734 ^{DTC} | 0.794 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.000857 ^{DTC} | 0.000102 | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.73 | 4.88 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 6.46 ^{DTC} | 8.57 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.245 ^{DTC} | 0.201 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00119 ^{DTC} | 0.000692 | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.00105 | 0.00086 | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0010 | <0.0010 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1998023-1, -2 |
| Matrix Spike | Total Inorganic Carbon | MS-B | L1998023-1, -2 |
| Matrix Spike | Total Inorganic Carbon | MS-B | L1998023-1, -2 |
| Matrix Spike | Total Organic Carbon | MS-B | L1998023-1, -2 |
| Matrix Spike | Total Organic Carbon | MS-B | L1998023-1, -2 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| BR-L-IC-N-WR | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CARBONS-TIC-VA | Water | Total inorganic carbon by CO2 purge | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". | | | |
| CARBONS-TOC-VA | Water | Total organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CN-T-CFA-VA | Water | Total Cyanide in water by CFA | ISO 14403:2002 |
| This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| F-IC-N-WR | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |

Reference Information

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

| | | | |
|---|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| P-T-PRES-COL-VA | Water | Total P in Water by Colour | APHA 4500-P Phosphorus |
| This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample. | | | |
| Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples. | | | |
| Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis. | | | |
| P-TD-COL-VA | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |
| This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter. | | | |
| Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples. | | | |
| Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-VA | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. | | | |
| Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |
| TURBIDITY-VA | Water | Turbidity by Meter | APHA 2130 Turbidity |
| This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

Reference Information

1 of 1

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 27-SEP-17
Report Date: 02-OCT-17 16:28 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1998329
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT
C of C Numbers: 1 of 1
Legal Site Desc:

Can Dang
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998329-1 | L1998329-2 | L1998329-3 | L1998329-4 |
|-----------------------------------|---------------------------------------|--------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 26-SEP-17 | 26-SEP-17 | 26-SEP-17 | 26-SEP-17 |
| | | Sampled Time | | | | |
| | | Client ID | LMC | LBC | LBCX | 4MC |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Physical Tests | Conductivity (uS/cm) | | 340 | 217 | 214 | 523 |
| | Hardness (as CaCO3) (mg/L) | | 175 | 103 | 103 | 260 |
| | pH (pH) | | 8.22 | 8.18 | 8.16 | 8.08 |
| | Total Suspended Solids (mg/L) | | 3.5 | <3.0 | 4.1 | <3.0 |
| | Total Dissolved Solids (mg/L) | | 225 | 152 | 150 | 317 |
| | Turbidity (NTU) | | 0.75 | 0.89 | 0.87 | 0.20 |
| Anions and Nutrients | Alkalinity, Total (as CaCO3) (mg/L) | | 172 | 105 | 98.2 | 234 |
| | Ammonia, Total (as N) (mg/L) | | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| | Chloride (Cl) (mg/L) | | 1.65 | 0.59 | 0.59 | 4.41 |
| | Fluoride (F) (mg/L) | | 0.442 | 0.132 | 0.136 | 0.583 |
| | Nitrate (as N) (mg/L) | | 0.0423 | 0.0053 | 0.0055 | 0.160 |
| | Nitrite (as N) (mg/L) | | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Phosphorus (P)-Total Dissolved (mg/L) | | 0.0038 | 0.0023 | 0.0023 | 0.0056 |
| | Phosphorus (P)-Total (mg/L) | | 0.0050 | 0.0037 | 0.0022 | 0.0053 |
| | Sulfate (SO4) (mg/L) | | 20.0 | 16.4 | 16.4 | 55.3 |
| Cyanides | Cyanide, Total (mg/L) | | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | 9.02 | 7.63 | 7.67 | 5.84 |
| | Total Inorganic Carbon (mg/L) | | 38.1 | 22.3 | 22.3 | 54.2 |
| | Total Organic Carbon (mg/L) | | 9.02 | 7.50 | 7.57 | 5.54 |
| Total Metals | Aluminum (Al)-Total (mg/L) | | 0.0181 | 0.0376 | 0.0409 | 0.0055 |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | 0.00014 | 0.00015 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | | 0.00048 | 0.00081 | 0.00079 | 0.00025 |
| | Barium (Ba)-Total (mg/L) | | 0.0604 | 0.0664 | 0.0661 | 0.0680 |
| | Beryllium (Be)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Total (mg/L) | | <0.010 | <0.010 | <0.010 | 0.025 |
| | Cadmium (Cd)-Total (mg/L) | | <0.0000050 | 0.0000078 | 0.0000051 | <0.0000050 |
| | Calcium (Ca)-Total (mg/L) | | 45.3 | 25.8 | 25.3 | 59.0 |
| | Chromium (Cr)-Total (mg/L) | | 0.00024 | 0.00030 | 0.00025 | <0.00010 |
| | Cobalt (Co)-Total (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | | 0.00159 | 0.00193 | 0.00200 | 0.00251 |
| | Iron (Fe)-Total (mg/L) | | 0.067 | 0.079 | 0.087 | 0.025 |
| | Lead (Pb)-Total (mg/L) | | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | | 0.0014 | 0.0012 | 0.0014 | 0.0032 |
| | Magnesium (Mg)-Total (mg/L) | | 16.3 | 10.2 | 10.3 | 28.8 |
| | Manganese (Mn)-Total (mg/L) | | 0.00336 | 0.0145 | 0.0144 | 0.0474 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1998329-1 Water 26-SEP-17 LMC | L1998329-2 Water 26-SEP-17 LBC | L1998329-3 Water 26-SEP-17 LBCX | L1998329-4 Water 26-SEP-17 4MC |
|---|---------------------------------------|---|---|--|---|
| Grouping | Analyte | | | | |
| WATER | | | | | |
| Total Metals | Mercury (Hg)-Total (mg/L) | <0.0000050 | <0.000025 ^{DLM} | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00163 | 0.00127 | 0.00122 | 0.00480 |
| | Nickel (Ni)-Total (mg/L) | 0.00097 | 0.00106 | 0.00104 | 0.00092 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 1.51 | 0.865 | 0.869 | 2.35 |
| | Selenium (Se)-Total (mg/L) | 0.000081 | 0.000072 | 0.000076 | 0.000310 |
| | Silicon (Si)-Total (mg/L) | 6.22 | 5.86 | 5.85 | 6.33 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 10.2 | 7.81 | 7.98 | 18.7 |
| | Strontium (Sr)-Total (mg/L) | 0.448 | 0.275 | 0.275 | 0.767 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Total (mg/L) | 0.00174 | 0.00279 | 0.00276 | 0.00259 |
| | Vanadium (V)-Total (mg/L) | 0.00060 | 0.00081 | 0.00081 | <0.00050 |
| | Zinc (Zn)-Total (mg/L) | 0.0044 | <0.0030 | <0.0030 | <0.0030 |
| Dissolved Metals | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0050 | 0.0126 | 0.0126 | 0.0029 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00012 | 0.00012 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00046 | 0.00067 | 0.00066 | 0.00024 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0628 | 0.0683 | 0.0674 | 0.0709 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | 0.021 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Calcium (Ca)-Dissolved (mg/L) | 42.4 | 24.1 | 24.1 | 55.6 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00019 | 0.00021 | 0.00021 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00153 | 0.00174 | 0.00173 | 0.00253 |
| | Iron (Fe)-Dissolved (mg/L) | 0.040 | 0.039 | 0.041 | 0.020 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0017 | 0.0016 | 0.0015 | 0.0033 |
| | Magnesium (Mg)-Dissolved (mg/L) | 16.9 | 10.4 | 10.4 | 29.4 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00221 | 0.0128 | 0.0129 | 0.0467 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00142 | 0.00111 | 0.00111 | 0.00414 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998329-1 | L1998329-2 | L1998329-3 | L1998329-4 |
|-------------------------|---------------------------------|--------------|------------|------------|------------|------------|
| | | Description | Water | Water | Water | Water |
| | | Sampled Date | 26-SEP-17 | 26-SEP-17 | 26-SEP-17 | 26-SEP-17 |
| | | Sampled Time | | | | |
| | | Client ID | LMC | LBC | LBCX | 4MC |
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Dissolved Metals | Nickel (Ni)-Dissolved (mg/L) | | 0.00086 | 0.00090 | 0.00088 | 0.00081 |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | | 1.59 | 0.897 | 0.900 | 2.48 |
| | Selenium (Se)-Dissolved (mg/L) | | 0.000101 | <0.000050 | 0.000051 | 0.000321 |
| | Silicon (Si)-Dissolved (mg/L) | | 6.01 | 5.63 | 5.60 | 6.00 |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | | 10.5 | 7.77 | 7.73 | 18.7 |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.428 | 0.262 | 0.259 | 0.711 |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | | 0.00156 | 0.00248 | 0.00246 | 0.00227 |
| | Vanadium (V)-Dissolved (mg/L) | | 0.00057 | 0.00074 | 0.00074 | <0.00050 |
| | Zinc (Zn)-Dissolved (mg/L) | | 0.0027 | <0.0010 | 0.0013 | <0.0010 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1998329-1, -2, -3, -4 |
| Matrix Spike | Total Inorganic Carbon | MS-B | L1998329-1, -2, -3, -4 |
| Matrix Spike | Total Inorganic Carbon | MS-B | L1998329-1, -2, -3, -4 |
| Matrix Spike | Total Organic Carbon | MS-B | L1998329-1, -2, -3, -4 |
| Matrix Spike | Total Organic Carbon | MS-B | L1998329-1, -2, -3, -4 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|---------------------------------------|
| ALK-TITR-VA | Water | Alkalinity Species by Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| BR-L-IC-N-WR | Water | Bromide in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CARBONS-TIC-VA | Water | Total inorganic carbon by CO2 purge | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". | | | |
| CARBONS-TOC-VA | Water | Total organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". | | | |
| CL-L-IC-N-WR | Water | Chloride in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| CN-T-CFA-VA | Water | Total Cyanide in water by CFA | ISO 14403:2002 |
| This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero. | | | |
| EC-PCT-VA | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| F-IC-N-WR | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| HARDNESS-CALC-VA | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| HG-D-CVAA-VA | Water | Diss. Mercury in Water by CVAAS or CVAFS | APHA 3030B/EPA 1631E (mod) |
| Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| HG-T-CVAA-VA | Water | Total Mercury in Water by CVAAS or CVAFS | EPA 1631E (mod) |
| Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS. | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |

Reference Information

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

| | | | |
|--|-------|---------------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | APHA 4500 NH3-NITROGEN (AMMONIA) |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |
| NO2-L-IC-N-WR | Water | Nitrite in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-L-IC-N-WR | Water | Nitrate in Water by IC (Low Level) | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| P-T-PRES-COL-VA | Water | Total P in Water by Colour | APHA 4500-P Phosphorus |
| This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample. Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples. | | | |
| Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis. | | | |
| P-TD-COL-VA | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |
| This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter. Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples. | | | |
| Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis. | | | |
| PH-PCT-VA | Water | pH by Meter (Automated) | APHA 4500-H pH Value |
| This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode | | | |
| It is recommended that this analysis be conducted in the field. | | | |
| SO4-IC-WR | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| TDS-VA | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius. | | | |
| TSS-VA | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |
| This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples. | | | |
| TURBIDITY-VA | Water | Turbidity by Meter | APHA 2130 Turbidity |
| This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| WR | ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

Reference Information

1 of 1

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| | | |
|---|---|--|
| Report To | Report Format / Distribution | Service Requested (Rush for routine analysis subject to availability) |
| Company: Minnow Environmental Inc. | <input checked="" type="checkbox"/> Standard <input type="checkbox"/> Other | <input type="radio"/> Regular (Standard Turnaround Times - Business Days) |
| Contact: Lisa Bowron | <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Digital <input type="checkbox"/> Fax | <input checked="" type="radio"/> Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT |
| Address: 101 - 1025 Hillside Ave. Victoria, BC | Email 1: lbowron@minnow.ca Email 2: pstecko@minnow.ca | <input type="radio"/> Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT |
| Phone: (250)595-1627 x21 Fax: (250) 595-1625 | Email 3: | <input type="radio"/> Same Day or Weekend Emergency - Contact ALS to Confirm TAT |

| | | | | | | | | | | | | | | |
|---|-------------------------------------|--|------------------------|------------------------------|-------------------------------|--------------------------|---------|-------------------------------|--------------------------|--------------------|------------------------------|-------------------------|------------------------------|----------------------|
| Invoice To Same as Report? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Client / Project Information | Analysis Request Please indicate below Filtered, Preserved or both (F, P, F/P) | | | | | | | | | | | | |
| Hardcopy of Invoice with Report? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Job #: Minnow Project | Metals by CCMS & ICPOES | Mercury by CVAFS (Low) | Alkalinity by Auto Titration | Phosphorus in water by colour | Organic/Inorganic Carbon | Cyanide | Conductivity, Hardness and pH | TDS & TSS by Gravimetric | Turbidity by Meter | Anions by Ion Chromatography | Ammonia by Fluorescence | **See Complete Quote #Q51327 | Number of Containers |
| Company: Minto Explorations Ltd | PO / AFE: | | | | | | | | | | | | | |
| Contact: Cindy Keehn | LSD: | | | | | | | | | | | | | |
| Address: Suite 2100 - 510 West Georgia St., Vancouver, BC | Quote #: Q51327 | | | | | | | | | | | | | |
| Phone: 604-684-8894 Fax: 604-688-2180 | ALS Jerry Contact: Holzbecher | Sampler: Lisa Bowron | | | | | | | | | | | | |

Lab Work Order # _____ (lab use only)

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Metals by CCMS & ICPOES | Mercury by CVAFS (Low) | Alkalinity by Auto Titration | Phosphorus in water by colour | Organic/Inorganic Carbon | Cyanide | Conductivity, Hardness and pH | TDS & TSS by Gravimetric | Turbidity by Meter | Anions by Ion Chromatography | Ammonia by Fluorescence | **See Complete Quote #Q51327 | Number of Containers |
|----------|---|---------------------|-----------------|-------------|-------------------------|------------------------|------------------------------|-------------------------------|--------------------------|---------|-------------------------------|--------------------------|--------------------|------------------------------|-------------------------|------------------------------|----------------------|
| | LMC | 26-Sep-17 | | Water | X | X | X | X | X | X | X | X | X | X | X | X | 9 |
| | LBC | 26-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | X | X | 9 |
| | LBCX | 26-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | X | X | 9 |
| | LMC | 26-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | X | X | 9 |

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

| SHIPMENT, RELEASE (client use) | | | SHIPMENT, RECEPTION (lab use only) | | | SHIPMENT, VERIFICATION (lab use only) | | | Observations: | |
|---------------------------------|-------------------------------|---------------|------------------------------------|--------------------|----------------|---------------------------------------|--------------|-------|---------------|------------------------------|
| Released by: <i>Low Gunn</i> | Date (dd-mmm-yy): 27-09-17 | Time (hh-mm): | Received by: <i>[Signature]</i> | Date: Sep 27/17 | Time: 12:15 | Temperature: 2 °C | Verified by: | Date: | Time: | Yes / No ? If Yes add SIF |

Low Gunn SEP 28/17. 10:25.3 °C.
AM



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 27-SEP-17
Report Date: 13-OCT-17 15:16 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1998299
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT
C of C Numbers: 1 of 1
Legal Site Desc:

Can Dang
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998299-1 | L1998299-2 | L1998299-3 | L1998299-4 | L1998299-5 |
|-----------------------|-----------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Tissue | Tissue | Tissue | Tissue | Tissue |
| | | Sampled Date | 21-SEP-17 | 21-SEP-17 | 23-SEP-17 | 23-SEP-17 | 23-SEP-17 |
| | | Sampled Time | | | | | |
| | | Client ID | LMC-5 | LMC-4 | LWC-5 | LWC-4 | LWC-3 |
| Grouping | Analyte | | | | | | |
| BIOTA | | | | | | | |
| Field Tests | Area Sampled (cm2) | | 16 | 16 | 16 | 16 | 16 |
| Plant Pigments | Chlorophyll a (mg/m2) | | 73.5 | 33.2 | 11.7 | 10.5 | 21.7 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998299-6 | L1998299-7 | L1998299-8 | L1998299-9 | L1998299-10 |
|-----------------------|-----------------------|--------------|------------|------------|------------|------------|-------------|
| | | Description | Tissue | Tissue | Tissue | Tissue | Tissue |
| | | Sampled Date | 24-SEP-17 | 24-SEP-17 | 23-SEP-17 | 26-SEP-17 | 26-SEP-17 |
| | | Sampled Time | | | | | |
| | | Client ID | LWC-2 | LWC-1 | LWC-3X | LMC-3 | LMC-2 |
| Grouping | Analyte | | | | | | |
| BIOTA | | | | | | | |
| Field Tests | Area Sampled (cm2) | 16 | 16 | 16 | 16 | 16 | 16 |
| Plant Pigments | Chlorophyll a (mg/m2) | 11.1 | 8.43 | 18.9 | 45.6 | 79.5 | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1998299-11 Tissue 26-SEP-17 LMC-1 | | | | |
|--|---|------|--|--|--|
| Grouping | Analyte | | | | |
| BIOTA | | | | | |
| Field Tests | Area Sampled (cm2) | 16 | | | |
| Plant Pigments | Chlorophyll a (mg/m2) | 24.6 | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|-----------------|--------|---------------------------------------|--------------------|
| AREA SAMPLED-VA | Biota | Area Sampled (cm2) | Not Applicable |
| CHLOROA-F-VA | Biota | Chlorophyll a in Biota by Fluorometer | EPA 445.0 |

This analysis is done using procedures adapted from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b. Note: Biota samples are typically submitted as scrapings on a filter.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

1 of 1

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| | | |
|---|---|---|
| Report To | Report Format / Distribution | Service Requested (Rush for routine analysis subject to availability) |
| Company: Minnow Environmental Inc. | <input checked="" type="checkbox"/> Standard <input type="checkbox"/> Other | <input checked="" type="radio"/> Regular (Standard Turnaround Times - Business Days) |
| Contact: Lisa Bowron | <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Digital <input type="checkbox"/> Fax | <input type="radio"/> Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT |
| Address: 101 - 1025 Hillside Ave. Victoria, BC | Email 1: lbowron@minnow.ca Email 2: pstECKO@minnow.ca | <input type="radio"/> Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT |
| Phone: (250)595-1627 x21 Fax: (250) 595-1625 | Email 3: | <input type="radio"/> Same Day or Weekend Emergency - Contact ALS to Confirm TAT |

| | | | |
|---|-------------------------------------|---|------------------------------|
| Invoice To Same as Report? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Client / Project Information | Analysis Request | |
| Hardcopy of Invoice with Report? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Job #: Minnow Project | Please indicate below Filtered, Preserved or both (F, P, F/P) | |
| Company: Minto Explorations Ltd | PO / AFE: | Chlorophyll a | **See Complete Quote #Q51327 |
| Contact: Cindy Keehn | LSD: | | |
| Address: Suite 2100 - 510 West George St., Vancouver, BC | Quote #: Q51327 | | |
| Phone: 604-684-8894 Fax: 604-688-2180 | | | |

| | | |
|------------------------------------|-------------------------------|----------------------|
| Lab Work Order # (lab use only) | ALS Contact: Jerry Holzbecher | Sampler: Lisa Bowron |
|------------------------------------|-------------------------------|----------------------|

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Chlorophyll a | **See Complete Quote #Q51327 | Number of Containers |
|----------|---|---------------------|-----------------|-------------|---------------|------------------------------|----------------------|
| | LMC-5 | 21-Sep-17 | | Tissue | X | X | 1 |
| | LMC-4 | 21-Sep-17 | | | X | X | 1 |
| | LWC-5 | 23-Sep-17 | | | X | X | 1 |
| | LWC-4 | 23-Sep-17 | | | X | X | 1 |
| | LWC-3 | 23-Sep-17 | | | X | X | 1 |
| | LWC-2 | 24-Sep-17 | | | X | X | 1 |
| | LWC-1 | 24-Sep-17 | | | X | X | 1 |
| | LWC-3x | 23-Sep-17 | | | X | X | 1 |
| | LMC-3 | 26-Sep-17 | | | X | X | 1 |
| | Lmc-2 | 26-Sep-17 | | | X | X | 1 |
| | Lmc-1 | 26-Sep-17 | | | X | X | 1 |

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs. Periphytic samples.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | SHIPMENT VERIFICATION (lab use only) | | | | |
|-------------------------------|--------------------------------|---------------|-----------------------------------|--------------------|----------------|--------------------------------------|--------------|-------|-------|--|
| Released by: Lisa Bowron | Date (dd-mmm-yy): 27-Sep-17 | Time (hh:mm): | Received by: (Signature) | Date: Sep 27/17 | Time: 12:15 | Temperature: 2 °C | Verified by: | Date: | Time: | Observations: Yes / No? If Yes add SIF |

(Arrive Sept 28/17 10:25 A.M. 3 °C.

APPENDIX C
SEDIMENT, PERIPHYTON AND BENTHIC
INVERTEBRATE QUALITY DATA

Tables
Laboratory Reports

APPENDIX C
SEDIMENT, PERIPHYTON AND BENTHIC
INVERTEBRATE QUALITY DATA

Tables

Table C.1: Sediment Chemistry Data Collected at Reference and Exposed Areas, Minto Mine WUL, 2017

| Analyte | Units | CSQG ^a | | Upper McGinty Creek (Reference) | | | | | | Upper Minto Creek (Exposed) | | | | | | |
|--|--|-------------------|------|------------------------------------|-----------|-----------|-----------|-----------|-----------|--------------------------------|-----------|-----------|-----------|-----------|-----------|------|
| | | | | URC-1 | URC-2 | URC-3 | URC-4 | URC-5 | URC | UMC-1 | UMC-2 | UMC-3 | UMC-4 | UMC-5 | UMC | |
| | | | | 25-Sep-17 | 25-Sep-17 | 25-Sep-17 | 25-Sep-17 | 25-Sep-17 | 25-Sep-17 | 25-Sep-17 | 25-Sep-17 | 25-Sep-17 | 25-Sep-17 | 25-Sep-17 | 25-Sep-17 | |
| Particle size, TKN, carbon analytes and pH | Loss on Ignition @ 550 °C | % | - | - | 10 | 4.0 | 6.0 | 5.0 | 4.0 | - | 5.0 | 7.0 | 9.0 | 2.0 | 5.0 | - |
| | pH (1:2 soil:water) | pH units | - | - | 7.04 | 6.70 | 6.63 | 7.39 | 7.69 | - | 7.46 | 7.93 | 7.89 | 8.16 | 7.97 | - |
| | Gravel (> 2 mm) | % | - | - | - | - | - | - | - | <1.0 | - | - | - | - | - | <1.0 |
| | Sand (2.0 mm - 0.063 mm) | % | - | - | - | - | - | - | - | 64 | - | - | - | - | - | 63 |
| | Silt (0.063 mm - 4 µm) | % | - | - | - | - | - | - | - | 31 | - | - | - | - | - | 30 |
| | Clay (< 4 µm) | % | - | - | - | - | - | - | - | 4.7 | - | - | - | - | - | 6.7 |
| | Total Kjeldahl Nitrogen (TKN) | % | - | - | 0.20 | 0.096 | 0.14 | 0.11 | 0.11 | - | 0.12 | 0.19 | 0.18 | 0.049 | 0.11 | - |
| | Inorganic Carbon | % | - | - | 0.11 | 0.055 | 0.081 | 0.083 | 0.078 | - | 0.12 | 0.16 | 0.16 | 0.064 | 0.095 | - |
| | Inorganic Carbon (as CaCO ₃ Equivalent) | % | - | - | 0.91 | 0.46 | 0.68 | 0.69 | 0.65 | - | 1.0 | 1.3 | 1.3 | 0.54 | 0.79 | - |
| | Total Carbon by Combustion | % | - | - | 4.4 | 1.8 | 2.8 | 2.4 | 2.2 | - | 2.3 | 4.4 | 4.6 | 0.99 | 2.3 | - |
| Total Organic Carbon | % | - | - | 4.3 | 1.8 | 2.8 | 2.3 | 2.2 | - | 2.2 | 4.2 | 4.4 | 0.93 | 2.2 | - | |
| Total Metals | Aluminum (Al) | mg/kg | - | - | 10,700 | 8,640 | 7,840 | 6,050 | 7,270 | - | 11,400 | 11,100 | 11,800 | 9,060 | 9,930 | - |
| | Antimony (Sb) | mg/kg | - | - | 0.39 | 0.28 | 0.30 | 0.27 | 0.26 | - | 0.42 | 0.54 | 0.71 | 0.38 | 0.42 | - |
| | Arsenic (As) | mg/kg | 5.9 | 17 | 8.1 | 5.6 | 7.1 | 7.6 | 4.1 | - | 5.5 | 5.8 | 6.3 | 5.5 | 5.8 | - |
| | Barium (Ba) | mg/kg | - | - | 213 | 138 | 140 | 125 | 87 | - | 170 | 274 | 281 | 127 | 160 | - |
| | Beryllium (Be) | mg/kg | - | - | 0.34 | 0.24 | 0.26 | 0.21 | 0.24 | - | 0.41 | 0.44 | 0.45 | 0.36 | 0.39 | - |
| | Bismuth (Bi) | mg/kg | - | - | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | - | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | - |
| | Boron (B) | mg/kg | - | - | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | - | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | - |
| | Cadmium (Cd) | mg/kg | 0.60 | 3.5 | 0.21 | 0.077 | 0.099 | 0.076 | 0.079 | - | 0.18 | 0.30 | 0.29 | 0.10 | 0.15 | - |
| | Calcium (Ca) | mg/kg | - | - | 9,560 | 4,850 | 5,430 | 5,120 | 5,790 | - | 7,180 | 9,120 | 9,030 | 5,770 | 7,670 | - |
| | Chromium (Cr) | mg/kg | 37 | 90 | 21 | 17 | 16 | 12 | 15 | - | 28 | 25 | 29 | 25 | 25 | - |
| | Cobalt (Co) | mg/kg | - | - | 10 | 7.3 | 6.5 | 5.8 | 6.1 | - | 9.6 | 11 | 12 | 9.2 | 9.6 | - |
| | Copper (Cu) | mg/kg | 36 | 197 | 20 | 12 | 14 | 11 | 13 | - | 170 | 274 | 212 | 46 | 71 | - |
| | Iron (Fe) | mg/kg | - | - | 23,800 | 18,300 | 21,400 | 20,200 | 15,400 | - | 23,100 | 23,300 | 25,200 | 22,100 | 21,700 | - |
| | Lead (Pb) | mg/kg | 35 | 91 | 4.5 | 3.4 | 3.3 | 2.8 | 3.2 | - | 5.9 | 6.0 | 6.3 | 4.9 | 5.2 | - |
| | Lithium (Li) | mg/kg | - | - | 6.5 | 5.5 | 5.0 | 4.4 | 5.3 | - | 8.4 | 8.4 | 8.6 | 6.6 | 6.7 | - |
| | Magnesium (Mg) | mg/kg | - | - | 4,190 | 3,240 | 3,350 | 2,760 | 3,380 | - | 6,230 | 6,880 | 6,870 | 5,660 | 6,140 | - |
| | Manganese (Mn) | mg/kg | - | - | 1,050 | 383 | 245 | 514 | 404 | - | 1,760 | 3,690 | 3,620 | 491 | 865 | - |
| | Mercury (Hg) | mg/kg | 0.17 | 0.49 | 0.042 | 0.057 | 0.060 | 0.017 | 0.021 | - | 0.024 | 0.027 | 0.028 | 0.012 | 0.021 | - |
| | Molybdenum (Mo) | mg/kg | - | - | 0.65 | 0.32 | 0.43 | 0.41 | 0.41 | - | 1.3 | 2.4 | 2.2 | 0.76 | 0.95 | - |
| | Nickel (Ni) | mg/kg | - | - | 16 | 12 | 12 | 11 | 12 | - | 25 | 28 | 29 | 24 | 26 | - |
| | Phosphorus (P) | mg/kg | - | - | 815 | 687 | 882 | 755 | 715 | - | 861 | 873 | 933 | 914 | 881 | - |
| | Potassium (K) | mg/kg | - | - | 690 | 550 | 580 | 440 | 480 | - | 1,310 | 1,350 | 1,510 | 1,140 | 1,180 | - |
| | Selenium (Se) | mg/kg | - | - | 0.45 | 0.24 | 0.31 | 0.38 | 0.35 | - | 0.56 | 0.78 | 0.73 | <0.20 | 0.30 | - |
| | Silver (Ag) | mg/kg | - | - | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | - | 0.11 | 0.24 | 0.12 | <0.10 | <0.10 | - |
| | Sodium (Na) | mg/kg | - | - | 198 | 173 | 185 | 147 | 160 | - | 316 | 308 | 340 | 315 | 350 | - |
| | Strontium (Sr) | mg/kg | - | - | 66 | 39 | 45 | 46 | 54 | - | 80 | 116 | 109 | 62 | 87 | - |
| | Thallium (Tl) | mg/kg | - | - | 0.063 | <0.050 | <0.050 | <0.050 | <0.050 | - | 0.086 | 0.083 | 0.096 | 0.071 | 0.074 | - |
| | Tin (Sn) | mg/kg | - | - | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | - | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | - |
| | Titanium (Ti) | mg/kg | - | - | 645 | 596 | 543 | 484 | 355 | - | 650 | 573 | 579 | 683 | 625 | - |
| | Uranium (U) | mg/kg | - | - | 1.4 | 0.72 | 0.56 | 0.68 | 1.0 | - | 0.84 | 1.1 | 1.2 | 0.54 | 0.80 | - |
| Vanadium (V) | mg/kg | - | - | 48 | 38 | 37 | 31 | 33 | - | 51 | 50 | 59 | 51 | 50 | - | |
| Zinc (Zn) | mg/kg | 123 | 315 | 44 | 33 | 34 | 27 | 31 | - | 62 | 67 | 68 | 48 | 50 | - | |

Indicates sediment concentration exceeding CSQG ISQG.

Indicates sediment concentration exceeding CSQG PEL.

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

Table C.1: Sediment Chemistry Data Collected at Reference and Exposed Areas, Minto Mine WUL, 2017

| Analyte | Units | CSQG ^a | | Lower Wolverine Creek (Reference) | | | | | Lower Minto Creek (Exposed) | | | | | |
|--|--|-------------------|------|--------------------------------------|-----------|-----------|-----------|-----------|--------------------------------|-----------|-----------|-----------|-----------|--------|
| | | | | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 | |
| | | ISQG | PEL | 24-Sep-17 | 24-Sep-17 | 24-Sep-17 | 24-Sep-17 | 24-Sep-17 | 21-Sep-17 | 21-Sep-17 | 21-Sep-17 | 20-Sep-17 | 20-Sep-17 | |
| Particle size, TKN, carbon analytes and pH | Loss on Ignition @ 550 °C | % | - | - | 12 | 10 | 17 | 15 | 15 | 9.0 | 10 | 14 | 8.0 | 9.0 |
| | pH (1:2 soil:water) | pH units | - | - | 6.69 | 7.18 | 6.82 | 7.01 | 6.92 | 8.02 | 7.83 | 7.88 | 7.70 | 7.89 |
| | Gravel (> 2 mm) | % | - | - | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | 1.2 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Sand (2.0 mm - 0.063 mm) | % | - | - | 38 | 57 | 11 | 28 | 17 | 21 | 7.2 | 3.3 | 33 | 9.4 |
| | Silt (0.063 mm - 4 µm) | % | - | - | 57 | 40 | 84 | 66 | 77 | 68 | 83 | 87 | 55 | 80 |
| | Clay (< 4 µm) | % | - | - | 5.0 | 3.4 | 5.4 | 6.0 | 5.7 | 9.3 | 9.8 | 9.1 | 11 | 11 |
| | Total Kjeldahl Nitrogen (TKN) | % | - | - | 0.25 | 0.21 | 0.39 | 0.32 | 0.35 | 0.26 | 0.26 | 0.33 | 0.22 | 0.23 |
| | Inorganic Carbon | % | - | - | 0.11 | 0.11 | 0.16 | 0.16 | 0.14 | 0.18 | 0.17 | 0.19 | 0.14 | 0.15 |
| | Inorganic Carbon (as CaCO ₃ Equivalent) | % | - | - | 0.93 | 0.94 | 1.3 | 1.4 | 1.2 | 1.5 | 1.4 | 1.6 | 1.2 | 1.2 |
| | Total Carbon by Combustion | % | - | - | 5.1 | 5.2 | 9.4 | 6.6 | 7.2 | 4.8 | 6.0 | 7.6 | 4.0 | 4.3 |
| Total Organic Carbon | % | - | - | 5.0 | 5.1 | 9.2 | 6.4 | 7.0 | 4.6 | 5.8 | 7.4 | 3.9 | 4.2 | |
| Total Metals | Aluminum (Al) | mg/kg | - | - | 15,200 | 13,000 | 15,000 | 18,500 | 16,000 | 13,300 | 12,300 | 14,700 | 15,200 | 13,600 |
| | Antimony (Sb) | mg/kg | - | - | 0.48 | 0.49 | 0.47 | 0.54 | 0.46 | 0.48 | 0.52 | 0.57 | 0.58 | 0.45 |
| | Arsenic (As) | mg/kg | 5.9 | 17 | 6.0 | 6.7 | 6.0 | 4.3 | 4.9 | 6.6 | 7.6 | 7.5 | 8.2 | 6.7 |
| | Barium (Ba) | mg/kg | - | - | 201 | 187 | 204 | 220 | 200 | 216 | 237 | 254 | 257 | 214 |
| | Beryllium (Be) | mg/kg | - | - | 0.77 | 0.80 | 0.79 | 0.85 | 0.78 | 0.46 | 0.47 | 0.52 | 0.53 | 0.41 |
| | Bismuth (Bi) | mg/kg | - | - | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 |
| | Boron (B) | mg/kg | - | - | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | Cadmium (Cd) | mg/kg | 0.60 | 3.5 | 0.24 | 0.28 | 0.24 | 0.31 | 0.23 | 0.19 | 0.25 | 0.25 | 0.24 | 0.17 |
| | Calcium (Ca) | mg/kg | - | - | 9,580 | 11,700 | 10,800 | 11,600 | 10,200 | 10,400 | 11,700 | 12,100 | 11,300 | 8,650 |
| | Chromium (Cr) | mg/kg | 37 | 90 | 48 | 42 | 47 | 55 | 48 | 30 | 29 | 33 | 34 | 31 |
| | Cobalt (Co) | mg/kg | - | - | 13 | 13 | 13 | 13 | 13 | 10 | 11 | 11 | 12 | 10 |
| | Copper (Cu) | mg/kg | 36 | 197 | 28 | 28 | 29 | 38 | 28 | 44 | 51 | 52 | 57 | 44 |
| | Iron (Fe) | mg/kg | - | - | 27,700 | 26,200 | 27,000 | 27,400 | 26,700 | 24,500 | 23,800 | 25,500 | 27,700 | 24,200 |
| | Lead (Pb) | mg/kg | 35 | 91 | 6.4 | 6.0 | 6.3 | 7.3 | 6.5 | 5.8 | 5.8 | 6.5 | 6.6 | 5.5 |
| | Lithium (Li) | mg/kg | - | - | 11 | 9.4 | 11 | 14 | 12 | 10 | 9.2 | 11 | 12 | 10 |
| | Magnesium (Mg) | mg/kg | - | - | 9,430 | 8,760 | 9,420 | 11,000 | 9,760 | 7,010 | 6,600 | 7,460 | 7,610 | 6,910 |
| | Manganese (Mn) | mg/kg | - | - | 520 | 549 | 539 | 204 | 236 | 813 | 1,090 | 1,010 | 1,120 | 844 |
| | Mercury (Hg) | mg/kg | 0.17 | 0.49 | 0.047 | 0.046 | 0.042 | 0.045 | 0.041 | 0.031 | 0.038 | 0.040 | 0.041 | 0.028 |
| | Molybdenum (Mo) | mg/kg | - | - | 0.54 | 0.61 | 0.55 | 0.68 | 0.56 | 0.63 | 0.72 | 0.72 | 0.76 | 0.59 |
| | Nickel (Ni) | mg/kg | - | - | 38 | 35 | 37 | 42 | 37 | 28 | 28 | 30 | 30 | 28 |
| | Phosphorus (P) | mg/kg | - | - | 1,060 | 988 | 1,050 | 1,080 | 1,070 | 833 | 832 | 865 | 937 | 885 |
| | Potassium (K) | mg/kg | - | - | 1,050 | 1,020 | 1,160 | 1,300 | 1,140 | 1,150 | 1,100 | 1,210 | 1,330 | 1,190 |
| | Selenium (Se) | mg/kg | - | - | 0.37 | 0.43 | 0.36 | 0.44 | 0.34 | 0.46 | 0.63 | 0.61 | 0.70 | 0.44 |
| | Silver (Ag) | mg/kg | - | - | 0.10 | 0.11 | <0.10 | 0.11 | 0.10 | <0.10 | <0.10 | 0.10 | 0.11 | <0.10 |
| | Sodium (Na) | mg/kg | - | - | 436 | 417 | 478 | 500 | 458 | 316 | 281 | 332 | 335 | 323 |
| | Strontium (Sr) | mg/kg | - | - | 91 | 114 | 107 | 108 | 93 | 103 | 118 | 125 | 113 | 83 |
| | Thallium (Tl) | mg/kg | - | - | 0.087 | 0.080 | 0.090 | 0.11 | 0.095 | 0.092 | 0.087 | 0.11 | 0.11 | 0.092 |
| Tin (Sn) | mg/kg | - | - | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | |
| Titanium (Ti) | mg/kg | - | - | 436 | 803 | 812 | 916 | 841 | 867 | 718 | 648 | 791 | 713 | |
| Uranium (U) | mg/kg | - | - | 2.8 | 3.8 | 3.1 | 3.5 | 2.7 | 0.96 | 1.4 | 1.4 | 1.5 | 0.94 | |
| Vanadium (V) | mg/kg | - | - | 70 | 67 | 72 | 73 | 69 | 53 | 51 | 55 | 60 | 52 | |
| Zinc (Zn) | mg/kg | 123 | 315 | 63 | 55 | 61 | 74 | 64 | 57 | 55 | 61 | 68 | 61 | |

Indicates sediment concentration exceeding CSQG ISQG.

Indicates sediment concentration exceeding CSQG PEL.

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

Table C.2: Periphyton Tissue Quality Results at Reference and Exposure Areas, Minto Mine WUL, 2017

| Analyte | Units | Lower Wolverine Creek (Reference) | | | | | | | | Lower Big Creek (Reference) | | | | | | | Lower Minto Creek (Exposed) | | | | | | |
|----------------------|-----------------------|-----------------------------------|---------|--------|--------|--------|--------|--------------------|--------|-----------------------------|-------|--------|--------|-------|--------------------|---------|-----------------------------|--------|--------|--------|--------|--------------------|--------|
| | | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 | Mean | Standard Deviation | LBC-1 | LBC-2 | LBC-3 | LBC-4 | LBC-5 | Mean | Standard Deviation | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 | Mean | Standard Deviation | |
| Physical Tests | Moisture | % | 55 | 72 | 71 | 66 | 65 | 66 | 6.5 | 93 | 61 | 66 | 74 | 56 | 70 | 15 | 70 | 76 | 65 | 76 | 76 | 72 | 5.0 |
| Total Metals | Total Aluminum (Al) | mg/kg dw | 2,309 | 2,042 | 2,958 | 945 | 1,850 | 2,021 | 733 | 2,739 | 2,149 | 2,928 | 2,594 | 3,941 | 2,870 | 664 | 2,643 | 730 | 1,867 | 2,837 | 1,736 | 1,963 | 838 |
| | Total Antimony (Sb) | mg/kg dw | 0.060 | 0.061 | 0.063 | 0.050 | 0.063 | 0.059 | 0.0056 | 0.17 | 0.12 | 0.10 | 0.14 | 0.086 | 0.12 | 0.031 | 0.092 | 0.069 | 0.092 | 0.093 | 0.090 | 0.087 | 0.010 |
| | Total Arsenic (As) | mg/kg dw | 1.7 | 2.9 | 1.6 | 1.1 | 1.4 | 1.7 | 0.71 | 7.6 | 3.5 | 3.9 | 5.5 | 6.8 | 5.5 | 1.8 | 2.5 | 0.88 | 2.0 | 2.5 | 2.4 | 2.0 | 0.68 |
| | Total Barium (Ba) | mg/kg dw | 57 | 92 | 63 | 35 | 42 | 58 | 22 | 100 | 50 | 96 | 71 | 72 | 78 | 20 | 165 | 111 | 97 | 161 | 139 | 135 | 30 |
| | Total Beryllium (Be) | mg/kg dw | 0.23 | 0.14 | 0.23 | 0.078 | 0.15 | 0.16 | 0.064 | 0.16 | 0.13 | 0.13 | 0.16 | 0.22 | 0.16 | 0.037 | 0.10 | 0.035 | 0.12 | 0.11 | 0.077 | 0.089 | 0.034 |
| | Total Bismuth (Bi) | mg/kg dw | 0.022 | 0.018 | 0.020 | 0.0090 | 0.018 | 0.017 | 0.0048 | 0.21 | 0.14 | 0.17 | 0.15 | 0.19 | 0.17 | 0.030 | 0.029 | 0.0098 | 0.025 | 0.030 | 0.021 | 0.023 | 0.0081 |
| | Total Boron (B) | mg/kg dw | 1.1 | 1.3 | 1.3 | 0.90 | 1.2 | 1.2 | 0.18 | <2.9 | 1.1 | 1.4 | 1.4 | 1.8 | 1.4 | 0.29 | 5.7 | 13 | 2.7 | 6.0 | 4.6 | 6.4 | 3.9 |
| | Total Cadmium (Cd) | mg/kg dw | 0.26 | 0.15 | 0.58 | 0.86 | 0.31 | 0.43 | 0.28 | 2.1 | 0.50 | 0.74 | 0.83 | 0.65 | 0.96 | 0.63 | 0.29 | 0.51 | 0.26 | 0.30 | 0.30 | 0.33 | 0.099 |
| | Total Calcium (Ca) | mg/kg dw | 2,668 | 1,435 | 2,823 | 1,783 | 2,266 | 2,195 | 585 | 4,232 | 2,188 | 3,362 | 2,844 | 3,759 | 3,277 | 795 | 2,387 | 2,320 | 3,192 | 2,718 | 2,749 | 2,673 | 348 |
| | Total Cesium (Cs) | mg/kg dw | 0.37 | 0.25 | 0.30 | 0.13 | 0.25 | 0.26 | 0.087 | 0.80 | 0.53 | 0.48 | 0.67 | 0.69 | 0.63 | 0.13 | 0.26 | 0.061 | 0.19 | 0.27 | 0.16 | 0.19 | 0.084 |
| | Total Chromium (Cr) | mg/kg dw | 11 | 8.8 | 21 | 6.3 | 14 | 12 | 5.5 | 14 | 6.8 | 7.5 | 15 | 10 | 11 | 3.6 | 9.8 | 3.3 | 17 | 11 | 8.7 | 10 | 4.9 |
| | Total Cobalt (Co) | mg/kg dw | 3.3 | 2.7 | 4.5 | 1.8 | 2.3 | 2.9 | 1.1 | 3.6 | 2.3 | 2.5 | 2.9 | 3.8 | 3.0 | 0.66 | 2.6 | 1.3 | 2.0 | 2.8 | 2.1 | 2.2 | 0.58 |
| | Total Copper (Cu) | mg/kg dw | 13 | 20 | 23 | 20 | 17 | 19 | 3.8 | 31 | 18 | 19 | 23 | 16 | 21 | 5.9 | 31 | 29 | 26 | 32 | 31 | 30 | 2.4 |
| | Total Iron (Fe) | mg/kg dw | 6,211 | 3,930 | 6,910 | 1,986 | 4,802 | 4,768 | 1,944 | 5,145 | 4,910 | 5,159 | 5,977 | 7,677 | 5,773 | 1,138 | 6,296 | 1,643 | 4,237 | 5,265 | 3,887 | 4,266 | 1,742 |
| | Total Lead (Pb) | mg/kg dw | 1.8 | 1.0 | 1.5 | 0.54 | 1.2 | 1.2 | 0.47 | 2.7 | 2.1 | 2.4 | 2.8 | 3.0 | 2.6 | 0.34 | 1.5 | 1.1 | 1.5 | 1.5 | 1.1 | 1.3 | 0.22 |
| | Total Lithium (Li) | mg/kg dw | 2.9 | 1.6 | 2.3 | 0.72 | 1.8 | 1.9 | 0.82 | 2.3 | 2.6 | 2.9 | 2.5 | 4.4 | 3.0 | 0.84 | 2.4 | 0.61 | 1.7 | 2.8 | 1.6 | 1.8 | 0.84 |
| | Total Magnesium (Mg) | mg/kg dw | 2,399 | 2,102 | 3,611 | 1,510 | 1,718 | 2,268 | 826 | 2,551 | 2,139 | 2,177 | 2,133 | 3,394 | 2,479 | 541 | 2,101 | 1,680 | 1,655 | 2,331 | 1,820 | 1,917 | 291 |
| | Total Manganese (Mn) | mg/kg dw | 307 | 544 | 382 | 223 | 193 | 330 | 141 | 496 | 293 | 635 | 342 | 401 | 433 | 136 | 549 | 400 | 506 | 690 | 753 | 580 | 142 |
| | Total Mercury (Hg) | mg/kg dw | 0.014 | 0.018 | <0.035 | 0.038 | 0.042 | 0.026 | 0.014 | 0.058 | 0.028 | 0.030 | 0.037 | 0.024 | 0.035 | 0.014 | 0.013 | 0.013 | 0.025 | 0.024 | 0.035 | 0.022 | 0.0092 |
| | Total Molybdenum (Mo) | mg/kg dw | 0.75 | 1.0 | 0.76 | 0.68 | 0.50 | 0.74 | 0.18 | 0.73 | 0.57 | 0.77 | 0.55 | 0.45 | 0.61 | 0.13 | 0.86 | 1.4 | 0.93 | 0.71 | 0.85 | 0.94 | 0.25 |
| | Total Nickel (Ni) | mg/kg dw | 11 | 10 | 20 | 5.1 | 8.5 | 11 | 5.5 | 11 | 5.4 | 6.6 | 7.8 | 9.2 | 8.0 | 2.2 | 8.9 | 5.1 | 8.0 | 10 | 6.9 | 7.8 | 1.9 |
| | Total Phosphorus (P) | mg/kg dw | 4,013 | 5,930 | 4,444 | 7,536 | 4,774 | 5,340 | 1,419 | 6,580 | 4,704 | 4,348 | 4,961 | 2,159 | 4,550 | 1,587 | 6,330 | 7,418 | 5,819 | 6,082 | 7,113 | 6,552 | 684 |
| | Total Potassium (K) | mg/kg dw | 3,543 | 9,368 | 3,410 | 6,261 | 3,955 | 5,307 | 2,547 | 6,377 | 4,216 | 4,290 | 4,844 | 2,251 | 4,395 | 1,481 | 10,000 | 13,811 | 6,045 | 10,980 | 10,042 | 10,176 | 2,783 |
| | Total Rubidium (Rb) | mg/kg dw | 3.9 | 3.1 | 4.8 | 5.1 | 3.7 | 4.1 | 0.82 | 9.6 | 4.6 | 3.6 | 5.2 | 4.6 | 5.5 | 2.4 | 3.6 | 3.3 | 3.4 | 3.7 | 3.4 | 3.5 | 0.17 |
| | Total Selenium (Se) | mg/kg dw | 0.93 | 1.1 | 1.1 | 2.0 | 1.1 | 1.2 | 0.43 | 1.2 | 0.60 | 1.4 | 0.76 | 0.47 | 0.90 | 0.42 | 1.6 | 1.1 | 1.8 | 1.8 | 1.9 | 1.7 | 0.31 |
| | Total Sodium (Na) | mg/kg dw | 1,305 | 1,811 | 1,719 | 2,533 | 1,624 | 1,798 | 453 | 2,725 | 1,465 | 1,287 | 1,957 | 784 | 1,644 | 736 | 2,212 | 2,209 | 2,096 | 2,457 | 2,456 | 2,286 | 163 |
| | Total Strontium (Sr) | mg/kg dw | 28 | 16 | 31 | 17 | 21 | 23 | 6.5 | 49 | 20 | 30 | 30 | 34 | 33 | 11 | 24 | 26 | 37 | 28 | 31 | 29 | 4.9 |
| | Total Tellurium (Te) | mg/kg dw | <0.0090 | <0.014 | <0.014 | <0.012 | <0.011 | <0.014 | - | <0.058 | 0.011 | <0.012 | <0.016 | 0.011 | 0.011 | 0.00042 | <0.013 | <0.016 | <0.011 | <0.016 | <0.017 | <0.016 | - |
| | Total Thallium (Tl) | mg/kg dw | 0.021 | 0.016 | 0.021 | 0.013 | 0.018 | 0.018 | 0.0036 | 0.045 | 0.024 | 0.027 | 0.034 | 0.034 | 0.033 | 0.0082 | 0.023 | 0.0066 | 0.018 | 0.024 | 0.017 | 0.018 | 0.0070 |
| Total Tin (Sn) | mg/kg dw | 0.37 | 0.12 | 0.28 | 0.24 | 0.28 | 0.26 | 0.091 | 0.81 | 0.18 | 0.15 | 0.38 | 0.15 | 0.33 | 0.28 | 0.11 | <0.082 | 0.11 | 0.15 | 0.17 | 0.12 | 0.028 | |
| Total Uranium (U) | mg/kg dw | 0.99 | 0.47 | 0.78 | 0.24 | 0.54 | 0.60 | 0.29 | 0.90 | 0.38 | 1.4 | 0.98 | 0.65 | 0.86 | 0.38 | 0.57 | 0.46 | 0.40 | 0.56 | 0.42 | 0.48 | 0.079 | |
| Total Vanadium (V) | mg/kg dw | 16 | 10 | 15 | 4.6 | 13 | 12 | 4.5 | 12 | 12 | 15 | 16 | 16 | 14 | 2.0 | 16 | 4.3 | 8.6 | 13 | 9.5 | 10 | 4.4 | |
| Total Zinc (Zn) | mg/kg dw | 53 | 92 | 78 | 114 | 101 | 88 | 23 | 113 | 62 | 75 | 86 | 51 | 78 | 24 | 124 | 223 | 95 | 128 | 147 | 144 | 48 | |
| Total Zirconium (Zr) | mg/kg dw | 3.5 | 2.5 | 5.2 | 1.6 | 2.8 | 3.1 | 1.4 | 3.8 | 2.7 | 2.7 | 3.7 | 3.4 | 3.3 | 0.53 | 3.1 | 0.29 | 2.8 | 2.9 | 3.2 | 2.5 | 1.2 | |

Indicates periphyton tissue concentration exceeding the higher reference mean by more than two times.

Table C.3: Benthic Tissue Quality Results at Reference and Exposure Areas, Minto Mine WUL, 2017

| Analyte | Units | Lower Wolverine Creek (Reference) | | | | | | | | Lower Big Creek (Reference) | | | | | | | | Lower Minto Creek (Exposed) | | | | | | | |
|----------------------|-----------------------|--------------------------------------|--------|--------|--------|--------|--------|--------------------|--------|--------------------------------|--------|--------|--------|--------|--------------------|-------|--------|--------------------------------|--------|--------|--------|--------------------|-------|--|--|
| | | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 | Mean | Standard Deviation | LBC-1 | LBC-2 | LBC-3 | LBC-4 | LBC-5 | Mean | Standard Deviation | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 | Mean | Standard Deviation | | | |
| Physical Tests | Moisture | % | 59 | 52 | 60 | 45 | 59 | 55 | 6.3 | 67 | 67 | 57 | 57 | 82 | 66 | 10 | 67 | 61 | 55 | 70 | 62 | 63 | 5.5 | | |
| Total Metals | Total Aluminum (Al) | mg/kg dw | 16,102 | 10,750 | 13,275 | 12,095 | 10,934 | 12,631 | 2,189 | 14,202 | 7,394 | 10,913 | 9,144 | 13,730 | 11,077 | 2,921 | 12,091 | 17,041 | 6,465 | 6,033 | 7,487 | 9,823 | 4,699 | | |
| | Total Antimony (Sb) | mg/kg dw | 0.042 | 0.037 | 0.038 | 0.028 | 0.051 | 0.039 | 0.0084 | 0.15 | 0.13 | 0.096 | 0.082 | 0.20 | 0.13 | 0.045 | 0.084 | 0.071 | <0.11 | 0.28 | 0.15 | 0.13 | 0.089 | | |
| | Total Arsenic (As) | mg/kg dw | 5.7 | 4.6 | 4.6 | 3.9 | 4.9 | 4.7 | 0.65 | 13 | 10 | 10 | 11 | 17 | 12 | 2.7 | 8.1 | 10 | 6.8 | 11 | 8.3 | 8.9 | 1.8 | | |
| | Total Barium (Ba) | mg/kg dw | 215 | 152 | 171 | 152 | 142 | 166 | 29 | 236 | 212 | 197 | 159 | 234 | 208 | 31 | 352 | 367 | 548 | 951 | 468 | 537 | 245 | | |
| | Total Beryllium (Be) | mg/kg dw | 0.80 | 0.54 | 0.64 | 0.55 | 0.57 | 0.62 | 0.11 | 0.55 | 0.37 | 0.43 | 0.41 | 0.62 | 0.48 | 0.10 | 0.43 | 0.58 | 0.28 | 0.31 | 0.29 | 0.38 | 0.13 | | |
| | Total Bismuth (Bi) | mg/kg dw | 0.097 | 0.064 | 0.072 | 0.075 | 0.059 | 0.074 | 0.015 | 0.58 | 0.33 | 0.31 | 1.2 | 0.63 | 0.62 | 0.38 | 0.10 | 0.16 | <0.11 | <0.13 | 0.090 | 0.11 | 0.031 | | |
| | Total Boron (B) | mg/kg dw | 4.7 | 2.6 | 2.9 | 2.5 | 2.9 | 3.1 | 0.92 | 4.1 | 4.2 | 2.9 | 1.8 | 4.8 | 3.5 | 1.2 | 10 | 6.5 | <11 | 32 | 30 | 17 | 13 | | |
| | Total Cadmium (Cd) | mg/kg dw | 0.19 | 0.11 | 0.14 | 0.12 | 0.15 | 0.14 | 0.031 | 0.19 | 0.14 | 0.14 | 0.14 | 0.23 | 0.17 | 0.042 | 0.28 | 0.26 | 0.45 | 0.69 | 0.34 | 0.41 | 0.18 | | |
| | Total Calcium (Ca) | mg/kg dw | 9,298 | 6,521 | 8,040 | 7,286 | 7,027 | 7,634 | 1,080 | 9,080 | 5,455 | 7,799 | 6,042 | 8,270 | 7,329 | 1,528 | 12,182 | 12,321 | 7,606 | 11,148 | 13,704 | 11,392 | 2,303 | | |
| | Total Cesium (Cs) | mg/kg dw | 2.0 | 1.2 | 1.5 | 1.4 | 1.3 | 1.5 | 0.29 | 2.5 | 1.6 | 1.8 | 1.8 | 3.2 | 2.2 | 0.68 | 1.0 | 1.4 | 0.55 | 0.54 | 0.62 | 0.82 | 0.36 | | |
| | Total Chromium (Cr) | mg/kg dw | 46 | 34 | 39 | 36 | 35 | 38 | 4.7 | 33 | 22 | 28 | 21 | 31 | 27 | 5.2 | 27 | 38 | 13 | 19 | 19 | 23 | 9.7 | | |
| | Total Cobalt (Co) | mg/kg dw | 14 | 11 | 12 | 11 | 12 | 12 | 1.3 | 9.8 | 6.8 | 8.3 | 7.8 | 9.8 | 8.5 | 1.3 | 12 | 14 | 21 | 26 | 14 | 17 | 6.0 | | |
| | Total Copper (Cu) | mg/kg dw | 22 | 15 | 17 | 15 | 16 | 17 | 2.8 | 23 | 16 | 18 | 20 | 29 | 21 | 5.3 | 46 | 52 | 38 | 47 | 42 | 45 | 5.3 | | |
| | Total Iron (Fe) | mg/kg dw | 27,603 | 22,708 | 23,697 | 20,947 | 24,570 | 23,905 | 2,467 | 23,988 | 22,030 | 20,890 | 18,634 | 23,946 | 21,898 | 2,250 | 22,182 | 30,357 | 17,159 | 15,705 | 17,196 | 20,520 | 6,022 | | |
| | Total Lead (Pb) | mg/kg dw | 6.6 | 4.6 | 5.5 | 5.2 | 4.9 | 5.4 | 0.75 | 8.9 | 6.0 | 6.7 | 7.1 | 9.7 | 7.7 | 1.6 | 5.5 | 7.7 | 3.9 | 4.0 | 4.9 | 5.2 | 1.5 | | |
| | Total Lithium (Li) | mg/kg dw | 14 | 8.8 | 11 | 10 | 8.9 | 11 | 2.0 | 10 | 6.2 | 8.2 | 8.3 | 10 | 8.7 | 1.8 | 9.7 | 14 | 5.8 | <6.6 | 6.6 | 8.4 | 3.7 | | |
| | Total Magnesium (Mg) | mg/kg dw | 10,436 | 8,063 | 8,834 | 8,124 | 7,764 | 8,644 | 1,076 | 7,607 | 4,455 | 6,183 | 5,602 | 7,081 | 6,186 | 1,241 | 6,091 | 8,214 | 4,295 | 4,689 | 4,868 | 5,631 | 1,592 | | |
| | Total Manganese (Mn) | mg/kg dw | 937 | 604 | 650 | 546 | 690 | 686 | 150 | 758 | 621 | 555 | 495 | 1,059 | 698 | 225 | 3,424 | 3,112 | 12,998 | 16,918 | 6,905 | 8,671 | 6,089 | | |
| | Total Mercury (Hg) | mg/kg dw | 0.030 | 0.016 | 0.021 | 0.017 | 0.021 | 0.021 | 0.0054 | 0.037 | 0.018 | 0.019 | 0.021 | 0.048 | 0.028 | 0.013 | 0.025 | 0.065 | 0.018 | 0.025 | 0.028 | 0.032 | 0.019 | | |
| | Total Molybdenum (Mo) | mg/kg dw | 0.40 | 0.39 | 0.36 | 0.29 | 1.2 | 0.53 | 0.39 | 0.81 | 0.59 | 0.63 | 0.62 | 0.92 | 0.71 | 0.14 | 0.75 | 0.78 | 1.0 | 1.9 | 1.0 | 1.1 | 0.47 | | |
| | Total Nickel (Ni) | mg/kg dw | 41 | 33 | 34 | 31 | 35 | 35 | 3.9 | 26 | 16 | 21 | 19 | 26 | 22 | 4.5 | 27 | 35 | 26 | 33 | 25 | 29 | 4.4 | | |
| | Total Phosphorus (P) | mg/kg dw | 1,358 | 1,156 | 1,243 | 1,169 | 1,165 | 1,218 | 86 | 1,402 | 973 | 1,316 | 1,060 | 1,189 | 1,188 | 177 | 1,336 | 1,416 | 1,025 | 2,233 | 1,717 | 1,545 | 457 | | |
| | Total Potassium (K) | mg/kg dw | 1,349 | 1,023 | 1,099 | 1,004 | 1,133 | 1,121 | 138 | 1,571 | 1,109 | 1,244 | 1,093 | 2,124 | 1,428 | 434 | 2,021 | 2,112 | 1,320 | 3,902 | 2,646 | 2,400 | 963 | | |
| | Total Rubidium (Rb) | mg/kg dw | 15 | 10 | 12 | 11 | 11 | 12 | 2.1 | 13 | 7.9 | 9.9 | 9.6 | 16 | 11 | 3.3 | 12 | 16 | 7.5 | 8.0 | 8.4 | 10 | 3.6 | | |
| | Total Selenium (Se) | mg/kg dw | 0.37 | 0.26 | 0.29 | 0.22 | 0.26 | 0.28 | 0.054 | 0.20 | 0.20 | 0.16 | 0.15 | 0.36 | 0.21 | 0.086 | 1.5 | 1.3 | <1.1 | 3.0 | 2.0 | 1.8 | 0.73 | | |
| | Total Sodium (Na) | mg/kg dw | 409 | 348 | 402 | 337 | 432 | 386 | 41 | 469 | 376 | 368 | 289 | 475 | 395 | 78 | 272 | 276 | <224 | <262 | 262 | 255 | 7.1 | | |
| | Total Strontium (Sr) | mg/kg dw | 91 | 58 | 74 | 66 | 62 | 70 | 13 | 79 | 47 | 59 | 54 | 82 | 64 | 16 | 112 | 121 | 113 | 168 | 110 | 125 | 24 | | |
| Total Tellurium (Te) | mg/kg dw | 0.019 | 0.017 | 0.018 | 0.014 | 0.019 | 0.017 | 0.0021 | 0.044 | 0.026 | 0.025 | 0.036 | 0.049 | 0.036 | 0.011 | 0.030 | 0.031 | <0.22 | <0.26 | <0.11 | 0.030 | 0.00043 | | | |
| Total Thallium (Tl) | mg/kg dw | 0.10 | 0.063 | 0.078 | 0.074 | 0.068 | 0.077 | 0.015 | 0.12 | 0.081 | 0.089 | 0.089 | 0.15 | 0.11 | 0.029 | 0.10 | 0.14 | 0.069 | 0.079 | 0.071 | 0.092 | 0.031 | | | |
| Total Tin (Sn) | mg/kg dw | 0.39 | 0.31 | 0.32 | 0.31 | 0.34 | 0.33 | 0.034 | 0.39 | 0.31 | 0.29 | 0.27 | 0.45 | 0.34 | 0.075 | 0.36 | 0.41 | <1.1 | <1.3 | <0.53 | 0.38 | 0.038 | | | |
| Total Uranium (U) | mg/kg dw | 1.0 | 0.82 | 1.0 | 0.86 | 1.1 | 0.98 | 0.13 | 1.4 | 1.8 | 1.1 | 1.1 | 1.5 | 1.4 | 0.30 | 0.86 | 0.95 | 0.55 | 0.64 | 0.55 | 0.71 | 0.18 | | | |
| Total Vanadium (V) | mg/kg dw | 62 | 54 | 55 | 48 | 55 | 55 | 4.9 | 58 | 59 | 52 | 43 | 55 | 53 | 6.5 | 47 | 62 | 34 | 39 | 39 | 44 | 11 | | | |
| Total Zinc (Zn) | mg/kg dw | 67 | 50 | 57 | 53 | 66 | 59 | 7.7 | 66 | 43 | 52 | 51 | 69 | 56 | 11 | 59 | 75 | 58 | 73 | 55 | 64 | 9.4 | | | |
| Total Zirconium (Zr) | mg/kg dw | 13 | 9.6 | 11 | 9.7 | 11 | 11 | 1.4 | 9.2 | 6.9 | 6.9 | 6.5 | 11 | 8.0 | 1.8 | 9.5 | 12 | 2.9 | 4.3 | 4.5 | 6.7 | 4.0 | | | |

■ Indicates periphyton tissue concentration exceeding the higher reference mean by more than two times.

APPENDIX C
SEDIMENT, PERIPHYTON AND BENTHIC
INVERTEBRATE QUALITY DATA

Laboratory Reports



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 27-SEP-17
Report Date: 11-OCT-17 17:38 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1998308
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT
C of C Numbers: 1 of 2, 2 of 2
Legal Site Desc:

Can Dang
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1998308-1 Sediment 20-SEP-17 LMC-5 | L1998308-2 Sediment 20-SEP-17 LMC-4 | L1998308-3 Sediment 21-SEP-17 LMC-3 | L1998308-4 Sediment 21-SEP-17 LMC-2 | L1998308-5 Sediment 21-SEP-17 LMC-1 |
|---|--|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | Loss On Ignition @ 420 C (%) | 9 | 8 | 14 | 10 | 9 |
| | pH (1:2 soil:water) (pH) | 7.89 | 7.70 | 7.88 | 7.83 | 8.02 |
| Particle Size | % Gravel (>2mm) (%) | <1.0 | <1.0 | <1.0 | <1.0 | 1.2 |
| | % Sand (2.0mm - 0.063mm) (%) | 9.4 | 33.0 | 3.3 | 7.2 | 21.2 |
| | % Silt (0.063mm - 4um) (%) | 79.9 | 55.2 | 87.4 | 82.6 | 68.4 |
| | % Clay (<4um) (%) | 10.6 | 11.1 | 9.1 | 9.8 | 9.3 |
| | Texture | Silt | Silt loam | Silt | Silt | Silt loam |
| Leachable Anions & Nutrients | Total Kjeldahl Nitrogen (%) | 0.233 ^{DLHC} | 0.217 | 0.332 ^{DLHC} | 0.257 ^{DLHC} | 0.263 ^{DLHC} |
| | Organic / Inorganic Carbon | Inorganic Carbon (%) | 0.146 | 0.139 | 0.189 | 0.171 |
| | Inorganic Carbon (as CaCO3 Equivalent) (%) | 1.22 | 1.16 | 1.57 | 1.43 | 1.46 |
| | Total Carbon by Combustion (%) | 4.34 | 4.04 | 7.63 | 5.97 | 4.79 |
| | Total Organic Carbon (%) | 4.19 | 3.90 | 7.44 | 5.80 | 4.62 |
| Metals | Aluminum (Al) (mg/kg) | 13600 | 15200 | 14700 | 12300 | 13300 |
| | Antimony (Sb) (mg/kg) | 0.45 | 0.58 | 0.57 | 0.52 | 0.48 |
| | Arsenic (As) (mg/kg) | 6.68 | 8.21 | 7.51 | 7.55 | 6.62 |
| | Barium (Ba) (mg/kg) | 214 | 257 | 254 | 237 | 216 |
| | Beryllium (Be) (mg/kg) | 0.41 | 0.53 | 0.52 | 0.47 | 0.46 |
| | Bismuth (Bi) (mg/kg) | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 |
| | Boron (B) (mg/kg) | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | Cadmium (Cd) (mg/kg) | 0.169 | 0.244 | 0.245 | 0.245 | 0.191 |
| | Calcium (Ca) (mg/kg) | 8650 | 11300 | 12100 | 11700 | 10400 |
| | Chromium (Cr) (mg/kg) | 30.8 | 34.4 | 33.1 | 29.1 | 30.1 |
| | Cobalt (Co) (mg/kg) | 10.2 | 11.5 | 11.0 | 10.5 | 10.4 |
| | Copper (Cu) (mg/kg) | 44.1 | 56.6 | 51.6 | 51.2 | 43.7 |
| | Iron (Fe) (mg/kg) | 24200 | 27700 | 25500 | 23800 | 24500 |
| | Lead (Pb) (mg/kg) | 5.48 | 6.56 | 6.48 | 5.83 | 5.83 |
| | Lithium (Li) (mg/kg) | 10.2 | 11.6 | 11.3 | 9.2 | 10.2 |
| | Magnesium (Mg) (mg/kg) | 6910 | 7610 | 7460 | 6600 | 7010 |
| | Manganese (Mn) (mg/kg) | 844 | 1120 | 1010 | 1090 | 813 |
| | Mercury (Hg) (mg/kg) | 0.0277 | 0.0408 | 0.0397 | 0.0379 | 0.0307 |
| | Molybdenum (Mo) (mg/kg) | 0.59 | 0.76 | 0.72 | 0.72 | 0.63 |
| | Nickel (Ni) (mg/kg) | 27.5 | 29.9 | 29.8 | 27.5 | 27.5 |
| | Phosphorus (P) (mg/kg) | 885 | 937 | 865 | 832 | 833 |
| | Potassium (K) (mg/kg) | 1190 | 1330 | 1210 | 1100 | 1150 |
| | Selenium (Se) (mg/kg) | 0.44 | 0.70 | 0.61 | 0.63 | 0.46 |
| Silver (Ag) (mg/kg) | <0.10 | 0.11 | 0.10 | <0.10 | <0.10 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1998308-6 Sediment 24-SEP-17 LWC-5 | L1998308-7 Sediment 24-SEP-17 LWC-5X | L1998308-8 Sediment 24-SEP-17 LWC-4 | L1998308-9 Sediment 24-SEP-17 LWC-3 | L1998308-10 Sediment 24-SEP-17 LWC-2 | |
|---|--|---|--|--|---|-----------------------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | Loss On Ignition @ 420 C (%) | 15 | 16 | 15 | 17 | 10 |
| | pH (1:2 soil:water) (pH) | 6.92 | 6.77 | 7.01 | 6.82 | 7.18 |
| Particle Size | % Gravel (>2mm) (%) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | % Sand (2.0mm - 0.063mm) (%) | 17.1 | 20.5 | 27.7 | 10.9 | 56.7 |
| | % Silt (0.063mm - 4um) (%) | 76.8 | 73.8 | 66.3 | 83.7 | 39.7 |
| | % Clay (<4um) (%) | 5.7 | 5.4 | 6.0 | 5.4 | 3.4 |
| | Texture | Silt loam | Silt loam | Silt loam | Silt | Sandy loam |
| Leachable Anions & Nutrients | Total Kjeldahl Nitrogen (%) | 0.354 ^{DLHC} | 0.340 ^{DLHC} | 0.315 | 0.394 ^{DLHC} | 0.214 ^{DLHC} |
| Organic / Inorganic Carbon | Inorganic Carbon (%) | 0.141 | 0.137 | 0.163 | 0.157 | 0.113 |
| | Inorganic Carbon (as CaCO3 Equivalent) (%) | 1.17 | 1.14 | 1.36 | 1.31 | 0.94 |
| | Total Carbon by Combustion (%) | 7.15 | 5.38 | 6.60 | 9.35 | 5.22 |
| | Total Organic Carbon (%) | 7.01 | 5.24 | 6.44 | 9.19 | 5.11 |
| Metals | Aluminum (Al) (mg/kg) | 16000 | 15900 | 18500 | 15000 | 13000 |
| | Antimony (Sb) (mg/kg) | 0.46 | 0.48 | 0.54 | 0.47 | 0.49 |
| | Arsenic (As) (mg/kg) | 4.88 | 5.66 | 4.30 | 6.03 | 6.72 |
| | Barium (Ba) (mg/kg) | 200 | 221 | 220 | 204 | 187 |
| | Beryllium (Be) (mg/kg) | 0.78 | 0.83 | 0.85 | 0.79 | 0.80 |
| | Bismuth (Bi) (mg/kg) | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 |
| | Boron (B) (mg/kg) | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | Cadmium (Cd) (mg/kg) | 0.227 | 0.262 | 0.313 | 0.244 | 0.278 |
| | Calcium (Ca) (mg/kg) | 10200 | 11100 | 11600 | 10800 | 11700 |
| | Chromium (Cr) (mg/kg) | 48.0 | 48.8 | 54.9 | 47.0 | 41.7 |
| | Cobalt (Co) (mg/kg) | 12.8 | 13.1 | 13.2 | 13.4 | 12.7 |
| | Copper (Cu) (mg/kg) | 27.9 | 29.7 | 37.8 | 28.5 | 28.2 |
| | Iron (Fe) (mg/kg) | 26700 | 28400 | 27400 | 27000 | 26200 |
| | Lead (Pb) (mg/kg) | 6.49 | 6.61 | 7.27 | 6.31 | 5.99 |
| | Lithium (Li) (mg/kg) | 11.7 | 11.6 | 13.5 | 10.9 | 9.4 |
| | Magnesium (Mg) (mg/kg) | 9760 | 9730 | 11000 | 9420 | 8760 |
| | Manganese (Mn) (mg/kg) | 236 | 259 | 204 | 539 | 549 |
| | Mercury (Hg) (mg/kg) | 0.0411 | 0.0466 | 0.0449 | 0.0420 | 0.0455 |
| | Molybdenum (Mo) (mg/kg) | 0.56 | 0.52 | 0.68 | 0.55 | 0.61 |
| | Nickel (Ni) (mg/kg) | 37.0 | 37.9 | 41.9 | 37.4 | 35.0 |
| | Phosphorus (P) (mg/kg) | 1070 | 1120 | 1080 | 1050 | 988 |
| | Potassium (K) (mg/kg) | 1140 | 1130 | 1300 | 1160 | 1020 |
| | Selenium (Se) (mg/kg) | 0.34 | 0.43 | 0.44 | 0.36 | 0.43 |
| | Silver (Ag) (mg/kg) | 0.10 | 0.12 | 0.11 | <0.10 | 0.11 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1998308-11 Sediment 24-SEP-17 LWC-1 | L1998308-12 Sediment 25-SEP-17 URC-5 | L1998308-13 Sediment 25-SEP-17 URC-4 | L1998308-14 Sediment 25-SEP-17 URC-3 | L1998308-15 Sediment 25-SEP-17 URC-2 | |
|---|---|---|---|---|---|--------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | Loss On Ignition @ 420 C (%) | 12 | 4 | 5 | 6 | 4 |
| | pH (1:2 soil:water) (pH) | 6.69 | 7.69 | 7.39 | 6.63 | 6.70 |
| Particle Size | % Gravel (>2mm) (%) | <1.0 | | | | |
| | % Sand (2.0mm - 0.063mm) (%) | 38.0 | | | | |
| | % Silt (0.063mm - 4um) (%) | 56.9 | | | | |
| | % Clay (<4um) (%) | 5.0 | | | | |
| | Texture | Silt loam | | | | |
| Leachable Anions & Nutrients | Total Kjeldahl Nitrogen (%) | 0.253 ^{DLHC} | 0.108 | 0.105 | 0.136 | 0.096 |
| Organic / Inorganic Carbon | Inorganic Carbon (%) | 0.112 | 0.078 | 0.083 | 0.081 | 0.055 |
| | Inorganic Carbon (as CaCO3 Equivalent) (%) | 0.93 | 0.65 | 0.69 | 0.68 | 0.46 |
| | Total Carbon by Combustion (%) | 5.07 | 2.24 | 2.35 | 2.84 | 1.83 |
| | Total Organic Carbon (%) | 4.96 | 2.16 | 2.27 | 2.76 | 1.78 |
| Metals | Aluminum (Al) (mg/kg) | 15200 | 7270 | 6050 | 7840 | 8640 |
| | Antimony (Sb) (mg/kg) | 0.48 | 0.26 | 0.27 | 0.30 | 0.28 |
| | Arsenic (As) (mg/kg) | 6.03 | 4.08 | 7.57 | 7.10 | 5.60 |
| | Barium (Ba) (mg/kg) | 201 | 87.2 | 125 | 140 | 138 |
| | Beryllium (Be) (mg/kg) | 0.77 | 0.24 | 0.21 | 0.26 | 0.24 |
| | Bismuth (Bi) (mg/kg) | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 |
| | Boron (B) (mg/kg) | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | Cadmium (Cd) (mg/kg) | 0.236 | 0.079 | 0.076 | 0.099 | 0.077 |
| | Calcium (Ca) (mg/kg) | 9580 | 5790 | 5120 | 5430 | 4850 |
| | Chromium (Cr) (mg/kg) | 47.6 | 15.0 | 12.2 | 15.6 | 16.9 |
| | Cobalt (Co) (mg/kg) | 13.4 | 6.13 | 5.84 | 6.51 | 7.34 |
| | Copper (Cu) (mg/kg) | 28.0 | 13.1 | 10.7 | 13.9 | 12.4 |
| | Iron (Fe) (mg/kg) | 27700 | 15400 | 20200 | 21400 | 18300 |
| | Lead (Pb) (mg/kg) | 6.42 | 3.21 | 2.83 | 3.31 | 3.37 |
| | Lithium (Li) (mg/kg) | 11.3 | 5.3 | 4.4 | 5.0 | 5.5 |
| | Magnesium (Mg) (mg/kg) | 9430 | 3380 | 2760 | 3350 | 3240 |
| | Manganese (Mn) (mg/kg) | 520 | 404 | 514 | 245 | 383 |
| | Mercury (Hg) (mg/kg) | 0.0474 | 0.0209 | 0.0173 | 0.0598 | 0.0570 |
| | Molybdenum (Mo) (mg/kg) | 0.54 | 0.41 | 0.41 | 0.43 | 0.32 |
| | Nickel (Ni) (mg/kg) | 38.1 | 12.2 | 10.5 | 12.3 | 11.7 |
| | Phosphorus (P) (mg/kg) | 1060 | 715 | 755 | 882 | 687 |
| | Potassium (K) (mg/kg) | 1050 | 480 | 440 | 580 | 550 |
| | Selenium (Se) (mg/kg) | 0.37 | 0.35 | 0.38 | 0.31 | 0.24 |
| | Silver (Ag) (mg/kg) | 0.10 | <0.10 | <0.10 | <0.10 | <0.10 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

11-OCT-17 17:38 (MT)

Version: FINAL

| Sample ID Description Sampled Date Sampled Time Client ID | | L1998308-16 Sediment 25-SEP-17 URC-1 | L1998308-17 Sediment 25-SEP-17 URC | L1998308-18 Sediment 25-SEP-17 UMC | L1998308-19 Sediment 25-SEP-17 UMC-5 | L1998308-20 Sediment 25-SEP-17 UMC-4 |
|---|--|---|---|---|---|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | Loss On Ignition @ 420 C (%) | 10 | | | 5 | 2 |
| | pH (1:2 soil:water) (pH) | 7.04 | | | 7.97 | 8.16 |
| Particle Size | % Gravel (>2mm) (%) | | <1.0 | <1.0 | | |
| | % Sand (2.0mm - 0.063mm) (%) | | 64.4 | 63.2 | | |
| | % Silt (0.063mm - 4um) (%) | | 30.7 | 29.9 | | |
| | % Clay (<4um) (%) | | 4.7 | 6.7 | | |
| | Texture | | Sandy loam | Sandy loam | | |
| Leachable Anions & Nutrients | Total Kjeldahl Nitrogen (%) | 0.199 | | | 0.111 | 0.049 |
| Organic / Inorganic Carbon | Inorganic Carbon (%) | 0.109 | | | 0.095 | 0.064 |
| | Inorganic Carbon (as CaCO3 Equivalent) (%) | 0.91 | | | 0.79 | 0.54 |
| | Total Carbon by Combustion (%) | 4.38 | | | 2.30 | 0.99 |
| | Total Organic Carbon (%) | 4.27 | | | 2.20 | 0.927 |
| Metals | Aluminum (Al) (mg/kg) | 10700 | | | 9930 | 9060 |
| | Antimony (Sb) (mg/kg) | 0.39 | | | 0.42 | 0.38 |
| | Arsenic (As) (mg/kg) | 8.09 | | | 5.75 | 5.45 |
| | Barium (Ba) (mg/kg) | 213 | | | 160 | 127 |
| | Beryllium (Be) (mg/kg) | 0.34 | | | 0.39 | 0.36 |
| | Bismuth (Bi) (mg/kg) | <0.20 | | | <0.20 | <0.20 |
| | Boron (B) (mg/kg) | <5.0 | | | <5.0 | <5.0 |
| | Cadmium (Cd) (mg/kg) | 0.207 | | | 0.149 | 0.103 |
| | Calcium (Ca) (mg/kg) | 9560 | | | 7670 | 5770 |
| | Chromium (Cr) (mg/kg) | 21.0 | | | 25.4 | 24.9 |
| | Cobalt (Co) (mg/kg) | 10.4 | | | 9.57 | 9.21 |
| | Copper (Cu) (mg/kg) | 20.2 | | | 70.9 | 45.7 |
| | Iron (Fe) (mg/kg) | 23800 | | | 21700 | 22100 |
| | Lead (Pb) (mg/kg) | 4.47 | | | 5.21 | 4.92 |
| | Lithium (Li) (mg/kg) | 6.5 | | | 6.7 | 6.6 |
| | Magnesium (Mg) (mg/kg) | 4190 | | | 6140 | 5660 |
| | Manganese (Mn) (mg/kg) | 1050 | | | 865 | 491 |
| | Mercury (Hg) (mg/kg) | 0.0417 | | | 0.0205 | 0.0124 |
| | Molybdenum (Mo) (mg/kg) | 0.65 | | | 0.95 | 0.76 |
| | Nickel (Ni) (mg/kg) | 15.8 | | | 25.6 | 23.6 |
| | Phosphorus (P) (mg/kg) | 815 | | | 881 | 914 |
| | Potassium (K) (mg/kg) | 690 | | | 1180 | 1140 |
| | Selenium (Se) (mg/kg) | 0.45 | | | 0.30 | <0.20 |
| | Silver (Ag) (mg/kg) | <0.10 | | | <0.10 | <0.10 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1998308-21 Sediment 25-SEP-17 UMC-3 | L1998308-22 Sediment 25-SEP-17 UMC-2 | L1998308-23 Sediment 25-SEP-17 UMC-1 | |
|---|---|---|---|---|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | Loss On Ignition @ 420 C (%) | 9 | 7 | 5 | |
| | pH (1:2 soil:water) (pH) | 7.89 | 7.93 | 7.46 | |
| Particle Size | % Gravel (>2mm) (%) | | | | |
| | % Sand (2.0mm - 0.063mm) (%) | | | | |
| | % Silt (0.063mm - 4um) (%) | | | | |
| | % Clay (<4um) (%) | | | | |
| | Texture | | | | |
| Leachable Anions & Nutrients | Total Kjeldahl Nitrogen (%) | 0.179 | 0.192 | 0.120 | |
| Organic / Inorganic Carbon | Inorganic Carbon (%) | 0.156 | 0.160 | 0.121 | |
| | Inorganic Carbon (as CaCO3 Equivalent) (%) | 1.30 | 1.34 | 1.01 | |
| | Total Carbon by Combustion (%) | 4.59 | 4.37 | 2.27 | |
| | Total Organic Carbon (%) | 4.43 | 4.21 | 2.15 | |
| Metals | Aluminum (Al) (mg/kg) | 11800 | 11100 | 11400 | |
| | Antimony (Sb) (mg/kg) | 0.71 | 0.54 | 0.42 | |
| | Arsenic (As) (mg/kg) | 6.26 | 5.79 | 5.53 | |
| | Barium (Ba) (mg/kg) | 281 | 274 | 170 | |
| | Beryllium (Be) (mg/kg) | 0.45 | 0.44 | 0.41 | |
| | Bismuth (Bi) (mg/kg) | <0.20 | <0.20 | <0.20 | |
| | Boron (B) (mg/kg) | <5.0 | <5.0 | <5.0 | |
| | Cadmium (Cd) (mg/kg) | 0.289 | 0.297 | 0.179 | |
| | Calcium (Ca) (mg/kg) | 9030 | 9120 | 7180 | |
| | Chromium (Cr) (mg/kg) | 28.6 | 24.5 | 28.0 | |
| | Cobalt (Co) (mg/kg) | 11.8 | 10.7 | 9.55 | |
| | Copper (Cu) (mg/kg) | 212 | 274 | 170 | |
| | Iron (Fe) (mg/kg) | 25200 | 23300 | 23100 | |
| | Lead (Pb) (mg/kg) | 6.26 | 5.96 | 5.89 | |
| | Lithium (Li) (mg/kg) | 8.6 | 8.4 | 8.4 | |
| | Magnesium (Mg) (mg/kg) | 6870 | 6880 | 6230 | |
| | Manganese (Mn) (mg/kg) | 3620 | 3690 | 1760 | |
| | Mercury (Hg) (mg/kg) | 0.0283 | 0.0268 | 0.0244 | |
| | Molybdenum (Mo) (mg/kg) | 2.21 | 2.35 | 1.27 | |
| | Nickel (Ni) (mg/kg) | 29.2 | 28.1 | 24.9 | |
| | Phosphorus (P) (mg/kg) | 933 | 873 | 861 | |
| | Potassium (K) (mg/kg) | 1510 | 1350 | 1310 | |
| | Selenium (Se) (mg/kg) | 0.73 | 0.78 | 0.56 | |
| | Silver (Ag) (mg/kg) | 0.12 | 0.24 | 0.11 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998308-1 | L1998308-2 | L1998308-3 | L1998308-4 | L1998308-5 |
|---------------|------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Sediment | Sediment | Sediment | Sediment | Sediment |
| | | Sampled Date | 20-SEP-17 | 20-SEP-17 | 21-SEP-17 | 21-SEP-17 | 21-SEP-17 |
| | | Sampled Time | | | | | |
| | | Client ID | LMC-5 | LMC-4 | LMC-3 | LMC-2 | LMC-1 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Metals | Sodium (Na) (mg/kg) | | 323 | 335 | 332 | 281 | 316 |
| | Strontium (Sr) (mg/kg) | | 83.2 | 113 | 125 | 118 | 103 |
| | Thallium (Tl) (mg/kg) | | 0.092 | 0.111 | 0.105 | 0.087 | 0.092 |
| | Tin (Sn) (mg/kg) | | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Titanium (Ti) (mg/kg) | | 713 | 791 | 648 | 718 | 867 |
| | Uranium (U) (mg/kg) | | 0.943 | 1.45 | 1.37 | 1.37 | 0.962 |
| | Vanadium (V) (mg/kg) | | 52.3 | 60.1 | 55.1 | 51.2 | 52.5 |
| | Zinc (Zn) (mg/kg) | | 61.2 | 68.1 | 61.0 | 54.6 | 56.7 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998308-6 | L1998308-7 | L1998308-8 | L1998308-9 | L1998308-10 |
|---------------|------------------------|--------------|------------|------------|------------|------------|-------------|
| | | Description | Sediment | Sediment | Sediment | Sediment | Sediment |
| | | Sampled Date | 24-SEP-17 | 24-SEP-17 | 24-SEP-17 | 24-SEP-17 | 24-SEP-17 |
| | | Sampled Time | | | | | |
| | | Client ID | LWC-5 | LWC-5X | LWC-4 | LWC-3 | LWC-2 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Metals | Sodium (Na) (mg/kg) | | 458 | 456 | 500 | 478 | 417 |
| | Strontium (Sr) (mg/kg) | | 93.3 | 103 | 108 | 107 | 114 |
| | Thallium (Tl) (mg/kg) | | 0.095 | 0.099 | 0.113 | 0.090 | 0.080 |
| | Tin (Sn) (mg/kg) | | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Titanium (Ti) (mg/kg) | | 841 | 908 | 916 | 812 | 803 |
| | Uranium (U) (mg/kg) | | 2.74 | 3.15 | 3.51 | 3.09 | 3.75 |
| | Vanadium (V) (mg/kg) | | 68.6 | 68.2 | 72.5 | 71.7 | 67.4 |
| | Zinc (Zn) (mg/kg) | | 63.5 | 64.4 | 73.8 | 61.3 | 55.0 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998308-11 | L1998308-12 | L1998308-13 | L1998308-14 | L1998308-15 |
|---------------|------------------------|--------------|-------------|-------------|-------------|-------------|-------------|
| | | Description | Sediment | Sediment | Sediment | Sediment | Sediment |
| | | Sampled Date | 24-SEP-17 | 25-SEP-17 | 25-SEP-17 | 25-SEP-17 | 25-SEP-17 |
| | | Sampled Time | | | | | |
| | | Client ID | LWC-1 | URC-5 | URC-4 | URC-3 | URC-2 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Metals | Sodium (Na) (mg/kg) | | 436 | 160 | 147 | 185 | 173 |
| | Strontium (Sr) (mg/kg) | | 91.1 | 54.2 | 46.0 | 45.2 | 39.0 |
| | Thallium (Tl) (mg/kg) | | 0.087 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Tin (Sn) (mg/kg) | | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Titanium (Ti) (mg/kg) | | 436 | 355 | 484 | 543 | 596 |
| | Uranium (U) (mg/kg) | | 2.81 | 1.03 | 0.676 | 0.556 | 0.717 |
| | Vanadium (V) (mg/kg) | | 69.6 | 32.9 | 31.3 | 36.5 | 38.1 |
| | Zinc (Zn) (mg/kg) | | 62.9 | 31.1 | 27.1 | 34.4 | 32.6 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998308-16 | L1998308-17 | L1998308-18 | L1998308-19 | L1998308-20 |
|---------------|------------------------|--------------|-------------|-------------|-------------|-------------|-------------|
| | | Description | Sediment | Sediment | Sediment | Sediment | Sediment |
| | | Sampled Date | 25-SEP-17 | 25-SEP-17 | 25-SEP-17 | 25-SEP-17 | 25-SEP-17 |
| | | Sampled Time | | | | | |
| | | Client ID | URC-1 | URC | UMC | UMC-5 | UMC-4 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Metals | Sodium (Na) (mg/kg) | | 198 | | | 350 | 315 |
| | Strontium (Sr) (mg/kg) | | 65.9 | | | 87.4 | 61.5 |
| | Thallium (Tl) (mg/kg) | | 0.063 | | | 0.074 | 0.071 |
| | Tin (Sn) (mg/kg) | | <2.0 | | | <2.0 | <2.0 |
| | Titanium (Ti) (mg/kg) | | 645 | | | 625 | 683 |
| | Uranium (U) (mg/kg) | | 1.37 | | | 0.796 | 0.541 |
| | Vanadium (V) (mg/kg) | | 47.5 | | | 50.3 | 51.4 |
| | Zinc (Zn) (mg/kg) | | 44.3 | | | 50.2 | 47.6 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998308-21 | L1998308-22 | L1998308-23 | | |
|---------------|------------------------|--------------|-------------|-------------|-------------|--|--|
| | | Description | Sediment | Sediment | Sediment | | |
| | | Sampled Date | 25-SEP-17 | 25-SEP-17 | 25-SEP-17 | | |
| | | Sampled Time | | | | | |
| | | Client ID | UMC-3 | UMC-2 | UMC-1 | | |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Metals | Sodium (Na) (mg/kg) | | 340 | 308 | 316 | | |
| | Strontium (Sr) (mg/kg) | | 109 | 116 | 79.8 | | |
| | Thallium (Tl) (mg/kg) | | 0.096 | 0.083 | 0.086 | | |
| | Tin (Sn) (mg/kg) | | <2.0 | <2.0 | <2.0 | | |
| | Titanium (Ti) (mg/kg) | | 579 | 573 | 650 | | |
| | Uranium (U) (mg/kg) | | 1.15 | 1.11 | 0.835 | | |
| | Vanadium (V) (mg/kg) | | 59.4 | 49.8 | 51.1 | | |
| | Zinc (Zn) (mg/kg) | | 68.2 | 66.7 | 61.8 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---|---|-----------|-----------------------------|
| Qualifiers for Individual Parameters Listed: | | | |
| Qualifier | Description | | |
| DLHC | Detection Limit Raised: Dilution required due to high concentration of test analyte(s). | | |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|----------------------------|--------|---|---|
| C-TIC-PCT-SK | Soil | Total Inorganic Carbon in Soil | CSSS (2008) P216-217 |
| | | A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate. | |
| C-TOC-CALC-SK | Soil | Total Organic Carbon Calculation | CSSS (2008) 21.2 |
| | | Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC) | |
| C-TOT-LECO-SK | Soil | Total Carbon by combustion method | CSSS (2008) 21.2 |
| | | The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector. | |
| HG-200.2-CVAF-VA | Soil | Mercury in Soil by CVAFS | EPA 200.2/1631E (mod) |
| | | Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS. | |
| IC-CACO3-CALC-SK | Soil | Inorganic Carbon as CaCO3 Equivalent | Calculation |
| LOI-420-SK | Soil | Loss on Ignition @ 420 C | CSSS (1978) METHOD 3.81 |
| | | The dry-ash method involves the removal of organic matter by combustion at 420OC for 2 hours. Samples are dried prior to combustion. | |
| | | Reference: McKeague, J.A. Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci.(1978) method 3.81 | |
| MET-200.2-CCMS-VA | Soil | Metals in Soil by CRC ICPMS | EPA 200.2/6020A (mod) |
| | | This method uses a heated strong acid digestion with HNO3 and HCl and is intended to liberate metals that may be environmentally available. Silicate minerals are not solubilized. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. Analysis is by Collision/Reaction Cell ICPMS. | |
| N-TOTKJ-COL-SK | Soil | Total Kjeldahl Nitrogen | CSSS (2008) 22.2.3 |
| | | The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colorimetrically at 660 nm. | |
| PH-1:2-VA | Soil | pH in Soil (1:2 Soil:Water Extraction) | BC WLAP METHOD: PH, ELECTROMETRIC, SOIL |
| | | This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe. | |
| PSA-PIPET+GRAVEL-SK | Soil | Particle size - Sieve and Pipette | SSIR-51 METHOD 3.2.1 |
| | | Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles. | |
| | | Reference: Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service. | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| SK | ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

Reference Information

1 of 2

2 of 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| | | |
|---|---|---|
| Report To | Report Format / Distribution | Service Requested (Rush for routine analysis subject to availability) |
| Company: Minnow Environmental Inc. | <input checked="" type="checkbox"/> Standard <input type="checkbox"/> Other | <input checked="" type="radio"/> Regular (Standard Turnaround Times - Business Days) |
| Contact: Lisa Bowron | <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Digital <input type="checkbox"/> Fax | <input type="radio"/> Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT |
| Address: 101 - 1025 Hillside Ave. Victoria, BC | Email 1: lbowron@minnow.ca Email 2: pstecko@minnow.ca | <input type="radio"/> Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT |
| Phone: (250)595-1627 x21 Fax: (250) 595-1625 | Email 3: | <input type="radio"/> Same Day or Weekend Emergency - Contact ALS to Confirm TAT |

| | | |
|---|-------------------------------------|--|
| Invoice To Same as Report? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Client / Project Information | Analysis Request Please indicate below Filtered, Preserved or both (F, P, F/P) |
| Hardcopy of Invoice with Report? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Job #: Minnow Project | |
| Company: Minto Explorations Ltd | PO / AFE: | |
| Contact: Cindy Keehn | LSD: | |
| Address: Suite 2100-510 West Georgia Street, Vancouver, BC | | |
| Phone: 604-684-8894 Fax: 604-688-2180 | Quote #: Q51327 | |

| | | |
|------------------------------------|--------------------------------|----------------------|
| Lab Work Order # (lab use only) | ALS Contact: Jerry Holzebecker | Sampler: Lisa Bowron |
|------------------------------------|--------------------------------|----------------------|

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Rescan Low Level Sediments | Inorganic Carbon | Total Carbon by combustion | Mercury by CVAFS | Loss on Ignition | pH in soil | Particle Size | Total Organic Carbon | Total Kjeldahl Nitrogen | **See Complete Quote #Q51327 | Number of Containers |
|----------|---|---------------------|-----------------|-------------|----------------------------|------------------|----------------------------|------------------|------------------|------------|---------------|----------------------|-------------------------|------------------------------|----------------------|
| | LMC-5 | 20-Sep-17 | | Sediment | X | X | X | X | X | X | X | X | X | X | 2 |
| | LMC-4 | 20-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | 2 |
| | LMC-3 | 21-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | 2 |
| | LMC-2 | 21-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | 2 |
| | LMC-1 | 21-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | 2 |
| | LWC-5 | 24-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | 2 |
| | LWC-5X | 24-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | 2 |
| | LWC-4 | 24-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | 2 |
| | LWC-3 | 24-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | 2 |
| | LWC-2 | 24-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | 2 |
| | LWC-1 | 24-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | 2 |
| | LWC-5 | 25-Sep-17 | | | X | X | X | X | X | X | X | X | X | X | 1 |

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|-------------------------------|------------------|--------------|-----------------------------------|-----------|-------|--------------|--------------------------------------|-------|-------|---|
| Released by: | Date (dd-mmm-yy) | Time (hh-mm) | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Lisa Bowron | 27-Sep-17 | | (Signature) | Sep 27/17 | 12:15 | 2 °C | | | | |

10:25:30C



| | | |
|---|---|---|
| Report To | Report Format / Distribution | Service Requested (Rush for routine analysis subject to availability) |
| Company: Minnow Environmental Inc. | <input checked="" type="checkbox"/> Standard <input type="checkbox"/> Other | <input checked="" type="radio"/> Regular (Standard Turnaround Times - Business Days) |
| Contact: Lisa Bowron | <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Digital <input type="checkbox"/> Fax | <input type="radio"/> Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT |
| Address: 101 - 1025 Hillside Ave. Victoria, BC | Email 1: lbowron@minnow.ca Email 2: pstecko@minnow.ca | <input type="radio"/> Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT |
| Phone: (250)595-1627 x21 Fax: (250) 595-1625 | Email 3: | <input type="radio"/> Same Day or Weekend Emergency - Contact ALS to Confirm TAT |

| | | | | | | | | | | | | |
|---|-------------------------------------|--|------------------|----------------------------|------------------|------------------|------------|---------------|----------------------|-------------------------|------------------------------|----------------------|
| Invoice To Same as Report? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Client / Project Information | Analysis Request Please indicate below Filtered, Preserved or both (F, P, F/P) | | | | | | | | | | |
| Hardcopy of Invoice with Report? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Job #: Minnow Project | Rescan Low Level Sediments | Inorganic Carbon | Total Carbon by combustion | Mercury by CVAFS | Loss on Ignition | pH in soil | Particle Size | Total Organic Carbon | Total Kjeldahl Nitrogen | **See Complete Quote #Q51327 | Number of Containers |
| Company: Minto Explorations Ltd | PO / AFE: | | | | | | | | | | | |
| Contact: Cindy Keehn | LSD: | | | | | | | | | | | |
| Address: Suite 2100-510 West Georgia Street, Vancouver, BC | Quote #: Q51327 | | | | | | | | | | | |
| Phone: 604-684-8894 Fax: 604-688-2180 | ALS Contact: Jerry Holzbecher | Sampler: Lisa Bowron | | | | | | | | | | |

Lab Work Order # (lab use only)

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Rescan Low Level Sediments | Inorganic Carbon | Total Carbon by combustion | Mercury by CVAFS | Loss on Ignition | pH in soil | Particle Size | Total Organic Carbon | Total Kjeldahl Nitrogen | **See Complete Quote #Q51327 | Number of Containers |
|----------|---|----------------------|-----------------|-------------|----------------------------|------------------|----------------------------|------------------|------------------|--------------|---------------|----------------------|-------------------------|------------------------------|----------------------|
| | Urc-4 | 25-Sep-17 | | Sediment | X | X | X | X | X | X | | X | X | X | 1 |
| | Urc-3 | 25-Sep-17 | | | X | X | X | X | X | X | | X | X | X | 1 |
| | Urc-2 | 25-Sep-17 | | | X | X | X | X | X | X | | X | X | X | 1 |
| | Urc-1 | 25-Sep-17 | | | X | X | X | X | X | X | | X | X | X | 1 |
| | Urc | 25-Sep-17 | | | X | X | X | X | X | X | | X | X | X | 1 |
| | Urc | 25-Sep-17 | | Sediment | | | | | | | X | | | | 1 |
| | Umc | 25-Sep-17 | | | | | | | | | X | | | | 1 |
| | Umc-5 | 25-Sep-17 | | | X | X | X | X | X | X | | X | X | X | 1 |
| | Umc-4 | 25-Sep-17 | | | X | X | X | X | X | X | | X | X | X | 1 |
| | Umc-3 | 25-Sep-17 | | | X | X | X | X | X | X | | X | X | X | 1 |
| | Umc-2 | 25-Sep-17 | | | X | X | X | X | X | X | | X | X | X | 1 |
| | Umc-1 | 25-Sep-17 | | | X | X | X | X | X | X | | X | X | X | 1 |

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs.
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

| SHIPMENT, RELEASE (client use) | | | SHIPMENT, RECEPTION (lab use only) | | | | SHIPMENT, VERIFICATION (lab use only) | | | |
|------------------------------------|--------------------------------|---------------|------------------------------------|--------------------|----------------|----------------------|---------------------------------------|-------|-------|--|
| Released by: <i>Lisa Bowron</i> | Date (dd-mmm-yy): 27-Sep-17 | Time (hh-mm): | Received by: <i>(Signature)</i> | Date: Sep 27/17 | Time: 12:15 | Temperature: 2 °C | Verified by: | Date: | Time: | Observations: Yes / No? If Yes add SIF |

Laura SEP 28/17 10:25 3°C



Toxicity testing for Minnow Environmental Inc.

September 2017 Sediment Samples

Final Report

December 11, 2017

Submitted to: **Minnow Environmental Inc.**
Victoria, BC

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SIGNATURE PAGE

Eric Cheung

Report By:
Eric Cheung, B. Sc.
Laboratory Biologist

Edmund Canaria

Reviewed By:
Edmund Canaria, R.P.Bio.
Senior Analyst

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

SUMMARY

Sample and Test Type Information

| | |
|----------------------------|--|
| Sample ID | LMC and LWC |
| Sample collection date | September 20, 21 and 24, 2017 |
| Sample receipt date | September 28, 2017 |
| Sample receipt temperature | 11.0°C |
| Test types | 14-d <i>Hyaella azteca</i> survival and growth 10-d <i>Chironomus dilutus</i> survival and growth |

Results

| Endpoint (mean + SD) | Sample ID | | |
|----------------------------|------------------|-------------|-----------------------------|
| | Control Sediment | LWC | LMC |
| <i>H. azteca</i> survival | 96.0 ± 5.5 | 94.0 ± 5.5 | 92.0 ± 13.0 |
| <i>H. azteca</i> growth | 0.11 ± 0.02 | 0.11 ± 0.02 | 0.13 ± 0.03 |
| <i>C. dilutus</i> survival | 86.0 ± 8.9 | 90.0 ± 17.3 | 48.0 ± 38.3 ^{*, α} |
| <i>C. dilutus</i> growth | 1.22 ± 0.25 | 1.92 ± 0.24 | 1.57 ± 0.32 ^α |

SD = Standard Deviation

(*) Indicates a statistically significant effect relative to the control sediment

(α) Indicates a statistically significant effect relative to reference sediment LWC

1.0 INTRODUCTION

Nautilus Environmental Company Inc. conducted freshwater sediment toxicity tests for Minnow Environmental Inc. on samples identified as LMC and LWC. The samples were collected on September 20, 21, and 24, 2017; each sample was transported in one 500-mL plastic container and delivered to laboratory in Burnaby, BC on September 28, 2017. The samples had a temperature of 11°C on receipt and were stored in the dark at $4 \pm 2^\circ\text{C}$ prior to testing. The following toxicity tests were performed on the samples:

- 14-d *Hyaella azteca* survival and growth
- 10-d *Chironomus dilutus* survival and growth

This report describes the results of these toxicity tests. Copies of raw laboratory data sheets and statistical analyses for each test species are provided in Appendices A and B. Analytical chemistry results and chain-of-custody form are provided in Appendices C and D, respectively.

2.0 METHODS

Methods for the toxicity tests are summarized in Tables 1 and 2. Testing was conducted according to procedures described by Environment Canada (1997 and 2013). Statistical analyses for all tests were performed using CETIS (Tidepool Scientific Software, 2013).

Ammonia concentrations were measured in-house three times per week on reference sediment sample LWC to ensure that un-ionized ammonia was below 0.2 mg/L (Environment Canada, 2013). Samples of overlying water were also collected at test initiation and termination and sent to ALS Environmental, Burnaby, BC for measurements of total ammonia concentration. Analytical results are provided in Appendix C.

Table 1. Summary of test conditions: *Hyalella azteca* survival and growth test.

| | |
|--|---|
| Test species | <i>Hyalella azteca</i> |
| Organism source | Aquatic Research Organisms, Hampton, NH |
| Organism age | 2- to 9-days old |
| Test type | Static |
| Test duration | 14 days |
| Test vessel | 375-mL glass container |
| Test volume | 100 mL sediment; 175 mL overlying water |
| Test replicates | 5 per sample |
| Number of organisms | 10 per replicate |
| Control/dilution water | Reconstituted water |
| Test solution renewal | None |
| Test temperature | 23 ± 1°C |
| Feeding | 0.75 mL of YCT and 1.35 mg of Tetramin per replicate daily |
| Light intensity | 500 to 1000 lux at water surface |
| Photoperiod | 16 hours light/8 hours dark |
| Aeration | Continuous gentle aeration |
| Test measurements | Temperature, dissolved oxygen, pH and conductivity of overlying water measured daily; hardness, alkalinity and total ammonia of overlying water measured at test initiation and termination; unionized ammonia measured three times weekly in overlying water of reference sample |
| Test protocol | Environment Canada (2013), EPS 1/RM/33 |
| Statistical software | CETIS Version 1.8.7 |
| Test endpoints | Survival and dry weight |
| Test acceptability criteria for controls | ≥80% survival and ≥0.1 mg/amphipod dry weight |
| Reference toxicant | Sodium chloride (NaCl) |

Table 2. Summary of test conditions: *Chironomus dilutus* survival and growth test.

| | |
|--|---|
| Test species | <i>Chironomus dilutus</i> |
| Organism source | Aquatic BioSystems, Fort Collins, CO |
| Organism age | Third instar |
| Test type | Static |
| Test duration | 10 days |
| Test vessel | 375-mL glass container |
| Test volume | 100 mL sediment; 175 mL overlying water |
| Test replicates | 5 per sample |
| Number of organisms | 10 per replicate |
| Control/dilution water | Reconstituted water |
| Test solution renewal | None |
| Test temperature | 23 ± 1°C |
| Feeding | 6 mg of Tetramin per replicate daily |
| Light intensity | 500 to 1000 lux at water surface |
| Photoperiod | 16 hours light/8 hours dark |
| Aeration | Continuous gentle aeration |
| Test measurements | Temperature, dissolved oxygen, pH and conductivity of overlying water measured daily; hardness, alkalinity and total ammonia of overlying water measured at test initiation and termination |
| Test protocol | Environment Canada (1997), EPS 1/RM/32 |
| Statistical software | CETIS Version 1.8.7 |
| Test endpoints | Survival and dry weight |
| Test acceptability criteria for controls | ≥70% survival and ≥0.6 mg/worm dry weight |
| Reference toxicant | Potassium chloride (KCl) |

3.0 RESULTS

Sample LMC did not show any adverse effects on either survival or dry weight of *H. azteca* relative to the control sediment or the reference sediment LWC (Table 3).

A significant difference in survival of *C. dilutus* was observed in sample LMC when compared to either the laboratory control and the reference sediment LWC (Table 4). A significant decrease in dry weight of *C. dilutus* was also observed in the sample LMC relative to the reference sediment LWC.

Measured total ammonia concentrations in the *H. azteca* and *C. dilutus* tests are summarized in Tables 5. These concentrations are at levels that are not expected to cause adverse effects to either species. Un-ionized ammonia measurements on the reference sediment sample were below 0.2 mg/L throughout the *H. azteca* test, therefore, no water change was required as specified by Environment Canada (2013).

Table 3. Results: *Hyaella azteca* survival and growth test.

| Sample ID | Mean ± SD | |
|------------------|--------------|-----------------------------|
| | Survival (%) | Average Dry Weight (mg/org) |
| Control Sediment | 96.0 ± 5.5 | 0.11 ± 0.02 |
| LWC | 94.0 ± 5.5 | 0.13 ± 0.03 |
| LMC | 92.0 ± 13.0 | 0.11 ± 0.02 |

SD = Standard Deviation

Table 4. Results: *Chironomus dilutus* survival and growth test.

| Sample ID | Mean ± SD | |
|------------------|-----------------------------|-----------------------------|
| | Survival (%) | Average Dry Weight (mg/org) |
| Control Sediment | 86.0 ± 8.9 | 1.22 ± 0.25 |
| LWC | 90.0 ± 17.3 | 1.92 ± 0.24 |
| LMC | 48.0 ± 38.3 ^{*, α} | 1.57 ± 0.32 ^α |

SD = Standard Deviation

(*) Indicates a statistically significant effect relative to the control sediment

(α) Indicates a statistically significant effect relative to reference sediment LWC

Table 5. Summary of total overlying ammonia concentrations (mg/L N) measured in the toxicity tests.

| Sample ID | <i>Hyaella azteca</i> | | <i>Chironomus dilutus</i> | |
|------------------|-----------------------|--------|---------------------------|--------|
| | Day 0 | Day 14 | Day 0 | Day 10 |
| Control Sediment | 0.137 | 1.920 | 0.137 | 0.682 |
| LWC | 0.335 | 0.091 | 0.335 | 0.882 |
| LMC | 0.084 | 0.066 | 0.084 | 0.123 |

4.0 QA/QC

The health histories of the test organisms used in the exposures were acceptable and met the requirements of the Environment Canada protocols. The tests met all control acceptability criteria and water quality parameters remained within ranges specified in the protocols throughout the tests. There were no deviations from the test methodologies. Uncertainty associated with these tests is best described by the standard deviations around the means.

Results of the reference toxicant tests conducted during the testing program are summarized in Table 7. Results for these tests fell within the acceptable range for organism performance of mean and two standard deviations, based on historical results obtained by the laboratory with these tests. Thus, the sensitivity of the organisms used in these tests was appropriate.

Table 6. Reference toxicant test results.

| Test Species | Endpoint | Historical Mean (2 SD Range) | CV (%) | Test Date |
|-------------------|-------------------------------|---------------------------------|-----------|------------------|
| <i>H. azteca</i> | Survival (LC50): 5.2 g/L NaCl | 5.8 (5.2–6.5) | 6 | October 13, 2017 |
| <i>C. dilutus</i> | Survival (LC50): 2.9 g/L KCl | 4.8 (2.7 – 8.7) | 34 | October 13, 2017 |

SD = Standard Deviation, CV = Coefficient of Variation, LC = Lethal Concentration

5.0 REFERENCES

- Environment Canada. 2013. Biological test method: test for survival and growth in sediment and water using the freshwater amphipod, *Hyalella azteca*. EPS 1/RM/33, Second Edition, January 2013.
- Environment Canada. 1997. Biological test method: test for survival and growth in sediment using the larvae of freshwater midges (*Chironomus tentans* and *Chironomus riparius*). Environmental Protection Series EPS 1/RM/32. December 1997. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 131 pp.
- Tidepool Scientific Software. 2013. CETIS comprehensive environmental toxicity information system, version 1.8.7.16 Tidepool Scientific Software, McKinleyville, CA. 275 pp.

APPENDIX A – *Hyaella azteca* Toxicity Test Data

Hyalella azteca Sediment Test Summary Sheet

Client: Minnow
 Work Order No.: 171052

Start Date: Oct 13/17
 Set up by: EC

Sample Information:

Sample ID: Various (see below)
 Sample Date: Sept 20, 21/17
 Date Received: Sept 29/17
 Sample Volume: 1 x 500mL per sample

Test Organism Information:

Species: Hyalella azteca
 Supplier: Aquatic Biosystems, CO
 Date received: Oct 13/17
 Age or size (Day 0): 2-9 days

NaCl Reference Toxicant Results:

Reference Toxicant ID: HA141
 Stock Solution ID: n/a
 Date Initiated: Oct 13/17

96-h LC50 (95% CL): 5.2(4.3-6.4)g/L NaCl

96-h LC50 Reference Toxicant Mean and Range: 5.8(5.2-6.5)g/L NaCl CV (%): 6

Test Results:

| Sample ID | Survival ± SD (%) | Average Dry Wt. ± SD (mg) |
|------------------|-------------------|---------------------------|
| Control Sediment | 96.0 ± 5.5 | 0.0911 ± 0.0032 |
| LMC | 92.0 ± 13.0 | 0.11 ± 0.02 |
| LWC | 94.0 ± 5.5 | 0.13 ± 0.0043 |
| | ± | ± |
| | ± | ± |
| | ± | ± |
| | ± | ± |

Reviewed by: 

Date reviewed: Nov 28, 2017

Chronic *H. azteca* Sediment Toxicity Test Data Sheet

Freshwater Sediment Water Quality

Client: Minnow
 Work Order No.: 171052

Start Date: Oct 13/17
 Termination Date: Oct 25/17 El 27/17
 CER #: 6
 Test Organism: Hyalella azteca

Temperature (°C)

| Sample ID | Day | | | | | | | | | | | | | | |
|---------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Control | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 |
| LMC | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 |
| LWC (ref) | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Technician Initials | EL | EL | ML | EL | EL | EL | AWB | EL | W | MM | ML | ML | ML | ML | ML |

Thermometer: 6

Conductivity (µS)

| Sample ID | Day | | | | | | | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Control | 418 | 436 | 437 | 436 | 423 | 453 | 450 | 487 | 466 | 476 | 489 | 487 | 460 | 463 | 488 |
| LMC | 465 | 473 | 530 | 547 | 587 | 582 | 604 | 640 | 657 | 676 | 699 | 691 | 723 | 733 | 758 |
| LWC | 392 | 409 | 419 | 415 | 423 | 431 | 418 | 450 | 450 | 461 | 472 | 458 | 475 | 479 | 491 |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Technician Initials | EL | EL | ML | EL | EL | EL | AWB | EL | W | MM | ML | ML | ML | ML | ML |

Conductivity meter/probe: 111

Comments: _____

Reviewed by: EL Date Reviewed: November 28, 2017

Chronic *H. azteca* Sediment Toxicity Test Data Sheet
 Freshwater Sediment Water Quality

Client: Minnow
 Work Order No.: 171052

Start Date: Oct 13/17
 Termination Date: Oct 27/17
 CER #: 6
 Test Organism: Hyalella azteca

Dissolved oxygen (mg/L)

| Sample ID | Day | | | | | | | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Control | 8.1 | 8.2 | 8.2 | 7.6 | 7.8 | 8.1 | 8.0 | 8.1 | 7.8 | 7.9 | 7.9 | 7.8 | 7.9 | 7.9 | 7.9 |
| LMC | 8.2 | 8.0 | 8.1 | 7.7 | 7.9 | 8.2 | 8.1 | 8.2 | 7.9 | 7.9 | 8.0 | 7.9 | 7.9 | 8.0 | 7.9 |
| LWC (ref) | 8.1 | 8.2 | 8.1 | 7.7 | 8.0 | 8.1 | 8.2 | 8.0 | 7.9 | 8.0 | 7.9 | 7.8 | 8.0 | 8.0 | 7.9 |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Technician Initials | EL | EL | ML | EL | EL | EL | AWB | EL | W | W | ML | ML | ML | ML | ML |

DO meter/probe: 1/1

pH

| Sample ID | Day | | | | | | | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Control | 7.6 | 7.5 | 7.5 | 7.5 | 7.6 | 7.5 | 7.7 | 7.8 | 7.8 | 7.7 | 7.8 | 7.8 | 7.8 | 7.9 | 7.9 |
| LMC | 7.9 | 7.9 | 7.8 | 7.8 | 8.0 | 8.0 | 8.2 | 8.2 | 8.3 | 8.2 | 8.3 | 8.2 | 8.2 | 8.1 | 8.2 |
| LWC | 7.7 | 7.7 | 7.7 | 7.8 | 7.9 | 7.9 | 7.9 | 8.1 | 8.0 | 8.1 | 8.2 | 8.1 | 8.2 | 8.1 | 8.2 |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Technician Initials | EL | EL | ML | EL | EL | EL | AWB | EL | W | W | ML | ML | ML | ML | ML |

pH meter/probe: 1/1

Light meter: lit 1

Light intensity (Lux): 510-820

Comments: _____

Reviewed by: EW

Date Reviewed: November 28, 2017

H. azteca Sediment Toxicity Test Data Sheet
Freshwater Sediment 14-d Survival and Weight

Client:

Minnow

Work Order No:

171052

Sample ID:

Various

Start Date:

Oct 13/17

Termination Date:

Oct 27/17

Test Organism:

Hyalella azteca

Balance:

1

| Sample ID | Pan No. | Rep | No. alive | No. dead | No. missing | Initials | Pan weight (mg) | Pan + organism (mg) | No. weighed | Initials |
|------------------|---------|-----|------------------|----------|-------------|----------|-----------------|---------------------|-------------|----------|
| Control Sediment | 1 | A | 10 9 | 0 | 0 | MLT | 1027.49 | 1028.76 | 9 (1) | EC |
| | 2 | B | 10 10 | 0 | 1 | | 1035.27 | 1036.30 | 10 | |
| | 3 | C | 10 | 0 | 0 | | 1016.36 | 1017.53 | 10 | |
| | 4 | D | 10 | 0 | 0 | | 1037.17 | 1038.17 | 10 | |
| | 5 | E | 9 | 0 | 1 | | 1017.41 | 1018.42 | 9 | |
| LMC-1 | 6 | A | 10 | 0 | 0 | | 1008.95 | 1010.02 | 10 | |
| LMC-2 | 7 | B | 10 | 0 | 0 | | 1013.68 | 1014.72 | 10 | |
| LMC-3 | 8 | C | 10 | 0 | 0 | | 1020.31 | 1021.50 | 10 | |
| LMC-4 | 9 | D | 9 | 1 | 1 | | 1019.86 | 1021.17 | 9 | |
| LMC-5 | 10 | E | 7 (1) | 0 | 3 | | 1035.95 | 1036.55 | 7 | |
| LWC-1 | 11 | A | 10 | 0 | 0 | | 1049.33 | 1050.89 | 10 | |
| LWC-2 | 12 | B | 9 | 0 | 1 | | 1015.18 | 1015.97 | 9 | |
| LWC-3 | 13 | C | 9 | 0 | 1 | | 1009.14 | 1010.34 | 9 | |
| LWC-4 | 14 | D | 9 | 0 | 1 | | 1018.52 | 1019.85 | 8 (2) | |
| LWC-5 | 15 | E | 10 | 0 | 0 | | 1010.32 | 1011.38 | 10 | |
| | | A | | | | | | | | |
| | | B | | | | | | | | |
| | | C | | | | | | | | |
| | | D | | | | | | | | |
| | | E | | | | | | | | |

Comments:

(1) Checked by CMP (2) Lost in transfer
Reweighed on Pan 2: 1037.11 mg, Pan 4: 1038.01 mg

Reviewed by:

[Signature]

Date Reviewed:

Nov. 28/17

CETIS Summary Report

Report Date: 05 Dec-17 11:08 (p 1 of 1)
 Test Code: 171052 | 17-2296-8735

Hyalella 14-d Survival and Growth Sediment Test Nautilus Environmental

| | | |
|-------------------------------|---|-------------------------------------|
| Batch ID: 20-6218-0957 | Test Type: Growth-Survival (10d) | Analyst: Eric Cheung |
| Start Date: 13 Oct-17 | Protocol: EC/EPS 1/RM/33 | Diluent: Reconstituted Water |
| Ending Date: 27 Oct-17 | Species: Hyalella azteca | Brine: |
| Duration: 14d 0h | Source: Aquatic Biosystems, CO | Age: 2-9d |

| Sample Code | Sample ID | Sample Date | Receive Date | Sample Age | Client Name | Project |
|-------------|--------------|-------------|-----------------|----------------|-------------|---------|
| Control SED | 03-7657-6483 | 13 Oct-17 | 13 Oct-17 | NA | | |
| LMC | 12-3392-1475 | 20 Sep-17 | 28 Sep-17 10:30 | 23d 0h (11 °C) | Minnow | |
| LWC | 10-6552-7572 | 24 Sep-17 | 28 Sep-17 10:30 | 19d 0h (11 °C) | | |

| Sample Code | Material Type | Sample Source | Station Location | Latitude | Longitude |
|-------------|-----------------|----------------------|------------------|----------|-----------|
| Control SED | Sediment Sample | Minnow Environmental | Control Sediment | | |
| LMC | Sediment Sample | Minnow Environmental | LMC | | |
| LWC | Sediment Sample | Minnow Environmental | LWC | | |

10d Survival Rate Summary

| Sample Code | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|-------------|-------|------|---------|---------|-----|-----|---------|---------|--------|---------|
| Control SED | 5 | 0.96 | 0.892 | 1 | 0.9 | 1 | 0.02449 | 0.05477 | 5.71% | 0.0% |
| LMC | 5 | 0.92 | 0.7581 | 1 | 0.7 | 1 | 0.05831 | 0.1304 | 14.17% | 4.17% |
| LWC | 5 | 0.94 | 0.872 | 1 | 0.9 | 1 | 0.02449 | 0.05477 | 5.83% | 2.08% |

Mean Dry Weight-mg Summary

| Sample Code | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|-------------|-------|--------|---------|---------|---------|--------|----------|---------|--------|---------|
| Control SED | 5 | 0.1143 | 0.0941 | 0.1344 | 0.1 | 0.1411 | 0.007266 | 0.01625 | 14.22% | 0.0% |
| LMC | 5 | 0.1123 | 0.08481 | 0.1397 | 0.08573 | 0.1456 | 0.009884 | 0.0221 | 19.69% | 1.76% |
| LWC | 5 | 0.1299 | 0.08888 | 0.1709 | 0.08778 | 0.1662 | 0.01476 | 0.03301 | 25.42% | -13.66% |

10d Survival Rate Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| Control SED | 0.9 | 1 | 1 | 1 | 0.9 |
| LMC | 1 | 1 | 1 | 0.9 | 0.7 |
| LWC | 1 | 0.9 | 0.9 | 0.9 | 1 |

Mean Dry Weight-mg Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|--------|---------|--------|--------|---------|
| Control SED | 0.1411 | 0.103 | 0.115 | 0.1 | 0.1122 |
| LMC | 0.107 | 0.104 | 0.119 | 0.1456 | 0.08573 |
| LWC | 0.156 | 0.08778 | 0.1333 | 0.1662 | 0.106 |

10d Survival Rate Binomials

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| Control SED | 9/10 | 10/10 | 10/10 | 10/10 | 9/10 |
| LMC | 10/10 | 10/10 | 10/10 | 9/10 | 7/10 |
| LWC | 10/10 | 9/10 | 9/10 | 9/10 | 10/10 |

CETIS Analytical Report

Report Date: 05 Dec-17 11:08 (p 1 of 2)
 Test Code: 171052 | 17-2296-8735

| | | | |
|--|--------------------------------------|------------------------------|-------------------------------|
| Hyalella 14-d Survival and Growth Sediment Test | | | Nautilus Environmental |
| Analysis ID: 18-5087-2458 | Endpoint: 14d Survival Rate | CETIS Version: CETISv1.8.7 | |
| Analyzed: 05 Dec-17 11:07 | Analysis: STP 2x2 Contingency Tables | Official Results: Yes | |
| Batch ID: 20-6218-0957 | Test Type: Growth-Survival (10d) | Analyst: Eric Cheung | |
| Start Date: 13 Oct-17 | Protocol: EC/EPS 1/RM/33 | Diluent: Reconstituted Water | |
| Ending Date: 27 Oct-17 | Species: Hyalella azteca | Brine: | |
| Duration: 14d 0h | Source: Aquatic Biosystems, CO | Age: 2-9d | |

| Sample Code | Sample ID | Sample Date | Receive Date | Sample Age | Client Name | Project |
|-------------|--------------|-------------|-----------------|----------------|-------------|---------|
| Control SED | 03-7657-6483 | 13 Oct-17 | 13 Oct-17 | NA | | |
| LMC | 12-3392-1475 | 20 Sep-17 | 28 Sep-17 10:30 | 23d 0h (11 °C) | Minnow | |
| LWC | 10-6552-7572 | 24 Sep-17 | 28 Sep-17 10:30 | 19d 0h (11 °C) | | |

| Sample Code | Material Type | Sample Source | Station Location | Latitude | Longitude |
|-------------|-----------------|----------------------|------------------|----------|-----------|
| Control SED | Sediment Sample | Minnow Environmental | Control Sediment | | |
| LMC | Sediment Sample | Minnow Environmental | LMC | | |
| LWC | Sediment Sample | Minnow Environmental | LWC | | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | Test Result |
|----------------|------|---------|--------|------|-------------|
| Untransformed | | C > T | NA | NA | |

Fisher Exact/Bonferroni-Holm Test

| Sample | vs | Sample | Test Stat | P-Value | P-Type | Decision(α:5%) |
|-------------|----|--------|-----------|---------|--------|------------------------|
| Control SED | | LMC | 0.3389 | 0.6777 | Exact | Non-Significant Effect |
| Control SED | | LWC | 0.5 | 0.5000 | Exact | Non-Significant Effect |

Data Summary

| Sample Code | NR | R | NR + R | Prop NR | Prop R | %Effect |
|----------------------------|----|---|--------|---------|--------|---------|
| Control SED Negative Contr | 48 | 2 | 50 | 0.96 | 0.04 | 0.0% |
| LMC | 46 | 4 | 50 | 0.92 | 0.08 | 4.17% |
| LWC | 47 | 3 | 50 | 0.94 | 0.06 | 2.08% |

14d Survival Rate Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| Control SED | 0.9 | 1 | 1 | 1 | 0.9 |
| LMC | 1 | 1 | 1 | 0.9 | 0.7 |
| LWC | 1 | 0.9 | 0.9 | 0.9 | 1 |

14d Survival Rate Binomials

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| Control SED | 9/10 | 10/10 | 10/10 | 10/10 | 9/10 |
| LMC | 10/10 | 10/10 | 10/10 | 9/10 | 7/10 |
| LWC | 10/10 | 9/10 | 9/10 | 9/10 | 10/10 |

CETIS Analytical Report

Report Date: 05 Dec-17 11:08 (p 2 of 2)
Test Code: 171052 | 17-2296-8735

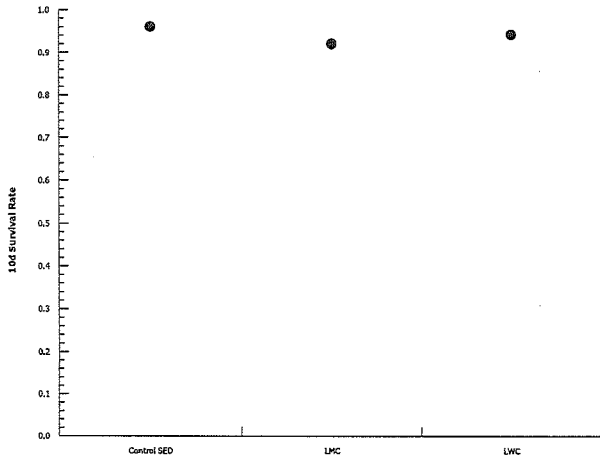
Hyalella 14-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID: 18-5087-2458 Endpoint: 14d Survival Rate
Analyzed: 05 Dec-17 11:07 Analysis: STP 2x2 Contingency Tables

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 21 Nov-17 14:24 (p 3 of 3)
 Test Code: 171052 | 17-2296-8735

Hyalella 14-d Survival and Growth Sediment Test

Nautilus Environmental

| | | |
|---------------------------|--------------------------------------|------------------------------|
| Analysis ID: 12-8931-4019 | Endpoint: 10d Survival Rate | CETIS Version: CETISv1.8.7 |
| Analyzed: 21 Nov-17 14:23 | Analysis: STP 2x2 Contingency Tables | Official Results: Yes |
| Batch ID: 20-6218-0957 | Test Type: Growth-Survival (10d) | Analyst: Eric Cheung |
| Start Date: 13 Oct-17 | Protocol: EC/EPS 1/RM/33 | Diluent: Reconstituted Water |
| Ending Date: 27 Oct-17 | Species: Hyalella azteca | Brine: |
| Duration: 14d 0h | Source: Aquatic Biosystems, CO | Age: 2-9d |

| Sample Code | Sample ID | Sample Date | Receive Date | Sample Age | Client Name | Project |
|-------------|--------------|-------------|-----------------|----------------|-------------|---------|
| LMC | 12-3392-1475 | 20 Sep-17 | 28 Sep-17 10:30 | 23d 0h (11 °C) | Minnow | |
| LWC | 10-6552-7572 | 24 Sep-17 | 28 Sep-17 10:30 | 19d 0h (11 °C) | | |

| Sample Code | Material Type | Sample Source | Station Location | Latitude | Longitude |
|-------------|-----------------|----------------------|------------------|----------|-----------|
| LMC | Sediment Sample | Minnow Environmental | LMC | | |
| LWC | Sediment Sample | Minnow Environmental | LWC | | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | Test Result |
|----------------|------|---------|--------|------|-------------|
| Untransformed | | C > T | NA | NA | |

Fisher Exact/Bonferroni-Holm Test

| Sample | vs Sample | Test Stat | P-Value | P-Type | Decision(α:5%) |
|--------|-----------|-----------|---------|--------|------------------------|
| LWC | LMC | 0.5 | 0.5000 | Exact | Non-Significant Effect |

Data Summary

| Sample Code | NR | R | NR + R | Prop NR | Prop R | %Effect |
|-------------|---------------|----|--------|---------|--------|---------|
| LMC | 46 | 4 | 50 | 0.92 | 0.08 | 2.13% |
| LWC | Reference Sed | 47 | 3 | 50 | 0.94 | 0.06 |

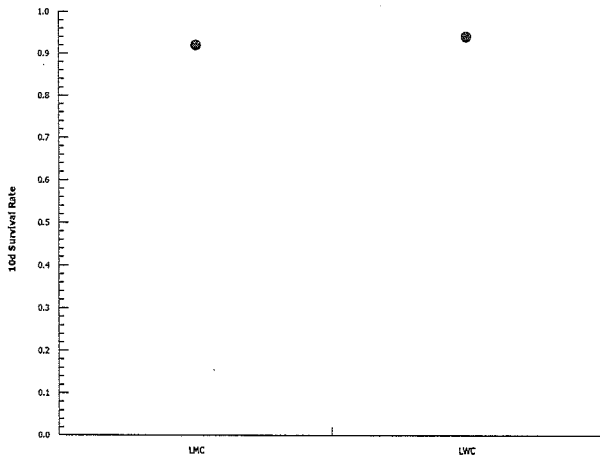
10d Survival Rate Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| LMC | 1 | 1 | 1 | 0.9 | 0.7 |
| LWC | 1 | 0.9 | 0.9 | 0.9 | 1 |

14 10d Survival Rate Binomials

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| LMC | 10/10 | 10/10 | 10/10 | 9/10 | 7/10 |
| LWC | 10/10 | 9/10 | 9/10 | 9/10 | 10/10 |

Graphics



CETIS Analytical Report

Report Date: 05 Dec-17 11:08 (p 1 of 2)
 Test Code: 171052 | 17-2296-8735

Hyalella 14-d Survival and Growth Sediment Test

Nautilus Environmental

| | | |
|---------------------------|--|------------------------------|
| Analysis ID: 01-8339-2184 | Endpoint: Mean Dry Weight-mg | CETIS Version: CETISv1.8.7 |
| Analyzed: 05 Dec-17 11:08 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 20-6218-0957 | Test Type: Growth-Survival (10d) | Analyst: Eric Cheung |
| Start Date: 13 Oct-17 | Protocol: EC/EPS 1/RM/33 | Diluent: Reconstituted Water |
| Ending Date: 27 Oct-17 | Species: Hyalella azteca | Brine: |
| Duration: 14d 0h | Source: Aquatic Biosystems, CO | Age: 2-9d |

| Sample Code | Sample ID | Sample Date | Receive Date | Sample Age | Client Name | Project |
|-------------|--------------|-------------|-----------------|----------------|-------------|---------|
| Control SED | 03-7657-6483 | 13 Oct-17 | 13 Oct-17 | NA | | |
| LMC | 12-3392-1475 | 20 Sep-17 | 28 Sep-17 10:30 | 23d 0h (11 °C) | Minnow | |
| LWC | 10-6552-7572 | 24 Sep-17 | 28 Sep-17 10:30 | 19d 0h (11 °C) | | |

| Sample Code | Material Type | Sample Source | Station Location | Latitude | Longitude |
|-------------|-----------------|----------------------|------------------|----------|-----------|
| Control SED | Sediment Sample | Minnow Environmental | Control Sediment | | |
| LMC | Sediment Sample | Minnow Environmental | LMC | | |
| LWC | Sediment Sample | Minnow Environmental | LWC | | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | PMSD | Test Result |
|----------------|------|---------|--------|------|-------|-------------|
| Untransformed | NA | C > T | NA | NA | 28.9% | |

Dunnett Multiple Comparison Test

| Sample Code | vs | Sample Code | Test Stat | Critical | MSD | DF | P-Value | P-Type | Decision(α:5%) |
|-------------|----|-------------|-----------|----------|-------|----|---------|--------|------------------------|
| Control SED | | LMC | 0.1284 | 2.108 | 0.033 | 8 | 0.6152 | CDF | Non-Significant Effect |
| | | LWC | -0.9955 | 2.108 | 0.033 | 8 | 0.9293 | CDF | Non-Significant Effect |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|--------------|--------------|----|--------|---------|------------------------|
| Between | 0.0009297162 | 0.0004648581 | 2 | 0.7569 | 0.4902 | Non-Significant Effect |
| Error | 0.007369674 | 0.0006141395 | 12 | | | |
| Total | 0.00829939 | | 14 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|-------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance | 1.799 | 9.21 | 0.4068 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality | 0.961 | 0.8328 | 0.7104 | Normal Distribution |

Mean Dry Weight-mg Summary

| Sample Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-------------|-------|--------|---------|---------|--------|---------|--------|----------|--------|---------|
| Control SED | 5 | 0.1143 | 0.0941 | 0.1344 | 0.1122 | 0.1 | 0.1411 | 0.007266 | 14.22% | 0.0% |
| LMC | 5 | 0.1123 | 0.08481 | 0.1397 | 0.107 | 0.08573 | 0.1456 | 0.009884 | 19.69% | 1.76% |
| LWC | 5 | 0.1299 | 0.08888 | 0.1709 | 0.1333 | 0.08778 | 0.1662 | 0.01476 | 25.42% | -13.66% |

Mean Dry Weight-mg Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|--------|---------|--------|--------|---------|
| Control SED | 0.1411 | 0.103 | 0.115 | 0.1 | 0.1122 |
| LMC | 0.107 | 0.104 | 0.119 | 0.1456 | 0.08573 |
| LWC | 0.156 | 0.08778 | 0.1333 | 0.1662 | 0.106 |

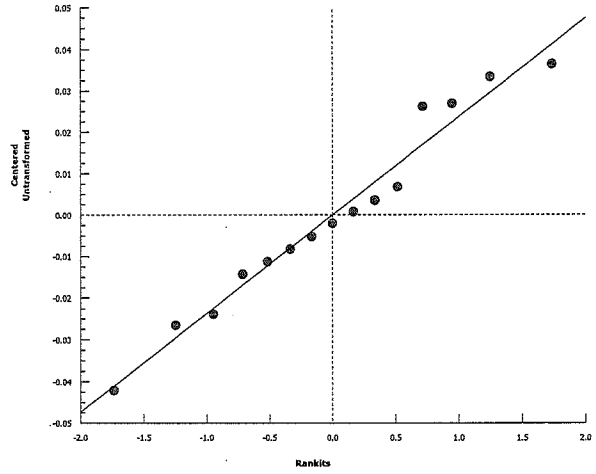
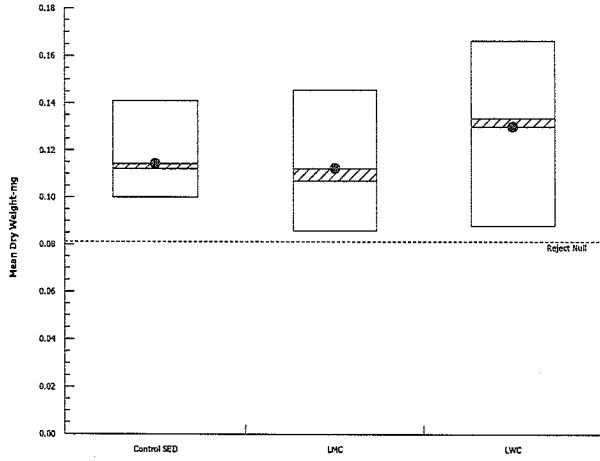
Hyalella 14-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID: 01-8339-2184 Endpoint: Mean Dry Weight-mg
Analyzed: 05 Dec-17 11:08 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 28 Nov-17 15:47 (p 1 of 2)
 Test Code: 171052 | 17-2296-8735

Hyalella 14-d Survival and Growth Sediment Test

Nautilus Environmental

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 05-9680-4235 | Endpoint: Mean Dry Weight-mg | CETIS Version: CETISv1.8.7 |
| Analyzed: 28 Nov-17 15:46 | Analysis: Parametric-Control vs Ord.Treatments | Official Results: Yes |
| Batch ID: 20-6218-0957 | Test Type: Growth-Survival (14d) | Analyst: Eric Cheung |
| Start Date: 13 Oct-17 | Protocol: EC/EPS 1/RM/33 | Diluent: Reconstituted Water |
| Ending Date: 27 Oct-17 | Species: Hyalella azteca | Brine: |
| Duration: 14d 0h | Source: Aquatic Biosystems, CO | Age: 2-9d |

| Sample Code | Sample ID | Sample Date | Receive Date | Sample Age | Client Name | Project |
|-------------|--------------|-------------|-----------------|----------------|-------------|---------|
| LMC | 12-3392-1475 | 20 Sep-17 | 28 Sep-17 10:30 | 23d 0h (11 °C) | Minnow | |
| LWC | 10-6552-7572 | 24 Sep-17 | 28 Sep-17 10:30 | 19d 0h (11 °C) | | |

| Sample Code | Material Type | Sample Source | Station Location | Latitude | Longitude |
|-------------|-----------------|----------------------|------------------|----------|-----------|
| LMC | Sediment Sample | Minnow Environmental | LMC | | |
| LWC | Sediment Sample | Minnow Environmental | LWC | | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | PMSD | Test Result |
|----------------|------|---------|--------|------|-------|-------------|
| Untransformed | NA | C > T | NA | NA | 25.4% | |

Williams Multiple Comparison Test

| Sample Code | vs | Sample Code | Test Stat | Critical | MSD | DF | P-Value | P-Type | Decision(α:5%) |
|-------------|----|-------------|-----------|----------|-------|----|---------|--------|------------------------|
| LWC | | LMC | 0.9914 | 1.86 | 0.033 | 8 | >0.05 | CDF | Non-Significant Effect |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|--------------|--------------|----|--------|---------|------------------------|
| Between | 0.0007757707 | 0.0007757707 | 1 | 0.983 | 0.3505 | Non-Significant Effect |
| Error | 0.006313807 | 0.0007892259 | 8 | | | |
| Total | 0.007089578 | | 9 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|--------------------------|-----------|----------|---------|---------------------|
| Variances | Variance Ratio F | 2.231 | 23.15 | 0.4560 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality | 0.954 | 0.7411 | 0.7160 | Normal Distribution |

Mean Dry Weight-mg Summary

| Sample Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-------------|-------|--------|---------|---------|--------|---------|--------|----------|--------|---------|
| LMC | 5 | 0.1123 | 0.08481 | 0.1397 | 0.107 | 0.08573 | 0.1456 | 0.009884 | 19.69% | 0.0% |
| LWC | 5 | 0.1299 | 0.08888 | 0.1709 | 0.1333 | 0.08778 | 0.1662 | 0.01476 | 25.42% | -15.69% |

Mean Dry Weight-mg Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|---------|--------|--------|---------|
| LMC | 0.107 | 0.104 | 0.119 | 0.1456 | 0.08573 |
| LWC | 0.156 | 0.08778 | 0.1333 | 0.1662 | 0.106 |

EL
Nov 28/17


Client : Minnow
 W.O.: 171052
 Date see below

Table of PKa values

| Temperature (°C) | TDS (mg/L) | | | Salinity (g/kg) | | |
|------------------|------------|-------|-------|-----------------|-------|-------|
| | 0 | 250 | 2000 | 10 | 20 | 30 |
| 12 | 9.662 | 9.699 | 9.754 | 9.788 | 9.819 | 9.837 |
| 15 | 9.564 | 9.601 | 9.655 | 9.688 | 9.719 | 9.737 |
| 18 | 9.465 | 9.502 | 9.557 | 9.588 | 9.619 | 9.636 |
| 20 | 9.401 | 9.438 | 9.492 | 9.523 | 9.554 | 9.571 |
| 22 | | 9.391 | | | | |
| 23 | 9.307 | 9.344 | 9.398 | 9.426 | 9.459 | 9.476 |
| 25 | 9.246 | 9.283 | 9.337 | 9.366 | 9.397 | 9.414 |

unionized ammonia must be <0.2mg/L

| Sample ID | Temperature (C) | pH | Salinity (ppt) | Total Ammonia as N (mg/L) | pKa | Unionized Ammonia (mg/L N) |
|-----------|-----------------|------------------|----------------|---------------------------|-------|----------------------------|
| LWC | 22.0 | 7.8 ⁷ | 0 | 0.27 | 9.391 | 0.01 |
| LWC | 22.0 | 7.8 | 0 | 1.00 | 9.391 | 0.03 |
| LWC | 22.0 | 7.9 | 0 | 0.40 | 9.391 | 0.01 |
| LWC | 22.0 | 8.1 | 0 | 0.10 | 9.391 | 0.00 |
| LWC | 22.0 | 7.9 | 0 | 0.10 | 9.391 | 0.00 |
| LWC | 22.0 | 7.9 | 0 | 0.20 | 9.391 | 0.01 |
| LWC | 22.0 | 7.9 | 0 | 0.07 | 9.391 | 0.00 |


 NOV 28, 2017

Nautilus Environmental Water Quality Data For Ammonia

Client : Minnow

Species : Hyallela azteca

Work Order No: 171052

Sample Type: Overlying ammonia

Date Measured: Oct 13, 16, 18, 20, 23, 25, 27/17

| Date | Sample ID | Temperature (°C) | pH | Total Ammonia as N (mg/L) | Unionized Ammonia (mg/L) | Tech. Init. |
|--------------|-----------|------------------|--------|---------------------------|--------------------------|-------------|
| EU Oct 13/17 | LWC | 22.0 | 7.7 | 0.27 | 0.01 | EC |
| Oct 16/17 | LWC | 22.0 | 7.8 | 0.10 1.0 | 0.03 | EL |
| Oct 18/17 | LWC | 22.0 | EX 7.9 | 0.4 | 0.01 | EL |
| Oct 20/17 | LWC | 22.0 | 8.1 | 0.1 | 0.00 | EL |
| Oct 23/17 | LWC | 22.0 | 7.9 | 0.1 0.1 | 0.00 | ML |
| Oct 25/17 | LWC | 22.0 | 7.9 | 0.2 | 0.01 | ML |
| Oct 27/17 | LWC | 22.0 | 7.9 | 0.07 | 0.00 | EL |
| | | | | | | |
| | | | | | | |

Ammonia Salicylate Lot #: A7150

Ammonia Cyanurate Lot #: A7130

Comments: _____

Reviewed by: [Signature]

Date Reviewed: Nov 28, 2017


Client: Minnow

W.O.#: 171052 & 171051

Hardness and Alkalinity Datasheet

| Day ^o Sample ID | Alkalinity | | | | | | Hardness | | | |
|-------------------------------|----------------|---------------|--------------------|--|---|---|--------------------|--------------------------------|--|------------|
| | Subsample Date | Date Measured | Sample Volume (mL) | (mL) 0.02N HCL/H ₂ SO ₄ used to pH 4.5 | (mL) of 0.02N HCL/H ₂ SO ₄ used to pH 4.2 | Total Alkalinity (mg/LCaCO ₃) | Sample Volume (mL) | Volume of 0.01M EDTA Used (mL) | Total Hardness (mg/L CaCO ₃) | Technician |
| Hyal Lab | Oct 13/17 | Oct 18/17 | 50 | 2.9 | 3.0 | 56 | 100 | 1.8 | 180 | AWZ |
| Control Day 0 | ↓ | ↓ | ↓ | | | | ↓ | | | ↓ |
| LMC | ↓ | ↓ | ↓ | 4.8 | 4.9 | 94 | ↓ | 2.2 | 220 | ↓ |
| LWC | ↓ | ↓ | ↓ | 4.5 | 4.6 | 88 | ↓ | 2.4 | 240 | ↓ |
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Notes: Ⓢ Diluted fig 100ml w DI

Reviewed by:  Date Reviewed: Nov-28, 2017

Client: Minnow

W.O.#: 171052

Hardness and Alkalinity Datasheet

| Day 14 Sample ID | Alkalinity | | | | | | Hardness | | | Technician |
|---------------------|----------------|---------------|--------------------|--|---|--|--------------------|--------------------------------|--|------------|
| | Subsample Date | Date Measured | Sample Volume (mL) | (mL) 0.02N HCL/H ₂ SO ₄ used to pH 4.5 | (mL) of 0.02N HCL/H ₂ SO ₄ used to pH 4.2 | Total Alkalinity (mg/L CaCO ₃) | Sample Volume (mL) | Volume of 0.01M EDTA Used (mL) | Total Hardness (mg/L CaCO ₃) | |
| Contr 1 | Oct 27/17 | Oct 27/17 | 50 | 2.6 | 2.7 | 50 | 50 | 6.1 | 122 | AWZ |
| Lml | ↓ | ↓ | 50 | 14.6 | 14.9 | 286 | 100 | 4.5 | 450 | ↓ |
| LWC | ↓ | ↓ | 50 | 7.7 | 7.9 | 150 | 100 | 2.7 | 270 | ↓ |
| | | | | | | | | | | |
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Notes: ① Diluted to 100ml w DI

Reviewed by:  Date Reviewed: Nov. 28, 2017

Sediment Description Data Sheet

Client:
Work Order No.:

Minnow
171051 & 171052

Date:
Test Organism:

Oct 12/17
Hyalella azteca + Chironomus dilutus

| Sample ID | Grain Size | Colour | Odour | Debris | Other | Initials |
|------------------|------------|--------|-------|--------------------------------|-------|----------|
| Control Sediment | Sand | grey | - | - | - | EC |
| LMC-5 | Clay | Brown | - | Some branches | - | EC |
| LMC-4 | Clay | Brown | - | Some branches | - | EC |
| LMC-3 | Clay/Silk | Brown | - | Some branches | - | EC |
| LMC-2 | Clay | Brown | - | Some branches | - | EC |
| LMC-1 | Clay/Silk | Brown | - | Some branches | - | EC |
| LWC-5 | Clay | Brown | - | Some branches + leaves + roots | - | EC |
| LWC-4 | Clay | Brown | - | Some branches | - | EC |
| LWC-3 | Clay | Brown | - | Some branches | - | EC |
| LWC-2 | Silk/Clay | Brown | - | Some branches | - | EC |
| LWC-1 | Silk/Clay | Brown | - | Some branches | - | EC |
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Reviewed by:



Date Reviewed:

Nov 28, 2017

APPENDIX B – *Chironomus dilutus* Toxicity Test Data

Chironomus dilutus Sediment Test Summary Sheet

Client: Minnow
 Work Order No.: 171051

Start Date: Oct 13 / 17
 Set up by: EV

Sample Information:

Sample ID: Various (See below)
 Sample Date: Sept 20, 21 / 2017
 Date Received: Sept 28 / 17
 Sample Volume: 1 x 550mL per sample

Test Organism Information:

Species: C. dilutus
 Supplier: Aquatic Biosystems, CO
 Date received: Oct 13 / 17
 Age or size (Day 0): 3rd in-star

① indicates there is a significant survival difference as compared to Control sediment.

② indicates there is a significant survival difference as compared to LWC (reference site).

③ indicates there is a significant dry weight difference as compared to LWC.

KCI Reference Toxicant Results:

Reference Toxicant ID: CT63
 Stock Solution ID: n/a
 Date Initiated: Oct 13 / 17

96-h LC50 (95% CL): 2.9 (2.1 - 4.0) g/L KCl

96-h LC50 Reference Toxicant Mean and Range: 4.8 (2.7 - 8.7) g/L KCl CV (%): 34

Test Results:

| Sample ID | Survival ± SD (%) | Average Dry Wt. ± SD (mg) |
|------------------|--------------------------|---------------------------|
| Control Sediment | 86.0 ± 8.9 ^{EV} | 1.22 ± 0.25 |
| LMC | ②① 48.0 ± 38.3 | ③ 1.57 ± 0.32 |
| LWC | 90.0 ± 17.3 | 1.92 ± 0.24 |
| | ± | ± |
| | ± | ± |
| | ± | ± |
| | ± | ± |

Reviewed by: 

Date reviewed: November 28, 2017

10-d Chironomid Sediment Toxicity Test Data Sheet
Freshwater Sediment 10-d Water Quality

Client: Minnow
W.O #: 171051

Start Date: Oct 13/17
Termination Date: Oct 23/17
CER #: 6
Test Organism: Chironomus dilutus

Temperature (°C)

| Sample ID | Day | | | | | | | | | | |
|---------------------|------|------|------|------|------|------|------|------|------|------|------|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Control | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 |
| LMC | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 |
| LWC (ref) | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |
| Technician Initials | EL | EL | MLG | EL | EL | EL | AWI | EL | K | MM | MLG |

Thermometer: 6

Conductivity (µS)

| Sample ID | Day | | | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Control | 397 | 411 | 415 | 417 | 436 | 430 | 459 | 454 | 498 | 514 | 629 |
| LMC | 461 | 492 | 532 | 548 | 547 | 574 | 576 | 625 | 634 | 698 | 727 |
| LWC | 403 | 400 | 415 | 420 | 415 | 422 | 430 | 429 | 470 | 434 | 440 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Technician Initials | EL | EL | MLG | EL | EL | EL | EL | EL | K | MM | MLG |

6514
678
430

Conductivity meter/probe: 111

②698

Comments: _____

Reviewed by: [Signature]

Date Reviewed: November 28, 2017

10-d Chironomid Sediment Toxicity Test Data Sheet

Freshwater Sediment 10-d Water Quality

Client: Minnow
 W.O. #: 171051

Start Date: Oct 13/17
 Termination Date: Oct 23/17
 CER #: 6
 Test Organism: Chironomus dilutus

Dissolved oxygen (mg/L)

| Sample ID | Day | | | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Control | 8.2 | 8.1 | 8.2 | 7.9 | 8.0 | 8.0 | 8.3 | 8.2 | 8.2 | 8.0 | 8.0 |
| LMC | 8.1 | 8.2 | 8.0 | 7.8 | 8.1 | 8.1 | 8.3 | 8.1 | 8.1 | 8.2 | 7.8 |
| LWC (ref) | 8.2 | 8.0 | 8.0 | 7.9 | 8.0 | 8.1 | 8.3 | 8.2 | 8.0 | 8.0 | 7.8 |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |
| Technician Initials | EL | EL | MLT | EL | EL | EL | AWT | EL | K | MM | MLT |

DO meter/probe: 1 / 1

pH ① 7.8
② 8.2
③ 7.1

| Sample ID | Day | | | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|------|-----|-----|-----|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Control | 7.6 | 7.5 | 7.5 | 7.5 | 7.6 | 7.5 | 7.7 | 8.3① | 7.7 | 7.8 | 7.8 |
| LMC | 7.9 | 7.9 | 7.8 | 7.8 | 8.0 | 8.0 | 8.1 | 8.3② | 8.3 | 8.2 | 8.2 |
| LWC | 7.7 | 7.7 | 7.7 | 7.8 | 7.9 | 7.9 | 7.7 | 8.3③ | 7.7 | 7.5 | 7.8 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Technician Initials | EL | A | MLT | EL | EL | EL | AWT | EL | K | MM | MLT |

pH meter/probe: 1 / 1

Light meter: LH 1

Light intensity (Lux): 510 - 810

Comments: _____

Reviewed by: [Signature]

Date Reviewed: November 28, 2017

10-d Chironomid Sediment Toxicity Test Data Sheet
Freshwater Sediment 10-d Survival and Weight

Client: Minnow
 W.O. #: 171051
 Sample ID: Various

Start Date: Oct 13/17
 Termination Date: Oct 27/23/17
 Test Organism: Chironomus dilutus
 Balance: 1

| Sample ID | Min Pan No. Blue | Rep | No. alive | No. dead | No. missing | Initials | Pan weight (mg) | Pan + organism (mg) | No. weighed | Initials |
|------------------|------------------|-----|-----------------|----------|-------------|----------|-----------------|---------------------|-------------|----------|
| Control Sediment | 1 | A | 9 | 0 | 1 | MLT | 1016.96 | 1026.39 | 9 | EL |
| | 2 | B | 9 | 0 | 1 | ↓ | 1018.89 | 1029.44 | 9 | |
| | 3 | C | 7 [ⓐ] | 0 | 3 | | 1027.26 | 1038.95 | 7 | |
| | 4 | D | 9 | 0 | 1 | | 1028.93 | 1038.77 | 9 | |
| | 5 | E | 9 | 0 | 1 | | 1035.27 | 1045.47 | 9 | |
| LMC-5 | 6 | A | 2 [ⓐ] | 0 | 8 | | KJL | 1032.24 | 1034.64 | 2 |
| | 7 | B | 5 [ⓐ] | 0 | 5 | 1027.53 | 1035.60 | 5 | | |
| | 8 | C | 8 [ⓐ] | 0 | 2 | 1011.74 | 1025.86 | 8 | | |
| | 9 | D | 0 ^{ⓐⓑ} | 0 | 10 | 1034.40 | - | 0 | | |
| | 10 | E | 9 | 0 | 1 | 1031.19 | 1048.25 | 9 | | |
| LWC-9 | 11 | A | 10 | 0 | 0 | MLT | 1021.92 | 1038.86 | 10 | ↓ |
| | 12 | B | 9 | 0 | 1 | 1028.89 | 1044.51 | 9 | | |
| | 13 | C | 10 | 0 | 0 | 1040.68 | 1063.61 | 10 | | |
| | 14 | D | 11 | 0 | 0 | 1021.20 | 1042.30 | 11 | | |
| | 15 | E | 6 [ⓐ] | 0 | 4 | KJL | 1024.89 | 1036.80 | 6 | |
| | | A | | | | | | | | |
| | | B | | | | | | | | |
| | | C | | | | | | | | |
| | | D | | | | | | | | |
| | | E | | | | | | | | |

Comments: ⓐ checked by MLT ⓑ checked by KJL ⓒ jar marked as seeded
Reweighed on Pan # 2: 1028.98 mg. Pan # 4: 1038.88 mg

Reviewed by:  Date Reviewed: November 28, 2017

CETIS Summary Report

Report Date: 21 Nov-17 14:55 (p 1 of 1)
 Test Code: 171051 | 11-2980-0764

Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

Batch ID: 05-3681-5362 Test Type: Growth-Survival (10d) Analyst: Eric Cheung
 Start Date: 13 Oct-17 Protocol: EC/EPS 1/RM/32 Diluent: Reconstituted Water
 Ending Date: 23 Oct-17 Species: Chironomus dilutus Brine:
 Duration: 10d 0h Source: Aquatic Biosystems, CO Age: 3rd instar

| Sample Code | Sample ID | Sample Date | Receive Date | Sample Age | Client Name | Project |
|-------------|--------------|-------------|-----------------|----------------|-------------|---------|
| Control SED | 03-7657-6483 | 13 Oct-17 | 13 Oct-17 | NA | | |
| LMC | 12-3392-1475 | 20 Sep-17 | 28 Sep-17 10:30 | 23d 0h (11 °C) | Minnow | |
| LWC | 10-6552-7572 | 24 Sep-17 | 28 Sep-17 10:30 | 19d 0h (11 °C) | | |

| Sample Code | Material Type | Sample Source | Station Location | Latitude | Longitude |
|-------------|-----------------|----------------------|------------------|----------|-----------|
| Control SED | Sediment Sample | Minnow Environmental | Control Sediment | | |
| LMC | Sediment Sample | Minnow Environmental | LMC | | |
| LWC | Sediment Sample | Minnow Environmental | LWC | | |

10d Survival Rate Summary

| Sample Code | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|-------------|-------|------|----------|---------|-----|-----|---------|---------|--------|---------|
| Control SED | 5 | 0.86 | 0.7489 | 0.9711 | 0.7 | 0.9 | 0.04 | 0.08944 | 10.4% | 0.0% |
| LMC | 5 | 0.48 | 0.003939 | 0.9561 | 0 | 0.9 | 0.1715 | 0.3834 | 79.88% | 44.19% |
| LWC | 5 | 0.9 | 0.6849 | 1 | 0.6 | 1 | 0.07746 | 0.1732 | 19.25% | -4.65% |

Mean Dry Weight-mg Summary

| Sample Code | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|-------------|-------|-------|---------|---------|-------|-------|---------|---------|--------|---------|
| Control SED | 5 | 1.223 | 0.908 | 1.539 | 1.048 | 1.67 | 0.1136 | 0.2539 | 20.76% | 0.0% |
| LMC | 4 | 1.569 | 1.061 | 2.076 | 1.2 | 1.896 | 0.1595 | 0.319 | 20.33% | -28.23% |
| LWC | 5 | 1.925 | 1.628 | 2.222 | 1.694 | 2.293 | 0.1068 | 0.2389 | 12.41% | -57.37% |

10d Survival Rate Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| Control SED | 0.9 | 0.9 | 0.7 | 0.9 | 0.9 |
| LMC | 0.2 | 0.5 | 0.8 | 0 | 0.9 |
| LWC | 1 | 0.9 | 1 | 1 | 0.6 |

Mean Dry Weight-mg Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| Control SED | 1.048 | 1.172 | 1.67 | 1.093 | 1.133 |
| LMC | 1.2 | 1.414 | 1.765 | | 1.896 |
| LWC | 1.694 | 1.736 | 2.293 | 1.918 | 1.985 |

10d Survival Rate Binomials

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| Control SED | 9/10 | 9/10 | 7/10 | 9/10 | 9/10 |
| LMC | 2/10 | 5/10 | 8/10 | 0/10 | 9/10 |
| LWC | 10/10 | 9/10 | 10/10 | 11/11 | 6/10 |

CETIS Analytical Report

Report Date: 21 Nov-17 14:49 (p 1 of 3)
 Test Code: 171051 | 11-2980-0764

Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 19-5778-6453 | Endpoint: 10d Survival Rate | CETIS Version: CETISv1.8.7 |
| Analyzed: 21 Nov-17 14:48 | Analysis: STP 2x2 Contingency Tables | Official Results: Yes |
| Batch ID: 05-3681-5362 | Test Type: Growth-Survival (10d) | Analyst: Eric Cheung |
| Start Date: 13 Oct-17 | Protocol: EC/EPS 1/RM/32 | Diluent: Reconstituted Water |
| Ending Date: 23 Oct-17 | Species: Chironomus tentans <i>dilutus</i> | Brine: |
| Duration: 10d 0h | Source: Aquatic Biosystems, CO | Age: 3rd <i>instar</i> |

| Sample Code | Sample ID | Sample Date | Receive Date | Sample Age | Client Name | Project |
|-------------|--------------|-------------|-----------------|----------------|-------------|---------|
| Control SED | 03-7657-6483 | 13 Oct-17 | 13 Oct-17 | NA | | |
| LMC | 12-3392-1475 | 20 Sep-17 | 28 Sep-17 10:30 | 23d 0h (11 °C) | Minnow | |
| LWC | 10-6552-7572 | 24 Sep-17 | 28 Sep-17 10:30 | 19d 0h (11 °C) | | |

| Sample Code | Material Type | Sample Source | Station Location | Latitude | Longitude |
|-------------|-----------------|----------------------|------------------|----------|-----------|
| Control SED | Sediment Sample | Minnow Environmental | Control Sediment | | |
| LMC | Sediment Sample | Minnow Environmental | LMC | | |
| LWC | Sediment Sample | Minnow Environmental | LWC | | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | Test Result |
|----------------|------|---------|--------|------|-------------|
| Untransformed | | C > T | NA | NA | |

Fisher Exact/Bonferroni-Holm Test

| Sample | vs | Sample | Test Stat | P-Value | P-Type | Decision(α:5%) |
|-------------|----|--------|-----------|---------|--------|------------------------|
| Control SED | | LMC | 4.772E-05 | <0.0001 | Exact | Significant Effect |
| Control SED | | LWC | 1 | 1.0000 | Exact | Non-Significant Effect |

Data Summary

| Sample Code | NR | R | NR + R | Prop NR | Prop R | %Effect |
|----------------------------|----|----|--------|---------|---------|---------|
| Control SED Negative Contr | 43 | 7 | 50 | 0.86 | 0.14 | 0.0% |
| LMC | 24 | 26 | 50 | 0.48 | 0.52 | 44.19% |
| LWC | 46 | 5 | 51 | 0.902 | 0.09804 | -4.88% |

10d Survival Rate Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| Control SED | 0.9 | 0.9 | 0.7 | 0.9 | 0.9 |
| LMC | 0.2 | 0.5 | 0.8 | 0 | 0.9 |
| LWC | 1 | 0.9 | 1 | 1 | 0.6 |

10d Survival Rate Binomials

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| Control SED | 9/10 | 9/10 | 7/10 | 9/10 | 9/10 |
| LMC | 2/10 | 5/10 | 8/10 | 0/10 | 9/10 |
| LWC | 10/10 | 9/10 | 10/10 | 11/11 | 6/10 |

Chironomus 10-d Survival and Growth Sediment Test

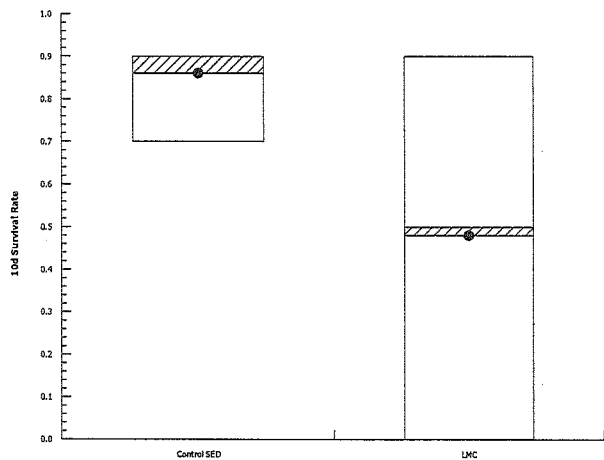
Nautilus Environmental

Analysis ID: 19-5778-6453
Analyzed: 21 Nov-17 14:48

Endpoint: 10d Survival Rate
Analysis: STP 2x2 Contingency Tables

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 21 Nov-17 14:55 (p 1 of 1)
 Test Code: 171051 | 11-2980-0764

Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

| | | |
|---------------------------|--------------------------------------|------------------------------|
| Analysis ID: 01-4065-3068 | Endpoint: 10d Survival Rate | CETIS Version: CETISv1.8.7 |
| Analyzed: 21 Nov-17 14:54 | Analysis: STP 2x2 Contingency Tables | Official Results: Yes |
| Batch ID: 05-3681-5362 | Test Type: Growth-Survival (10d) | Analyst: Eric Cheung |
| Start Date: 13 Oct-17 | Protocol: EC/EPS 1/RM/32 | Diluent: Reconstituted Water |
| Ending Date: 23 Oct-17 | Species: Chironomus dilutus | Brine: |
| Duration: 10d 0h | Source: Aquatic Biosystems, CO | Age: 3rd instar |

| Sample Code | Sample ID | Sample Date | Receive Date | Sample Age | Client Name | Project |
|-------------|--------------|-------------|-----------------|----------------|-------------|---------|
| LMC | 12-3392-1475 | 20 Sep-17 | 28 Sep-17 10:30 | 23d 0h (11 °C) | Minnow | |
| LWC | 10-6552-7572 | 24 Sep-17 | 28 Sep-17 10:30 | 19d 0h (11 °C) | | |

| Sample Code | Material Type | Sample Source | Station Location | Latitude | Longitude |
|-------------|-----------------|----------------------|------------------|----------|-----------|
| LMC | Sediment Sample | Minnow Environmental | LMC | | |
| LWC | Sediment Sample | Minnow Environmental | LWC | | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | Test Result |
|----------------|------|---------|--------|------|-------------|
| Untransformed | | C > T | NA | NA | |

Fisher Exact/Bonferroni-Holm Test

| Sample | vs | Sample | Test Stat | P-Value | P-Type | Decision(α:5%) |
|--------|----|--------|-----------|---------|--------|--------------------|
| LWC | | LMC | 3.286E-06 | <0.0001 | Exact | Significant Effect |

Data Summary

| Sample Code | NR | R | NR + R | Prop NR | Prop R | %Effect |
|-------------|---------------|----|--------|---------|---------|---------|
| LMC | 24 | 26 | 50 | 0.48 | 0.52 | 46.78% |
| LWC | Reference Sed | 46 | 5 | 0.902 | 0.09804 | 0.0% |

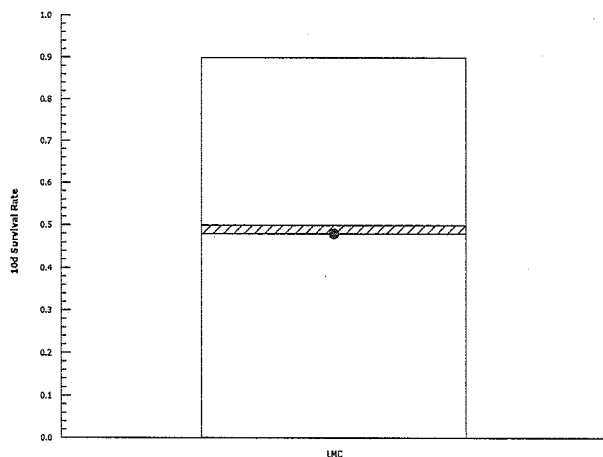
10d Survival Rate Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| LMC | 0.2 | 0.5 | 0.8 | 0 | 0.9 |
| LWC | 1 | 0.9 | 1 | 1 | 0.6 |

10d Survival Rate Binomials

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| LMC | 2/10 | 5/10 | 8/10 | 0/10 | 9/10 |
| LWC | 10/10 | 9/10 | 10/10 | 11/11 | 6/10 |

Graphics



CETIS Analytical Report

Report Date: 21 Nov-17 14:49 (p 1 of 4)
 Test Code: 171051 | 11-2980-0764

Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

| | | |
|---------------------------|---|------------------------------|
| Analysis ID: 14-1972-3414 | Endpoint: Mean Dry Weight-mg | CETIS Version: CETISv1.8.7 |
| Analyzed: 21 Nov-17 14:48 | Analysis: Parametric-Control vs Ord.Treatments | Official Results: Yes |
| Batch ID: 05-3681-5362 | Test Type: Growth-Survival (10d) | Analyst: Eric Cheung |
| Start Date: 13 Oct-17 | Protocol: EC/EPS 1/RM/32 | Diluent: Reconstituted Water |
| Ending Date: 23 Oct-17 | Species: <i>Chironomus tentans</i> ^{ev} <i>dilutus</i> | Brine: |
| Duration: 10d 0h | Source: Aquatic Biosystems, CO | Age: 3rd instar |

| Sample Code | Sample ID | Sample Date | Receive Date | Sample Age | Client Name | Project |
|-------------|--------------|-------------|-----------------|----------------|-------------|---------|
| Control SED | 03-7657-6483 | 13 Oct-17 | 13 Oct-17 | NA | | |
| LMC | 12-3392-1475 | 20 Sep-17 | 28 Sep-17 10:30 | 23d 0h (11 °C) | Minnow | |
| LWC | 10-6552-7572 | 24 Sep-17 | 28 Sep-17 10:30 | 19d 0h (11 °C) | | |

| Sample Code | Material Type | Sample Source | Station Location | Latitude | Longitude |
|-------------|-----------------|----------------------|------------------|----------|-----------|
| Control SED | Sediment Sample | Minnow Environmental | Control Sediment | | |
| LMC | Sediment Sample | Minnow Environmental | LMC | | |
| LWC | Sediment Sample | Minnow Environmental | LWC | | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | PMSD | Test Result |
|----------------|------|---------|--------|------|-------|-------------|
| Untransformed | NA | C > T | NA | NA | 26.2% | |

Williams Multiple Comparison Test

| Sample Code | vs | Sample Code | Test Stat | Critical | MSD | DF | P-Value | P-Type | Decision(α:5%) |
|-------------|----|-------------|-----------|----------|-------|----|---------|--------|------------------------|
| Control SED | | LMC | -1.919 | 1.796 | 0.323 | 7 | >0.05 | CDF | Non-Significant Effect |
| | | LWC | -3.203 | 1.889 | 0.321 | 8 | >0.05 | CDF | Non-Significant Effect |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 1.231467 | 0.6157336 | 2 | 8.557 | 0.0057 | Significant Effect |
| Error | 0.7914933 | 0.07195394 | 11 | | | |
| Total | 2.02296 | | 13 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|-------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance | 0.2896 | 9.21 | 0.8652 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality | 0.9287 | 0.8239 | 0.2925 | Normal Distribution |

Mean Dry Weight-mg Summary

| Sample Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-------------|-------|-------|---------|---------|--------|-------|-------|---------|--------|---------|
| Control SED | 5 | 1.223 | 0.908 | 1.539 | 1.133 | 1.048 | 1.67 | 0.1136 | 20.76% | 0.0% |
| LMC | 4 | 1.569 | 1.061 | 2.076 | 1.589 | 1.2 | 1.896 | 0.1595 | 20.33% | -28.23% |
| LWC | 5 | 1.925 | 1.628 | 2.222 | 1.918 | 1.694 | 2.293 | 0.1068 | 12.41% | -57.37% |

Mean Dry Weight-mg Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| Control SED | 1.048 | 1.172 | 1.67 | 1.093 | 1.133 |
| LMC | 1.2 | 1.414 | 1.765 | 1.896 | |
| LWC | 1.694 | 1.736 | 2.293 | 1.918 | 1.985 |

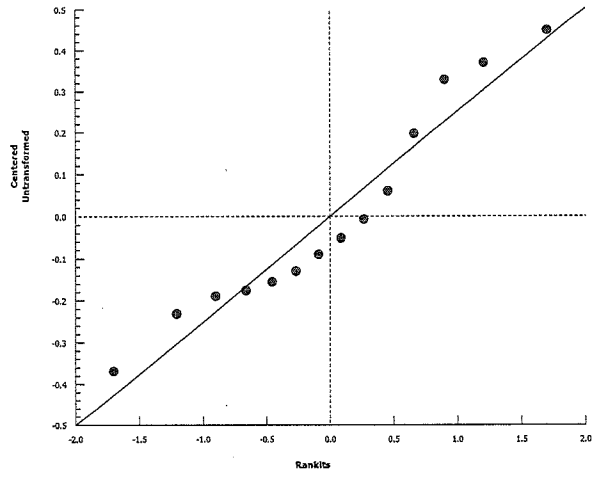
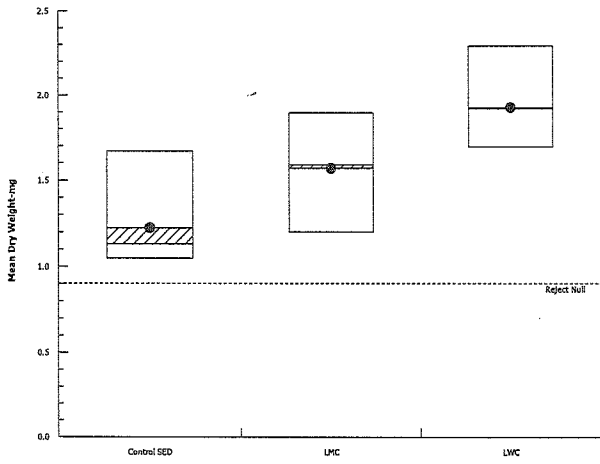
Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

Analysis ID: 14-1972-3414 Endpoint: Mean Dry Weight-mg
Analyzed: 21 Nov-17 14:48 Analysis: Parametric-Control vs Ord.Treatments

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 21 Nov-17 14:55 (p 1 of 2)
 Test Code: 171051 | 11-2980-0764

Chironomus 10-d Survival and Growth Sediment Test

Nautilus Environmental

| | | |
|---------------------------|--|------------------------------|
| Analysis ID: 17-7050-8428 | Endpoint: Mean Dry Weight-mg | CETIS Version: CETISv1.8.7 |
| Analyzed: 21 Nov-17 14:54 | Analysis: Parametric-Control vs Ord.Treatments | Official Results: Yes |
| Batch ID: 05-3681-5362 | Test Type: Growth-Survival (10d) | Analyst: Eric Cheung |
| Start Date: 13 Oct-17 | Protocol: EC/EPS 1/RM/32 | Diluent: Reconstituted Water |
| Ending Date: 23 Oct-17 | Species: Chironomus dilutus | Brine: |
| Duration: 10d 0h | Source: Aquatic Biosystems, CO | Age: 3rd instar |

| Sample Code | Sample ID | Sample Date | Receive Date | Sample Age | Client Name | Project |
|-------------|--------------|-------------|-----------------|----------------|-------------|---------|
| LMC | 12-3392-1475 | 20 Sep-17 | 28 Sep-17 10:30 | 23d 0h (11 °C) | Minnow | |
| LWC | 10-6552-7572 | 24 Sep-17 | 28 Sep-17 10:30 | 19d 0h (11 °C) | | |

| Sample Code | Material Type | Sample Source | Station Location | Latitude | Longitude |
|-------------|-----------------|----------------------|------------------|----------|-----------|
| LMC | Sediment Sample | Minnow Environmental | LMC | | |
| LWC | Sediment Sample | Minnow Environmental | LWC | | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | PMSD | Test Result |
|----------------|------|---------|--------|------|-------|-------------|
| Untransformed | NA | C > T | NA | NA | 18.2% | |

Williams Multiple Comparison Test

| Sample Code | vs | Sample Code | Test Stat | Critical | MSD | DF | P-Value | P-Type | Decision(α:5%) |
|-------------|----|-------------|-----------|----------|-------|----|---------|--------|--------------------|
| LWC | | LMC | 1.925 | 1.895 | 0.351 | 7 | <0.05 | CDF | Significant Effect |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 0.2824385 | 0.2824385 | 1 | 3.705 | 0.0956 | Non-Significant Effect |
| Error | 0.5335545 | 0.07622208 | 7 | | | |
| Total | 0.815993 | | 8 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|--------------------------|-----------|----------|---------|---------------------|
| Variances | Variance Ratio F | 1.783 | 24.26 | 0.5791 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality | 0.9485 | 0.7007 | 0.6736 | Normal Distribution |

Mean Dry Weight-mg Summary

| Sample Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-------------|-------|-------|---------|---------|--------|-------|-------|---------|--------|---------|
| LMC | 4 | 1.569 | 1.061 | 2.076 | 1.589 | 1.2 | 1.896 | 0.1595 | 20.33% | 0.0% |
| LWC | 5 | 1.925 | 1.628 | 2.222 | 1.918 | 1.694 | 2.293 | 0.1068 | 12.41% | -22.73% |

Mean Dry Weight-mg Detail

| Sample Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|-------------|-------|-------|-------|-------|-------|
| LMC | 1.2 | 1.414 | 1.765 | 1.896 | |
| LWC | 1.694 | 1.736 | 2.293 | 1.918 | 1.985 |

Chironomus 10-d Survival and Growth Sediment Test

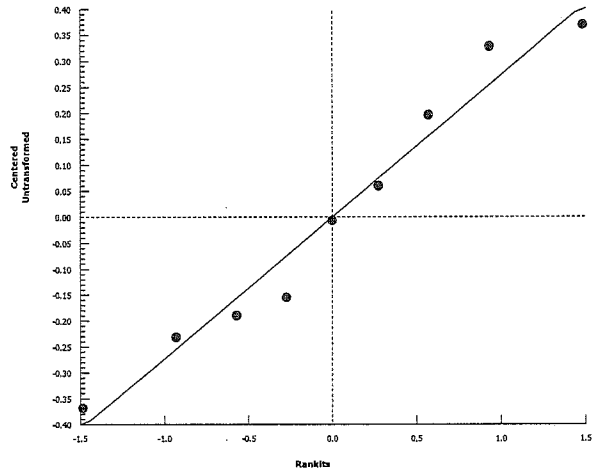
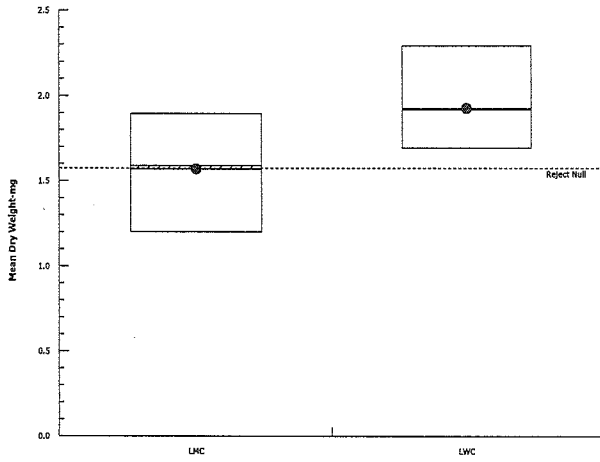
Nautilus Environmental

Analysis ID: 17-7050-8428
Analyzed: 21 Nov-17 14:54

Endpoint: Mean Dry Weight-mg
Analysis: Parametric-Control vs Ord.Treatments

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



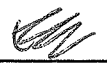
Client: Minnow

W.O.#: 171051

Hardness and Alkalinity Datasheet

| Day to | Alkalinity | | | | | | Hardness | | | Technician | |
|---------|------------|----------------|---------------|--------------------|--|---|---|--------------------|--------------------------------|------------|--|
| | Sample ID | Subsample Date | Date Measured | Sample Volume (mL) | (mL) 0.02N HCL/H ₂ SO ₄ used to pH 4.5 | (mL) of 0.02N HCL/H ₂ SO ₄ used to pH 4.2 | Total Alkalinity (mg/LCaCO ₃) | Sample Volume (mL) | Volume of 0.01M EDTA Used (mL) | | Total Hardness (mg/L CaCO ₃) |
| | | Oct 23/17 | Oct 23/17 | | | | | | | | |
| Control | | ↓ | ↓ | 50 | 2.2 | 2.3 | 42 | 10 (D) | 2.6 | 260 | ASP |
| LWC | | ↓ | ↓ | | 3.3 | 3.5 | 62 | ↓ | 1.8 | 180 | ↓ |
| LMC | | ↓ | ↓ | ↓ | 7.5 | 7.7 | 146 | ↓ | 3.2 | 320 | ↓ |
| | | | | | | | | | | | |
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Notes: (D) Diluted to 100 mL w/ DI water

Reviewed by: 

Date Reviewed: Nov-28, 2017

APPENDIX C – Analytical Chemistry



NAUTILUS ENVIRONMENTAL
ATTN: Eric Cheung
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 13-OCT-17
Report Date: 20-OCT-17 15:50 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L2007162
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Heather McKenzie
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2007162-1 | L2007162-2 | L2007162-3 | | |
|-----------------------------|------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 13-OCT-17 | 13-OCT-17 | 13-OCT-17 | | |
| | | Sampled Time | 10:35 | 10:35 | 10:35 | | |
| | | Client ID | LMC | LWC | CONTROL | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Anions and Nutrients | Ammonia, Total (as N) (mg/L) | | 0.0836 | 0.335 | 0.137 | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|----------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |
| This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L2007162-COFC

US
ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

Chain of Custody

Date Oct 13, 17 Page 1 of 1

| | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------|-------------------------------|---------------------|--|--------------------------|--------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Report to: | | Invoice To: | | ANALYSES REQUIRED | | | | | | | | | | | | | | | | | | | |
| Company | Nautilus Environmental | Company | (same) | overlying ammonia | Receipt Temperature (°C) | | | | | | | | | | | | | | | | | | |
| Address | 8664 Commerce Court | Address | | | | | | | | | | | | | | | | | | | | | |
| City/Prov/PC | Burnaby, BC | City/Prov/PC | | | | | | | | | | | | | | | | | | | | | |
| Contact | Eric Cheung | Contact | | | | | | | | | | | | | | | | | | | | | |
| Phone | 604-420-8773 | Phone | | | | | | | | | | | | | | | | | | | | | |
| Email | eric@nautilusenvironmental.ca | Email | (same) + lise@nautilusenvironmental.ca | | | | | | | | | | | | | | | | | | | | |
| PO No. | | PO No. | | | | | | | | | | | | | | | | | | | | | |

Sample Collection By: _____ Sample Type: Grab OR Composite

| SAMPLE ID | DATE (DD/MM/YY) | TIME | MATRIX | # OF CONTAINERS AND VOLUME (e.g. 1 x 20 L) | COMMENTS |
|-----------|-----------------|-------|--------|--|----------|
| 1 LMC | 13/10/17 | 1035h | water | 1x125mL | |
| 2 LWC | ↓ | ↓ | ↓ | ↓ | |
| 3 Contn 1 | 13/10/17 | 1035h | water | 1x125mL | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |

| | | | | |
|---|--|------------------------------|-----|---|
| SPECIAL INSTRUCTIONS/COMMENTS (CLIENT) | SAMPLE RECEIPT DETAILS (LABORATORY) | | | SAMPLE DESCRIPTION AND COMMENTS (LABORATORY) |
| | 1. Total No. of Containers | 4. Ice Present in Cooler? | Y/N | 15°C |
| | 2. Courier | 5. Seal Present? | Y/N | |
| | 3. Good Condition? | 6. Initials Present on Seal? | Y/N | |

| | | |
|--|---------------------------------------|--|
| RELINQUISHED BY (CLIENT) | RECEIVED BY (LABORATORY) | Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole. |
| Eric Cheung (Printed Name) | Michelle (Printed Name) | |
| Nautilus Environmental (Company) | Nautilus Environmental (Company) | |
| Oct 13/17 1730h (Date DD/MM/YY and Time) | Oct 13 18:34 (Date DD/MM/YY and Time) | |



NAUTILUS ENVIRONMENTAL
ATTN: Eric Cheung
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 27-OCT-17
Report Date: 06-NOV-17 12:47 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L2014712
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Heather McKenzie
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2014712-1 | L2014712-2 | L2014712-3 | | |
|-----------------------------|------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 23-OCT-17 | 23-OCT-17 | 23-OCT-17 | | |
| | | Sampled Time | | | | | |
| | | Client ID | LMC | LWC | CONTROL | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Anions and Nutrients | Ammonia, Total (as N) (mg/L) | | 0.123 | 0.882 | 0.682 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|-----------------------|-----------|-----------------------------|
| Matrix Spike | Ammonia, Total (as N) | MS-B | L2014712-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|----------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



TESTING LOCATION (Please Circle)

Burnaby
 8664 Commerce Court
 Burnaby, British Columbia, Canada
 V5A 4N7
 Phone 604.420.8773

Calgary
 #4, 6125 12 Street SE
 Calgary, Alberta, Canada
 T2H 2K1
 Phone 403.253.7121

Chain of Custody

Date Oct 23, 17 Page 1 of 1

| | | | | | | | | | | | |
|--|--|--|--|--------------------------|--|--|--|--|--|--|--|
| Report to: Company: Nautilus Environmental Address: 8664 Commerce Court City/Prov/PC: Burnaby, BC Contact: Eric Cheung Phone: 604-420-8773 Email: eric@nautilusenvironmental.ca | | Invoice To: Company: (same) Address: City/Prov/PC: Contact: Phone: Email: (same) + tise@nautilusenvironmental.ca PO No.: | | ANALYSES REQUIRED | | | | | | | |
|--|--|--|--|--------------------------|--|--|--|--|--|--|--|

Sample Collection By: _____ Sample Type: Grab OR Composite

| SAMPLE ID | DATE (DD/MM/YY) | TIME | MATRIX | # OF CONTAINERS AND VOLUME (e.g. 1 x 20 L) | COMMENTS |
|-----------|-----------------|------|--------|--|----------|
| 1 LMC | 23/10/17 | | water | 1x125mL | |
| 2 LWC | ↓ ↓ | | ↓ ↓ | ↓ ↓ | |
| 3 Control | ↓ | | ↓ | ↓ | |
| 4 | | | | | |
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|-------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| overlying ammonia | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
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|--|--|---|--------------------------|------------------------------|--|--|--|
| SPECIAL INSTRUCTIONS/COMMENTS (CLIENT) | | SAMPLE RECEIPT DETAILS (LABORATORY) | | | SAMPLE DESCRIPTION AND COMMENTS (LABORATORY) | | |
| | | 1. Total No. of Containers | <input type="checkbox"/> | 4. Ice Present in Cooler? | Y / N | | |
| | | 2. Courier | <input type="checkbox"/> | 5. Seal Present? | Y / N | | |
| | | 3. Good Condition? | Y / N | 6. Initials Present on Seal? | Y / N | | |
| RELINQUISHED BY (CLIENT) Mimi Tran (Printed Name) (Signature) | | RECEIVED BY (LABORATORY) TP (Printed Name) (Signature) | | | 12.6°C Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole. | | |
| Nautilus Environmental (Company) 23/10/17 @ 15:15h (Date DD/MM/YY and Time) | | (Company) Oct 27 18:20 (Date DD/MM/YY and Time) | | | | | |



NAUTILUS ENVIRONMENTAL
ATTN: Eric Cheung
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 27-OCT-17
Report Date: 06-NOV-17 12:41 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L2014711
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2014711-1 | L2014711-2 | L2014711-3 | | |
|-----------------------------|------------------------------|--------------|------------|------------|------------|--|--|
| | | Description | Water | Water | Water | | |
| | | Sampled Date | 27-OCT-17 | 27-OCT-17 | 27-OCT-17 | | |
| | | Sampled Time | | | | | |
| | | Client ID | LMC | LWC | CONTROL | | |
| Grouping | Analyte | | | | | | |
| WATER | | | | | | | |
| Anions and Nutrients | Ammonia, Total (as N) (mg/L) | | 0.0661 | 0.0906 | 1.92 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|-----------------------|-----------|-----------------------------|
| Matrix Spike | Ammonia, Total (as N) | MS-B | L2014711-1, -2, -3 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|----------------------------------|---|
| NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

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| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

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mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.




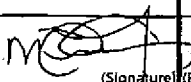

TESTING LOCATION (Please Circle)

Burnaby
 8664 Commerce Court
 Burnaby, British Columbia, Canada
 V5A 4N7
 Phone 604.420.8773

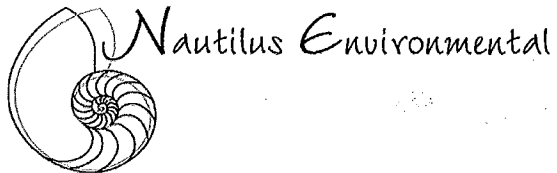
Calgary
 #4, 6125 12 Street SE
 Calgary, Alberta, Canada
 T2H 2K1
 Phone 403.253.7121

Chain of Custody

Date Oct 27, 17 Page 1 of 1

| | | | | | | | | | | | | | | | | | | | | | |
|--|---------|--|-------|---|-------|---|--|--|---------|--|---|---|--|---------|--|---|--|--|--|--|--|
| Report to: Company: Nautilus Environmental Address: 8664 Commerce Court City/Prov/PC: Burnaby, BC Contact: Eric Cheung Phone: 604-420-8773 Email: eric@nautilusenvironmental.ca | | Invoice To: Company: (same) Address: _____ City/Prov/PC: _____ Contact: _____ Phone: _____ Email: (same) + lise@nautilusenvironmental.ca PO No.: _____ | | ANALYSES REQUIRED | | | | | | | | | | | | | | | | | |
| Sample Collection By: _____ | | Sample Type: Grab <input type="radio"/> OR <input type="radio"/> Composite <input type="radio"/> | | overlying ammonia Receipt Temperature (°C) | | | | | | | | | | | | | | | | | |
| 1 | LMC | 27/10/17 | water | | | | | | | | | | | 1x125mL | | ✓ | | | | | |
| 2 | LWC | ↓ ↓ | ↓ ↓ | | | | | | | | | | | ↓ ↓ | | ✓ | | | | | |
| 3 | Control | ↓ | ↓ | | | | | | | | | | | ↓ | | ✓ | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | |
|  L2014711-COFC | | | | SPECIAL INSTRUCTIONS/COMMENTS (CLIENT) | | | SAMPLE RECEIPT DETAILS (LABORATORY) | | | | SAMPLE DESCRIPTION AND COMMENTS (LABORATORY) | | | | | | | | | | |
| | | | | 1. Total No. of Containers | | 4. Ice Present in Cooler? | Y / N | | 12.6 °C | | | | | | | | | | | | |
| | | | | 2. Courier | | 5. Seal Present? | Y / N | | | | | | | | | | | | | | |
| | | | | 3. Good Condition? | Y / N | 6. Initials Present on Seal? | Y / N | | | | | | | | | | | | | | |
| RELINQUISHED BY (CLIENT) | | | | RECEIVED BY (LABORATORY) | | | | Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole. | | | | | | | | | | | | | |
| Mini Tran <small>(Printed Name)</small> | |  <small>(Signature)</small> | | TP <small>(Printed Name)</small> | |  <small>(Signature)</small> | | | | | | | | | | | | | | | |
| Nautilus Environmental <small>(Company)</small> | | 27/10/17 <small>(Date DD/MM/YY and Time)</small> | | Oct 27 18:20 <small>(Date DD/MM/YY and Time)</small> | | (Company) | | | | | | | | | | | | | | | |
| Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted. | | | | | | | | | | | | Form 020; Version 1.2; Revised by CC 2016/10/06 | | | | | | | | | |

APPENDIX D – Chain-of-Custody Forms



4340 Vandever Ave.
San Diego, CA 92120
Phone 858.587.7333
Fax 858.587.3961

wo #
171051
171052

Chain of Custody

Date _____ Page ___ of ___

| Sample Collection By: | | | | | | | ANALYSES REQUIRED | | | | | | | | | | Receipt Temperature (°C) | | | | |
|--|--------------------------|--------------------------|----------|--|-------------------------|-----------|---------------------------|---------------------------|--|--------|--|--|--|--|--|--|--------------------------|--|--|--|------|
| Report to: | | | | Invoice To: | | | | | | | | | | | | | | | | | |
| Company <u>Minnow Environmental Inc.</u> Address <u>101-1025 Hillside Ave</u> City/State/Zip <u>Victoria, BC, V8T 2A2</u> Contact <u>Lisa Bowron</u> Phone <u>250-595-1627 x21</u> Email <u>lbowron@minnow.ca</u> | | | | Company <u>Minto Explorations Ltd.</u> Address <u>Suite 2100-510 West Georgia Street</u> City/State/Zip <u>Vancouver, BC, V6B 0M3</u> Contact <u>Cindy Keehn</u> Phone <u>604-684-8894</u> Email <u>ckeehe@capstonemining.com</u> | | | | | | | | | | | | | | | | | |
| SAMPLE ID | DATE | TIME | MATRIX | CONTAINER TYPE | NO. OF CONTAINERS | COMMENTS | 10 day Chironomus dilutus | 14 day Hyallela azteca | | | | | | | | | | | | | |
| 1 | LMC-5 | 20-Sep-17 | Sediment | (clean) 500ml glass jar | 1 | | X | X | | | | | | | | | | | | | 11.0 |
| 2 | LMC-4 | 20-Sep-17 | | | 1 | | X | X | | | | | | | | | | | | | |
| 3 | LMC-3 | 21-Sep-17 | | | 1 | | X | X | | | | | | | | | | | | | |
| 4 | LMC-2 | 21-Sep-17 | | | 1 | | X | X | | | | | | | | | | | | | |
| 5 | LMC-1 | 21-Sep-17 | | | 1 | | X | X | | | | | | | | | | | | | |
| 6 | LWC-5 | 24-Sep-17 | | | 1 | | X | X | | | | | | | | | | | | | |
| 7 | LWC-4 | 24-Sep-17 | | | 1 | | X | X | | | | | | | | | | | | | |
| 8 | LWC-3 | 24-Sep-17 | | | 1 | | X | X | | | | | | | | | | | | | |
| 9 | LWC-2 | 24-Sep-17 | | | 1 | | X | X | | | | | | | | | | | | | |
| 10 | LWC-1 | 24-Sep-17 | | | 1 | | X | X | | | | | | | | | | | | | |
| PROJECT INFORMATION | | SAMPLE RECEIPT | | | REINQUISHED BY (CLIENT) | | | RELINQUISHED BY (COURIER) | | | | | | | | | | | | | |
| Client: | Minnow Environmental Inc | Total No. of Containers | 10 | (Signature) | <i>[Signature]</i> | (Time) | 7:50am | (Signature) | | (Time) | | | | | | | | | | | |
| PO No.: | | Received Good Condition? | * | (Printed Name) | Lisa Bowron | (Date) | 27-Sep-17 | (Printed Name) | | (Date) | | | | | | | | | | | |
| Shipped Via: | | Matches Test Schedule? | Y | (Company) | Minnow Environmental | (Company) | | | | | | | | | | | | | | | |
| SPECIAL INSTRUCTIONS/COMMENTS: | | | | RECEIVED BY (COURIER) | | | RECEIVED BY (LABORATORY) | | | | | | | | | | | | | | |
| * Sample LMC - jars 1 and 3 arrived broken, contents were intact and been transferred to new container jars. NY | | | | (Signature) | NY | (Time) | 10:30 | (Signature) | | (Time) | | | | | | | | | | | |
| | | | | (Printed Name) | Naru Yamamoto | (Date) | Sept 28/17 | (Printed Name) | | (Date) | | | | | | | | | | | |
| | | | | (Company) | Nautilus | (Company) | | | | | | | | | | | | | | | |

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

END OF REPORT



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 27-SEP-17
Report Date: 17-NOV-17 16:15 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1998303
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT
C of C Numbers: 1 of 2, 2 of 2
Legal Site Desc:

Can Dang
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998303-1 | L1998303-2 | L1998303-3 | L1998303-4 | L1998303-5 |
|-----------------------|-----------------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Tissue | Tissue | Tissue | Tissue | Tissue |
| | | Sampled Date | 21-SEP-17 | 21-SEP-17 | 22-SEP-17 | 22-SEP-17 | 22-SEP-17 |
| | | Sampled Time | | | | | |
| | | Client ID | LMC-5 | LMC-4 | LBC-5 | LBC-4 | LBC-3 |
| Grouping | Analyte | | | | | | |
| TISSUE | | | | | | | |
| Physical Tests | % Moisture (%) | | 76.1 | 75.5 | 56.1 | 74.4 | 65.5 |
| Metals | Aluminum (Al)-Total (mg/kg wwt) | | 415 | 695 | 1730 | 664 | 1010 |
| | Antimony (Sb)-Total (mg/kg wwt) | | 0.0214 | 0.0229 | 0.0379 | 0.0351 | 0.0351 |
| | Arsenic (As)-Total (mg/kg wwt) | | 0.567 | 0.608 | 2.99 | 1.42 | 1.35 |
| | Barium (Ba)-Total (mg/kg wwt) | | 33.2 | 39.5 | 31.7 | 18.2 | 33.0 |
| | Beryllium (Be)-Total (mg/kg wwt) | | 0.0183 | 0.0275 | 0.0953 | 0.0399 | 0.0439 |
| | Bismuth (Bi)-Total (mg/kg wwt) | | 0.0049 | 0.0073 | 0.0838 | 0.0381 | 0.0581 |
| | Boron (B)-Total (mg/kg wwt) | | 1.09 | 1.48 | 0.79 | 0.36 | 0.49 |
| | Cadmium (Cd)-Total (mg/kg wwt) | | 0.0715 | 0.0744 | 0.287 | 0.213 | 0.254 |
| | Calcium (Ca)-Total (mg/kg wwt) | | 657 | 666 | 1650 | 728 | 1160 |
| | Cesium (Cs)-Total (mg/kg wwt) | | 0.0384 | 0.0655 | 0.301 | 0.171 | 0.166 |
| | Chromium (Cr)-Total (mg/kg wwt) | | 2.07 | 2.70 | 4.53 | 3.81 | 2.58 |
| | Cobalt (Co)-Total (mg/kg wwt) | | 0.490 | 0.693 | 1.69 | 0.733 | 0.870 |
| | Copper (Cu)-Total (mg/kg wwt) | | 7.50 | 7.86 | 6.90 | 5.90 | 6.71 |
| | Iron (Fe)-Total (mg/kg wwt) | | 929 | 1290 | 3370 | 1530 | 1780 |
| | Lead (Pb)-Total (mg/kg wwt) | | 0.263 | 0.362 | 1.30 | 0.726 | 0.822 |
| | Lithium (Li)-Total (mg/kg wwt) | | 0.38 | 0.68 | 1.93 | 0.65 | 1.01 |
| | Magnesium (Mg)-Total (mg/kg wwt) | | 435 | 571 | 1490 | 546 | 751 |
| | Manganese (Mn)-Total (mg/kg wwt) | | 180 | 169 | 176 | 87.5 | 219 |
| | Mercury (Hg)-Total (mg/kg wwt) | | 0.0083 | 0.0058 | 0.0106 | 0.0094 | 0.0103 |
| | Molybdenum (Mo)-Total (mg/kg wwt) | | 0.204 | 0.173 | 0.199 | 0.141 | 0.264 |
| | Nickel (Ni)-Total (mg/kg wwt) | | 1.66 | 2.50 | 4.05 | 1.99 | 2.27 |
| | Phosphorus (P)-Total (mg/kg wwt) | | 1700 | 1490 | 948 | 1270 | 1500 |
| | Potassium (K)-Total (mg/kg wwt) | | 2400 | 2690 | 988 | 1240 | 1480 |
| | Rubidium (Rb)-Total (mg/kg wwt) | | 0.819 | 0.917 | 2.02 | 1.34 | 1.23 |
| | Selenium (Se)-Total (mg/kg wwt) | | 0.450 | 0.450 | 0.207 | 0.194 | 0.497 |
| | Sodium (Na)-Total (mg/kg wwt) | | 587 | 602 | 344 | 501 | 444 |
| | Strontium (Sr)-Total (mg/kg wwt) | | 7.36 | 6.93 | 15.1 | 7.59 | 10.2 |
| | Tellurium (Te)-Total (mg/kg wwt) | | <0.0040 | <0.0040 | 0.0050 | <0.0040 | <0.0040 |
| | Thallium (Tl)-Total (mg/kg wwt) | | 0.00398 | 0.00580 | 0.0150 | 0.00861 | 0.00944 |
| | Tin (Sn)-Total (mg/kg wwt) | | 0.041 | 0.036 | 0.068 | 0.097 | 0.052 |
| | Uranium (U)-Total (mg/kg wwt) | | 0.0995 | 0.137 | 0.285 | 0.250 | 0.480 |
| | Vanadium (V)-Total (mg/kg wwt) | | 2.26 | 3.21 | 7.02 | 4.17 | 5.06 |
| | Zinc (Zn)-Total (mg/kg wwt) | | 35.2 | 31.4 | 22.5 | 22.0 | 26.0 |
| | Zirconium (Zr)-Total (mg/kg wwt) | | 0.773 | 0.715 | 1.51 | 0.936 | 0.922 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1998303-6 Tissue 22-SEP-17 LBC-2 | L1998303-7 Tissue 22-SEP-17 LBC-1 | L1998303-8 Tissue 23-SEP-17 LWC-5 | L1998303-9 Tissue 23-SEP-17 LWC-4 | L1998303-10 Tissue 23-SEP-17 LWC-3 |
|-----------------------|-----------------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | | |
| TISSUE | | | | | | | |
| Physical Tests | % Moisture (%) | 61.1 | 93.1 | 64.6 | 65.5 | 71.2 | |
| Metals | Aluminum (Al)-Total (mg/kg wwt) | 836 | 189 | 655 | 326 | 852 | |
| | Antimony (Sb)-Total (mg/kg wwt) | 0.0456 | 0.0115 | 0.0224 | 0.0171 | 0.0181 | |
| | Arsenic (As)-Total (mg/kg wwt) | 1.37 | 0.525 | 0.483 | 0.369 | 0.464 | |
| | Barium (Ba)-Total (mg/kg wwt) | 19.6 | 6.90 | 14.7 | 12.1 | 18.1 | |
| | Beryllium (Be)-Total (mg/kg wwt) | 0.0494 | 0.0111 | 0.0526 | 0.0269 | 0.0657 | |
| | Bismuth (Bi)-Total (mg/kg wwt) | 0.0529 | 0.0145 | 0.0062 | 0.0031 | 0.0057 | |
| | Boron (B)-Total (mg/kg wwt) | 0.42 | <0.20 | 0.43 | 0.31 | 0.38 | |
| | Cadmium (Cd)-Total (mg/kg wwt) | 0.195 | 0.142 | 0.111 | 0.295 | 0.166 | |
| | Calcium (Ca)-Total (mg/kg wwt) | 851 | 292 | 802 | 615 | 813 | |
| | Cesium (Cs)-Total (mg/kg wwt) | 0.206 | 0.0555 | 0.0899 | 0.0465 | 0.0862 | |
| | Chromium (Cr)-Total (mg/kg wwt) | 2.64 | 0.948 | 4.92 | 2.17 | 5.94 | |
| | Cobalt (Co)-Total (mg/kg wwt) | 0.897 | 0.246 | 0.802 | 0.608 | 1.30 | |
| | Copper (Cu)-Total (mg/kg wwt) | 6.81 | 2.11 | 5.87 | 6.92 | 6.58 | |
| | Iron (Fe)-Total (mg/kg wwt) | 1910 | 355 | 1700 | 685 | 1990 | |
| | Lead (Pb)-Total (mg/kg wwt) | 0.833 | 0.189 | 0.412 | 0.186 | 0.420 | |
| | Lithium (Li)-Total (mg/kg wwt) | 1.00 | 0.16 | 0.63 | 0.25 | 0.67 | |
| | Magnesium (Mg)-Total (mg/kg wwt) | 832 | 176 | 608 | 521 | 1040 | |
| | Manganese (Mn)-Total (mg/kg wwt) | 114 | 34.2 | 68.2 | 77.1 | 110 | |
| | Mercury (Hg)-Total (mg/kg wwt) | 0.0107 | 0.0040 | 0.0150 | 0.0131 | <0.010 | |
| | Molybdenum (Mo)-Total (mg/kg wwt) | 0.223 | 0.0505 | 0.178 | 0.233 | 0.218 | |
| | Nickel (Ni)-Total (mg/kg wwt) | 2.12 | 0.757 | 3.00 | 1.76 | 5.73 | |
| | Phosphorus (P)-Total (mg/kg wwt) | 1830 | 454 | 1690 | 2600 | 1280 | |
| | Potassium (K)-Total (mg/kg wwt) | 1640 | 440 | 1400 | 2160 | 982 | |
| | Rubidium (Rb)-Total (mg/kg wwt) | 1.78 | 0.661 | 1.32 | 1.77 | 1.38 | |
| | Selenium (Se)-Total (mg/kg wwt) | 0.234 | 0.086 | 0.384 | 0.686 | 0.315 | |
| | Sodium (Na)-Total (mg/kg wwt) | 570 | 188 | 575 | 874 | 495 | |
| | Strontium (Sr)-Total (mg/kg wwt) | 7.84 | 3.41 | 7.43 | 5.83 | 8.83 | |
| | Tellurium (Te)-Total (mg/kg wwt) | 0.0042 | <0.0040 | <0.0040 | <0.0040 | <0.0040 | |
| | Thallium (Tl)-Total (mg/kg wwt) | 0.00915 | 0.00311 | 0.00643 | 0.00440 | 0.00615 | |
| | Tin (Sn)-Total (mg/kg wwt) | 0.069 | 0.056 | 0.099 | 0.082 | 0.080 | |
| | Uranium (U)-Total (mg/kg wwt) | 0.148 | 0.0624 | 0.190 | 0.0814 | 0.225 | |
| | Vanadium (V)-Total (mg/kg wwt) | 4.63 | 0.858 | 4.51 | 1.60 | 4.38 | |
| | Zinc (Zn)-Total (mg/kg wwt) | 24.3 | 7.80 | 35.6 | 39.3 | 22.6 | |
| | Zirconium (Zr)-Total (mg/kg wwt) | 1.05 | 0.262 | 0.980 | 0.539 | 1.50 | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998303-11 | L1998303-12 | L1998303-13 | L1998303-14 | L1998303-15 |
|-----------------------|-----------------------------------|--------------|-------------|-------------|-------------|-------------|-------------|
| | | Description | Tissue | Tissue | Tissue | Tissue | Tissue |
| | | Sampled Date | 24-SEP-17 | 24-SEP-17 | 23-SEP-17 | 26-SEP-17 | 26-SEP-17 |
| | | Sampled Time | | | | | |
| | | Client ID | LWC-2 | LWC-1 | LWC-3X | LMC-3 | LMC-2 |
| Grouping | Analyte | | | | | | |
| TISSUE | | | | | | | |
| Physical Tests | % Moisture (%) | | 71.5 | 55.4 | 61.7 | 64.6 | 75.6 |
| Metals | Aluminum (Al)-Total (mg/kg wwt) | | 582 | 1030 | 862 | 661 | 178 |
| | Antimony (Sb)-Total (mg/kg wwt) | | 0.0175 | 0.0267 | 0.0190 | 0.0326 | 0.0168 |
| | Arsenic (As)-Total (mg/kg wwt) | | 0.835 | 0.756 | 0.530 | 0.706 | 0.215 |
| | Barium (Ba)-Total (mg/kg wwt) | | 26.3 | 25.6 | 24.3 | 34.5 | 27.1 |
| | Beryllium (Be)-Total (mg/kg wwt) | | 0.0402 | 0.101 | 0.0810 | 0.0420 | 0.0086 |
| | Bismuth (Bi)-Total (mg/kg wwt) | | 0.0051 | 0.0096 | 0.0072 | 0.0088 | 0.0024 |
| | Boron (B)-Total (mg/kg wwt) | | 0.38 | 0.51 | 0.41 | 0.97 | 3.16 |
| | Cadmium (Cd)-Total (mg/kg wwt) | | 0.0437 | 0.118 | 0.160 | 0.0938 | 0.124 |
| | Calcium (Ca)-Total (mg/kg wwt) | | 409 | 1190 | 985 | 1130 | 566 |
| | Cesium (Cs)-Total (mg/kg wwt) | | 0.0701 | 0.166 | 0.120 | 0.0669 | 0.0149 |
| | Chromium (Cr)-Total (mg/kg wwt) | | 2.50 | 4.88 | 5.13 | 6.01 | 0.810 |
| | Cobalt (Co)-Total (mg/kg wwt) | | 0.779 | 1.48 | 1.10 | 0.714 | 0.327 |
| | Copper (Cu)-Total (mg/kg wwt) | | 5.82 | 5.83 | 5.78 | 9.33 | 7.04 |
| | Iron (Fe)-Total (mg/kg wwt) | | 1120 | 2770 | 1990 | 1500 | 401 |
| | Lead (Pb)-Total (mg/kg wwt) | | 0.290 | 0.794 | 0.509 | 0.527 | 0.264 |
| | Lithium (Li)-Total (mg/kg wwt) | | 0.45 | 1.29 | 0.84 | 0.61 | 0.15 |
| | Magnesium (Mg)-Total (mg/kg wwt) | | 599 | 1070 | 766 | 586 | 410 |
| | Manganese (Mn)-Total (mg/kg wwt) | | 155 | 137 | 161 | 179 | 97.7 |
| | Mercury (Hg)-Total (mg/kg wwt) | | 0.0051 | 0.0061 | <0.014 | 0.0089 | 0.0031 |
| | Molybdenum (Mo)-Total (mg/kg wwt) | | 0.285 | 0.333 | 0.269 | 0.330 | 0.332 |
| | Nickel (Ni)-Total (mg/kg wwt) | | 2.86 | 4.82 | 3.62 | 2.83 | 1.24 |
| | Phosphorus (P)-Total (mg/kg wwt) | | 1690 | 1790 | 1390 | 2060 | 1810 |
| | Potassium (K)-Total (mg/kg wwt) | | 2670 | 1580 | 986 | 2140 | 3370 |
| | Rubidium (Rb)-Total (mg/kg wwt) | | 0.889 | 1.74 | 1.61 | 1.22 | 0.815 |
| | Selenium (Se)-Total (mg/kg wwt) | | 0.309 | 0.414 | 0.476 | 0.646 | 0.279 |
| | Sodium (Na)-Total (mg/kg wwt) | | 516 | 582 | 382 | 742 | 539 |
| | Strontium (Sr)-Total (mg/kg wwt) | | 4.65 | 12.5 | 9.82 | 13.1 | 6.45 |
| | Tellurium (Te)-Total (mg/kg wwt) | | <0.0040 | <0.0040 | <0.0040 | <0.0040 | <0.0040 |
| | Thallium (Tl)-Total (mg/kg wwt) | | 0.00463 | 0.00946 | 0.00712 | 0.00637 | 0.00161 |
| | Tin (Sn)-Total (mg/kg wwt) | | 0.033 | 0.163 | 0.082 | 0.040 | <0.020 |
| | Uranium (U)-Total (mg/kg wwt) | | 0.134 | 0.440 | 0.502 | 0.143 | 0.113 |
| | Vanadium (V)-Total (mg/kg wwt) | | 2.88 | 6.96 | 5.12 | 3.04 | 1.06 |
| | Zinc (Zn)-Total (mg/kg wwt) | | 26.2 | 23.7 | 29.1 | 33.7 | 54.5 |
| | Zirconium (Zr)-Total (mg/kg wwt) | | 0.722 | 1.57 | 1.25 | 0.975 | 0.071 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1998303-16 | | | |
|-----------------------|--|-------------|--|--|--|
| | | Tissue | | | |
| | | 26-SEP-17 | | | |
| | | LMC-1 | | | |
| Grouping | Analyte | | | | |
| TISSUE | | | | | |
| Physical Tests | % Moisture (%) | 70.3 | | | |
| Metals | Aluminum (Al)-Total (mg/kg wwt) | 785 | | | |
| | Antimony (Sb)-Total (mg/kg wwt) | 0.0273 | | | |
| | Arsenic (As)-Total (mg/kg wwt) | 0.731 | | | |
| | Barium (Ba)-Total (mg/kg wwt) | 49.1 | | | |
| | Beryllium (Be)-Total (mg/kg wwt) | 0.0302 | | | |
| | Bismuth (Bi)-Total (mg/kg wwt) | 0.0085 | | | |
| | Boron (B)-Total (mg/kg wwt) | 1.68 | | | |
| | Cadmium (Cd)-Total (mg/kg wwt) | 0.0866 | | | |
| | Calcium (Ca)-Total (mg/kg wwt) | 709 | | | |
| | Cesium (Cs)-Total (mg/kg wwt) | 0.0764 | | | |
| | Chromium (Cr)-Total (mg/kg wwt) | 2.91 | | | |
| | Cobalt (Co)-Total (mg/kg wwt) | 0.777 | | | |
| | Copper (Cu)-Total (mg/kg wwt) | 9.29 | | | |
| | Iron (Fe)-Total (mg/kg wwt) | 1870 | | | |
| | Lead (Pb)-Total (mg/kg wwt) | 0.446 | | | |
| | Lithium (Li)-Total (mg/kg wwt) | 0.72 | | | |
| | Magnesium (Mg)-Total (mg/kg wwt) | 624 | | | |
| | Manganese (Mn)-Total (mg/kg wwt) | 163 | | | |
| | Mercury (Hg)-Total (mg/kg wwt) | 0.0039 | | | |
| | Molybdenum (Mo)-Total (mg/kg wwt) | 0.255 | | | |
| | Nickel (Ni)-Total (mg/kg wwt) | 2.63 | | | |
| | Phosphorus (P)-Total (mg/kg wwt) | 1880 | | | |
| | Potassium (K)-Total (mg/kg wwt) | 2970 | | | |
| | Rubidium (Rb)-Total (mg/kg wwt) | 1.08 | | | |
| | Selenium (Se)-Total (mg/kg wwt) | 0.475 | | | |
| | Sodium (Na)-Total (mg/kg wwt) | 657 | | | |
| | Strontium (Sr)-Total (mg/kg wwt) | 7.21 | | | |
| | Tellurium (Te)-Total (mg/kg wwt) | <0.0040 | | | |
| | Thallium (Tl)-Total (mg/kg wwt) | 0.00697 | | | |
| | Tin (Sn)-Total (mg/kg wwt) | 0.033 | | | |
| | Uranium (U)-Total (mg/kg wwt) | 0.170 | | | |
| | Vanadium (V)-Total (mg/kg wwt) | 4.72 | | | |
| | Zinc (Zn)-Total (mg/kg wwt) | 36.8 | | | |
| | Zirconium (Zr)-Total (mg/kg wwt) | 0.920 | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|------------------------------------|
| HG-WET-MICR-CVAF-VA | Tissue | Mercury in Tissue by CVAFS Micro (WET) | EPA 200.3, EPA 245.7 |
| <p>This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.</p> | | | |
| MET-WET-MICR-HRMS-VA | Tissue | Metals in Tissue by HR-ICPMS Micro (WET) | EPA 200.3/200.8 |
| <p>Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.</p> <p>Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.</p> | | | |
| MOISTURE-BIOPSY-VA | Tissue | Moisture Content (low weight) in tissue | Puget Sound WQ Authority, Apr 1997 |
| <p>This analysis is carried out gravimetrically by drying the sample at <60 deg. C for a minimum of three days.</p> | | | |
| MOISTURE-MICR-VA | Tissue | Moisture in Tissue | Puget Sound WQ Authority, Apr 1997 |
| <p>This analysis is carried out gravimetrically by drying the sample at <60 deg. C.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

1 of 2 2 of 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| | | |
|---|---|---|
| Report To | Report Format / Distribution | Service Requested (Rush for routine analysis subject to availability) |
| Company: Minnow Environmental Inc. | <input checked="" type="checkbox"/> Standard <input type="checkbox"/> Other | <input checked="" type="radio"/> Regular (Standard Turnaround Times - Business Days) |
| Contact: Lisa Bowron | <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Digital <input type="checkbox"/> Fax | <input type="radio"/> Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT |
| Address: 101 - 1025 Hillside Ave. Victoria, BC | Email 1: lbowron@minnow.ca Email 2: pstecko@minnow.ca | <input type="radio"/> Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT |
| Phone: (250)595-1627 x21 Fax: (250) 595-1625 | Email 3: | <input type="radio"/> Same Day or Weekend Emergency - Contact ALS to Confirm TAT |

| | | | | | |
|---|-------------------------------------|---|-----------------------------|----------------------------|------------------------------|
| Invoice To Same as Report? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Client / Project Information | Analysis Request | | | |
| Hardcopy of Invoice with Report? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Job #: Minnow Project 6096 | Please indicate below Filtered, Preserved or both (F, P, F/P) | | | |
| Company: Minto Exploration Ltd | PO / AFE: | Moisture (%) | High Resolution ICP-MS scan | | |
| Contact: Cindy Keehn | LSD: | | | Mercury in Tissue by CVAFS | |
| Address: Suite 2100 - 510 West Georgia St., Vancouver, BC | Quote #: Q51327 | | | | **See Complete Quote #Q51327 |
| Phone: 604-684-8894 Fax: 604-688-2180 | | | | | |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | Moisture (%) | High Resolution ICP-MS scan | Mercury in Tissue by CVAFS | **See Complete Quote #Q51327 | Number of Containers |
|----------|---|--------------------|-----------------|-------------|--------------|-----------------------------|----------------------------|------------------------------|----------------------|
| | LMC-3 | 20-Sep-17 | | Tissue | X | X | X | X | 1 |
| | LMC-4 | 20-Sep-17 | | | X | X | X | X | 1 |
| | LBC-5 | 22-Sep-17 | | | X | X | X | X | 1 |
| | LBC-4 | 22-Sep-17 | | | X | X | X | X | 1 |
| | LBC-3 | 22-Sep-17 | | | X | X | X | X | 1 |
| | LBC-2 | 20-Sep-17 | | | X | X | X | X | 1 |
| | LBC-1 | 22-Sep-17 | | | X | X | X | X | 1 |
| | LWC-5 | 23-Sep-17 | | | X | X | X | X | 1 |
| | LWC-4 | 23-Sep-17 | | | X | X | X | X | 1 |
| | LWC-3 | 23-Sep-17 | | | X | X | X | X | 1 |
| | LWC-2 | 24-Sep-17 | | | X | X | X | X | 1 |
| | LWC-1 | 24-Sep-17 | | | X | X | X | X | 1 |

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs. Benthic samples.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

| | | | | | | | | | | |
|--------------------------------------|----------------------------|---------------|--|-----------------|-------------|---|--------------|-------|-------|--|
| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | SHIPMENT VERIFICATION (lab use only) | | | | |
| Released by: <i>Pro abner</i> | Date (dd-mm-yy): 27-Sep-17 | Time (hh-mm): | Received by: <i>(Signature)</i> | Date: Sep 29/17 | Time: 12:15 | Temperature: 2.0C | Verified by: | Date: | Time: | Observations: Yes / No? If Yes add SIF |

Laurie Sep 28/17 10:25 AM 3.0C



| | | |
|---|---|---|
| Report To | Report Format / Distribution | Service Requested (Rush for routine analysis subject to availability) |
| Company: Minnow Environmental Inc. | <input checked="" type="checkbox"/> Standard <input type="checkbox"/> Other | <input checked="" type="radio"/> Regular (Standard Turnaround Times - Business Days) |
| Contact: Lisa Bowron | <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Digital <input type="checkbox"/> Fax | <input type="radio"/> Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT |
| Address: 101 - 1025 Hillside Ave. Victoria, BC | Email 1: lbowron@minnow.ca Email 2: pstecko@minnow.ca | <input type="radio"/> Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT |
| Phone: (250)595-1627 x21 Fax: (250) 595-1625 | Email 3: | <input type="radio"/> Same Day or Weekend Emergency - Contact ALS to Confirm TAT |

| | | | | | | | | | | | | |
|---|-------------------------------------|---|-----------------------------|----------------------------|------------------------------|--|--|--|--|--|--|----------------------|
| Invoice To Same as Report? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Client / Project Information | Analysis Request | | | | | | | | | | |
| Hardcopy of Invoice with Report? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Job #: Minnow Project | Please indicate below Filtered, Preserved or both (F, P, F/P) | | | | | | | | | | |
| Company: Minto Exploration Ltd | PO / AFE: | Moisture (%) | High Resolution ICP-MS scan | Mercury in Tissue by CVAFS | **See Complete Quote #Q51327 | | | | | | | Number of Containers |
| Contact: Cindy Keehn | LSD: | | | | | | | | | | | |
| Address: Suite 2100 - 510 West Georgia St., Vancouver, BC | | | | | | | | | | | | |
| Phone: 604-684-8894 Fax: 604-688-2180 | Quote #: Q51327 | | | | | | | | | | | |

| | | |
|------------------------------------|---|----------------------|
| Lab Work Order # (lab use only) | ALS Contact: Jerry Schmitt Hal Zbecher | Sampler: Lisa Bowron |
|------------------------------------|---|----------------------|

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Moisture (%) | High Resolution ICP-MS scan | Mercury in Tissue by CVAFS | **See Complete Quote #Q51327 | | | | | | | | | | | Number of Containers |
|----------|---|---------------------|-----------------|-------------|--------------|-----------------------------|----------------------------|------------------------------|--|--|--|--|--|--|--|--|--|--|----------------------|
| | LWC-3X | 23-Sep-17 | | Tissue | X | X | h | X | | | | | | | | | | | 1 |
| | LMC-3 | 26-Sep-17 | | | X | X | h | X | | | | | | | | | | | 1 |
| | LMC-2 | 26-Sep-17 | | | X | h | h | h | | | | | | | | | | | 1 |
| | LMC-1 | 26-Sep-17 | | | X | h | h | h | | | | | | | | | | | 1 |

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs. Benthic samples
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
 By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
 Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

| | | | | | | | | | | |
|-------------------------------|-----------------------------|---------------|-----------------------------------|-----------------|-------------|--------------------------------------|--------------|-------|-------|--|
| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | SHIPMENT VERIFICATION (lab use only) | | | | |
| Released by: Lisa Bowron | Date (dd-mmm-yy): 27-Sep-17 | Time (hh-mm): | Received by: (Signature) | Date: Sep 27/17 | Time: 12:15 | Temperature: 2 °C | Verified by: | Date: | Time: | Observations: Yes / No? If Yes add SIF |

Laurie SEPT 28/17 10:25 A.M. 30C.



MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 27-SEP-17
Report Date: 17-NOV-17 16:40 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1998305
Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT
C of C Numbers: 1 of 2, 2 of 2
Legal Site Desc:

Can Dang
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1998305-1 Tissue 21-SEP-17 LMC-4 | L1998305-2 Tissue 21-SEP-17 LMC-5 | L1998305-3 Tissue 22-SEP-17 LBC-5 | L1998305-4 Tissue 22-SEP-17 LBC-4 | L1998305-5 Tissue 22-SEP-17 LBC-3 |
|---|-----------------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| TISSUE | | | | | | |
| Physical Tests | % Moisture (%) | 69.5 | 62.2 | 81.5 | 56.8 | 57.3 |
| Metals | Aluminum (Al)-Total (mg/kg wwt) | 1840 | 2830 | 2540 | 3950 | 4660 |
| | Antimony (Sb)-Total (mg/kg wwt) | 0.084 | 0.055 | 0.0364 | 0.0353 | 0.0409 |
| | Arsenic (As)-Total (mg/kg wwt) | 3.49 | 3.14 | 3.07 | 4.88 | 4.38 |
| | Barium (Ba)-Total (mg/kg wwt) | 290 | 177 | 43.2 | 68.7 | 84.2 |
| | Beryllium (Be)-Total (mg/kg wwt) | 0.095 | 0.110 | 0.115 | 0.179 | 0.183 |
| | Bismuth (Bi)-Total (mg/kg wwt) | <0.040 ^{DLA} | 0.034 | 0.116 | 0.538 | 0.134 |
| | Boron (B)-Total (mg/kg wwt) | 9.7 | 11.4 | 0.89 | 0.76 | 1.23 |
| | Cadmium (Cd)-Total (mg/kg wwt) | 0.210 | 0.130 | 0.0433 | 0.0617 | 0.0605 |
| | Calcium (Ca)-Total (mg/kg wwt) | 3400 | 5180 | 1530 | 2610 | 3330 |
| | Cesium (Cs)-Total (mg/kg wwt) | 0.166 | 0.236 | 0.595 | 0.777 | 0.751 |
| | Chromium (Cr)-Total (mg/kg wwt) | 5.71 | 7.16 | 5.76 | 9.14 | 11.9 |
| | Cobalt (Co)-Total (mg/kg wwt) | 7.97 | 5.46 | 1.82 | 3.37 | 3.53 |
| | Copper (Cu)-Total (mg/kg wwt) | 14.4 | 15.9 | 5.44 | 8.55 | 7.60 |
| | Iron (Fe)-Total (mg/kg wwt) | 4790 | 6500 | 4430 | 8050 | 8920 |
| | Lead (Pb)-Total (mg/kg wwt) | 1.23 | 1.85 | 1.80 | 3.06 | 2.85 |
| | Lithium (Li)-Total (mg/kg wwt) | <2.0 ^{DLA} | 2.5 | 1.94 | 3.57 | 3.49 |
| | Magnesium (Mg)-Total (mg/kg wwt) | 1430 | 1840 | 1310 | 2420 | 2640 |
| | Manganese (Mn)-Total (mg/kg wwt) | 5160 | 2610 | 196 | 214 | 237 |
| | Mercury (Hg)-Total (mg/kg wwt) | 0.0076 | 0.0107 | 0.0088 | 0.0089 | 0.0081 |
| | Molybdenum (Mo)-Total (mg/kg wwt) | 0.58 | 0.387 | 0.170 | 0.269 | 0.268 |
| | Nickel (Ni)-Total (mg/kg wwt) | 10.2 | 9.53 | 4.90 | 8.26 | 8.84 |
| | Phosphorus (P)-Total (mg/kg wwt) | 681 | 649 | 220 | 458 | 562 |
| | Potassium (K)-Total (mg/kg wwt) | 1190 | 1000 | 393 | 472 | 531 |
| | Rubidium (Rb)-Total (mg/kg wwt) | 2.43 | 3.19 | 2.99 | 4.14 | 4.23 |
| | Selenium (Se)-Total (mg/kg wwt) | 0.90 | 0.76 | 0.067 | 0.065 | 0.067 |
| | Sodium (Na)-Total (mg/kg wwt) | <80 ^{DLA} | 99 | 87.8 | 125 | 157 |
| | Strontium (Sr)-Total (mg/kg wwt) | 51.1 | 41.6 | 15.2 | 23.4 | 25.2 |
| | Tellurium (Te)-Total (mg/kg wwt) | <0.080 ^{DLA} | <0.040 ^{DLA} | 0.0090 | 0.0156 | 0.0107 |
| | Thallium (Tl)-Total (mg/kg wwt) | 0.0241 | 0.0268 | 0.0279 | 0.0384 | 0.0378 |
| | Tin (Sn)-Total (mg/kg wwt) | <0.40 ^{DLA} | <0.20 ^{DLA} | 0.083 | 0.115 | 0.125 |
| | Uranium (U)-Total (mg/kg wwt) | 0.194 | 0.208 | 0.272 | 0.456 | 0.451 |
| | Vanadium (V)-Total (mg/kg wwt) | 11.9 | 14.7 | 10.2 | 18.4 | 22.4 |
| | Zinc (Zn)-Total (mg/kg wwt) | 22.4 | 20.7 | 12.8 | 21.9 | 22.4 |
| | Zirconium (Zr)-Total (mg/kg wwt) | 1.31 | 1.71 | 1.97 | 2.81 | 2.96 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1998305-6 | L1998305-7 | L1998305-8 | L1998305-9 | L1998305-10 |
|-----------------------|-----------------------------------|--------------|------------|------------|------------|------------|-------------|
| | | Description | Tissue | Tissue | Tissue | Tissue | Tissue |
| | | Sampled Date | 23-SEP-17 | 23-SEP-17 | 23-SEP-17 | 23-SEP-17 | 24-SEP-17 |
| | | Sampled Time | | | | | |
| | | Client ID | LWC-5 | LWC-4 | LWC-3 | LWC-3X | LWC-2 |
| Grouping | Analyte | | | | | | |
| TISSUE | | | | | | | |
| Physical Tests | % Moisture (%) | | 59.3 | 45.1 | 59.7 | 72.4 | 52.0 |
| Metals | Aluminum (Al)-Total (mg/kg wwt) | | 4450 | 6640 | 5350 | 3630 | 5160 |
| | Antimony (Sb)-Total (mg/kg wwt) | | 0.0208 | 0.0154 | 0.0153 | 0.0147 | 0.0179 |
| | Arsenic (As)-Total (mg/kg wwt) | | 2.00 | 2.15 | 1.85 | 1.27 | 2.21 |
| | Barium (Ba)-Total (mg/kg wwt) | | 57.7 | 83.7 | 69.0 | 49.7 | 72.9 |
| | Beryllium (Be)-Total (mg/kg wwt) | | 0.233 | 0.303 | 0.258 | 0.169 | 0.257 |
| | Bismuth (Bi)-Total (mg/kg wwt) | | 0.0241 | 0.0414 | 0.0292 | 0.0208 | 0.0309 |
| | Boron (B)-Total (mg/kg wwt) | | 1.18 | 1.36 | 1.18 | 1.11 | 1.25 |
| | Cadmium (Cd)-Total (mg/kg wwt) | | 0.0630 | 0.0654 | 0.0547 | 0.0412 | 0.0531 |
| | Calcium (Ca)-Total (mg/kg wwt) | | 2860 | 4000 | 3240 | 2250 | 3130 |
| | Cesium (Cs)-Total (mg/kg wwt) | | 0.536 | 0.786 | 0.586 | 0.453 | 0.599 |
| | Chromium (Cr)-Total (mg/kg wwt) | | 14.2 | 19.9 | 15.8 | 10.7 | 16.3 |
| | Cobalt (Co)-Total (mg/kg wwt) | | 4.94 | 5.85 | 4.88 | 3.13 | 5.32 |
| | Copper (Cu)-Total (mg/kg wwt) | | 6.48 | 8.31 | 6.89 | 5.03 | 7.28 |
| | Iron (Fe)-Total (mg/kg wwt) | | 10000 | 11500 | 9550 | 6280 | 10900 |
| | Lead (Pb)-Total (mg/kg wwt) | | 2.01 | 2.87 | 2.22 | 1.52 | 2.20 |
| | Lithium (Li)-Total (mg/kg wwt) | | 3.62 | 5.54 | 4.44 | 2.97 | 4.24 |
| | Magnesium (Mg)-Total (mg/kg wwt) | | 3160 | 4460 | 3560 | 2270 | 3870 |
| | Manganese (Mn)-Total (mg/kg wwt) | | 281 | 300 | 262 | 222 | 290 |
| | Mercury (Hg)-Total (mg/kg wwt) | | 0.0086 | 0.0094 | 0.0086 | 0.0063 | 0.0076 |
| | Molybdenum (Mo)-Total (mg/kg wwt) | | 0.501 | 0.161 | 0.146 | 0.103 | 0.187 |
| | Nickel (Ni)-Total (mg/kg wwt) | | 14.3 | 16.9 | 13.7 | 8.89 | 15.8 |
| | Phosphorus (P)-Total (mg/kg wwt) | | 474 | 642 | 501 | 359 | 555 |
| | Potassium (K)-Total (mg/kg wwt) | | 461 | 551 | 443 | 344 | 491 |
| | Rubidium (Rb)-Total (mg/kg wwt) | | 4.38 | 6.25 | 4.90 | 3.50 | 4.88 |
| | Selenium (Se)-Total (mg/kg wwt) | | 0.107 | 0.120 | 0.116 | 0.111 | 0.126 |
| | Sodium (Na)-Total (mg/kg wwt) | | 176 | 185 | 162 | 108 | 167 |
| | Strontium (Sr)-Total (mg/kg wwt) | | 25.4 | 36.2 | 29.9 | 21.1 | 27.8 |
| | Tellurium (Te)-Total (mg/kg wwt) | | 0.0077 | 0.0076 | 0.0071 | <0.0040 | 0.0080 |
| | Thallium (Tl)-Total (mg/kg wwt) | | 0.0276 | 0.0408 | 0.0313 | 0.0238 | 0.0304 |
| | Tin (Sn)-Total (mg/kg wwt) | | 0.138 | 0.168 | 0.128 | 0.101 | 0.147 |
| | Uranium (U)-Total (mg/kg wwt) | | 0.455 | 0.473 | 0.416 | 0.266 | 0.394 |
| | Vanadium (V)-Total (mg/kg wwt) | | 22.4 | 26.5 | 22.3 | 14.9 | 26.0 |
| | Zinc (Zn)-Total (mg/kg wwt) | | 26.7 | 28.9 | 23.1 | 15.4 | 24.0 |
| | Zirconium (Zr)-Total (mg/kg wwt) | | 4.41 | 5.32 | 4.62 | 3.18 | 4.59 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1998305-11 Tissue 24-SEP-17 LWC-1 | L1998305-12 Tissue 25-SEP-17 LBC-2 | L1998305-13 Tissue 25-SEP-17 LBC-1 | L1998305-14 Tissue 26-SEP-17 LMC-3 | L1998305-15 Tissue 26-SEP-17 LMC-2 |
|---|-----------------------------------|---|---|---|---|---|
| Grouping | Analyte | | | | | |
| TISSUE | | | | | | |
| Physical Tests | % Moisture (%) | 58.7 | 67.0 | 67.4 | 55.3 | 60.8 |
| Metals | Aluminum (Al)-Total (mg/kg wwt) | 6650 | 2440 | 4630 | 2890 | 6680 |
| | Antimony (Sb)-Total (mg/kg wwt) | 0.0175 | 0.0429 | 0.0481 | <0.050 ^{DLA} | 0.0280 |
| | Arsenic (As)-Total (mg/kg wwt) | 2.36 | 3.39 | 4.37 | 3.02 | 3.91 |
| | Barium (Ba)-Total (mg/kg wwt) | 88.8 | 70.0 | 76.9 | 245 | 144 |
| | Beryllium (Be)-Total (mg/kg wwt) | 0.330 | 0.123 | 0.179 | 0.123 | 0.226 |
| | Bismuth (Bi)-Total (mg/kg wwt) | 0.0402 | 0.108 | 0.189 | <0.050 ^{DLA} | 0.0611 |
| | Boron (B)-Total (mg/kg wwt) | 1.96 | 1.37 | 1.33 | <5.0 ^{DLA} | 2.56 |
| | Cadmium (Cd)-Total (mg/kg wwt) | 0.0773 | 0.0451 | 0.0621 | 0.203 | 0.103 |
| | Calcium (Ca)-Total (mg/kg wwt) | 3840 | 1800 | 2960 | 3400 | 4830 |
| | Cesium (Cs)-Total (mg/kg wwt) | 0.815 | 0.521 | 0.804 | 0.248 | 0.535 |
| | Chromium (Cr)-Total (mg/kg wwt) | 18.8 | 7.41 | 10.8 | 5.8 | 14.9 |
| | Cobalt (Co)-Total (mg/kg wwt) | 5.77 | 2.25 | 3.20 | 9.27 | 5.38 |
| | Copper (Cu)-Total (mg/kg wwt) | 9.00 | 5.21 | 7.54 | 17.1 | 20.4 |
| | Iron (Fe)-Total (mg/kg wwt) | 11400 | 7270 | 7820 | 7670 | 11900 |
| | Lead (Pb)-Total (mg/kg wwt) | 2.71 | 1.97 | 2.90 | 1.73 | 3.01 |
| | Lithium (Li)-Total (mg/kg wwt) | 5.66 | 2.05 | 3.41 | 2.6 | 5.51 |
| | Magnesium (Mg)-Total (mg/kg wwt) | 4310 | 1470 | 2480 | 1920 | 3220 |
| | Manganese (Mn)-Total (mg/kg wwt) | 387 | 205 | 247 | 5810 | 1220 |
| | Mercury (Hg)-Total (mg/kg wwt) | 0.0122 | 0.0060 | 0.0120 | 0.0079 | 0.0254 |
| | Molybdenum (Mo)-Total (mg/kg wwt) | 0.164 | 0.194 | 0.263 | 0.45 | 0.305 |
| | Nickel (Ni)-Total (mg/kg wwt) | 17.0 | 5.32 | 8.53 | 11.6 | 13.6 |
| | Phosphorus (P)-Total (mg/kg wwt) | 561 | 321 | 457 | 458 | 555 |
| | Potassium (K)-Total (mg/kg wwt) | 557 | 366 | 512 | 590 | 828 |
| | Rubidium (Rb)-Total (mg/kg wwt) | 6.39 | 2.60 | 4.32 | 3.37 | 6.32 |
| | Selenium (Se)-Total (mg/kg wwt) | 0.151 | 0.067 | 0.065 | <0.50 ^{DLA} | 0.498 |
| | Sodium (Na)-Total (mg/kg wwt) | 169 | 124 | 153 | <100 ^{DLA} | 108 |
| | Strontium (Sr)-Total (mg/kg wwt) | 37.6 | 15.4 | 25.8 | 50.7 | 47.4 |
| | Tellurium (Te)-Total (mg/kg wwt) | 0.0078 | 0.0085 | 0.0145 | <0.10 ^{DLA} | 0.0120 |
| | Thallium (Tl)-Total (mg/kg wwt) | 0.0422 | 0.0267 | 0.0390 | 0.031 | 0.0562 |
| | Tin (Sn)-Total (mg/kg wwt) | 0.160 | 0.103 | 0.127 | <0.50 ^{DLA} | 0.161 |
| | Uranium (U)-Total (mg/kg wwt) | 0.431 | 0.578 | 0.471 | 0.244 | 0.371 |
| | Vanadium (V)-Total (mg/kg wwt) | 25.6 | 19.5 | 18.8 | 15.3 | 24.3 |
| | Zinc (Zn)-Total (mg/kg wwt) | 27.8 | 14.3 | 21.4 | 26.0 | 29.4 |
| | Zirconium (Zr)-Total (mg/kg wwt) | 5.36 | 2.29 | 2.99 | 1.3 | 4.85 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1998305-16 | | | |
|-----------------------|--|-------------|--|--|--|
| | | Tissue | | | |
| | | 26-SEP-17 | | | |
| | | LMC-1 | | | |
| Grouping | Analyte | | | | |
| TISSUE | | | | | |
| Physical Tests | % Moisture (%) | 67.0 | | | |
| Metals | Aluminum (Al)-Total (mg/kg wwt) | 3990 | | | |
| | Antimony (Sb)-Total (mg/kg wwt) | 0.0277 | | | |
| | Arsenic (As)-Total (mg/kg wwt) | 2.66 | | | |
| | Barium (Ba)-Total (mg/kg wwt) | 116 | | | |
| | Beryllium (Be)-Total (mg/kg wwt) | 0.141 | | | |
| | Bismuth (Bi)-Total (mg/kg wwt) | 0.0339 | | | |
| | Boron (B)-Total (mg/kg wwt) | 3.29 | | | |
| | Cadmium (Cd)-Total (mg/kg wwt) | 0.0915 | | | |
| | Calcium (Ca)-Total (mg/kg wwt) | 4020 | | | |
| | Cesium (Cs)-Total (mg/kg wwt) | 0.338 | | | |
| | Chromium (Cr)-Total (mg/kg wwt) | 8.95 | | | |
| | Cobalt (Co)-Total (mg/kg wwt) | 3.83 | | | |
| | Copper (Cu)-Total (mg/kg wwt) | 15.3 | | | |
| | Iron (Fe)-Total (mg/kg wwt) | 7320 | | | |
| | Lead (Pb)-Total (mg/kg wwt) | 1.81 | | | |
| | Lithium (Li)-Total (mg/kg wwt) | 3.21 | | | |
| | Magnesium (Mg)-Total (mg/kg wwt) | 2010 | | | |
| | Manganese (Mn)-Total (mg/kg wwt) | 1130 | | | |
| | Mercury (Hg)-Total (mg/kg wwt) | 0.0082 | | | |
| | Molybdenum (Mo)-Total (mg/kg wwt) | 0.247 | | | |
| | Nickel (Ni)-Total (mg/kg wwt) | 9.01 | | | |
| | Phosphorus (P)-Total (mg/kg wwt) | 441 | | | |
| | Potassium (K)-Total (mg/kg wwt) | 667 | | | |
| | Rubidium (Rb)-Total (mg/kg wwt) | 3.94 | | | |
| | Selenium (Se)-Total (mg/kg wwt) | 0.494 | | | |
| | Sodium (Na)-Total (mg/kg wwt) | 89.6 | | | |
| | Strontium (Sr)-Total (mg/kg wwt) | 37.1 | | | |
| | Tellurium (Te)-Total (mg/kg wwt) | 0.0099 | | | |
| | Thallium (Tl)-Total (mg/kg wwt) | 0.0329 | | | |
| | Tin (Sn)-Total (mg/kg wwt) | 0.118 | | | |
| | Uranium (U)-Total (mg/kg wwt) | 0.283 | | | |
| | Vanadium (V)-Total (mg/kg wwt) | 15.4 | | | |
| | Zinc (Zn)-Total (mg/kg wwt) | 19.6 | | | |
| | Zirconium (Zr)-Total (mg/kg wwt) | 3.14 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| DLA | Detection Limit adjusted for required dilution |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|------------------------------------|
| HG-WET-CVAFS-N-VA | Tissue | Mercury in Tissue by CVAFS (WET) | EPA 200.3, EPA 245.7 |
| <p>This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.</p> | | | |
| HG-WET-MICR-CVAF-VA | Tissue | Mercury in Tissue by CVAFS Micro (WET) | EPA 200.3, EPA 245.7 |
| <p>This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.</p> | | | |
| MET-WET-CCMS-N-VA | Tissue | Metals in Tissue by CRC ICPMS (WET) | EPA 200.3/6020A |
| <p>This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).</p> <p>Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.</p> | | | |
| MET-WET-MICR-HRMS-VA | Tissue | Metals in Tissue by HR-ICPMS Micro (WET) | EPA 200.3/200.8 |
| <p>Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.</p> <p>Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.</p> | | | |
| MOISTURE-MICR-VA | Tissue | Moisture in Tissue | Puget Sound WQ Authority, Apr 1997 |
| <p>This analysis is carried out gravimetrically by drying the sample at <60 deg. C.</p> | | | |
| MOISTURE-TISS-VA | Tissue | % Moisture in Tissues | Puget Sound WQ Authority, Apr 1997 |
| <p>This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

1 of 2 2 of 2

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



| Report To | | Report Format / Distribution | | | | Service Requested (Rush for routine analysis subject to availability) | | | | | | | | | | | | | | | | | | |
|--|---|---|---------------------------------|-------------------------|------------------------------------|---|------------------------------|----------------------------|------------------------------|---|--|---|--|--|--|--|----------------------|--|--|--|--|--|--|---|
| Company: Minnow Environmental Inc. | | <input checked="" type="checkbox"/> Standard <input type="checkbox"/> Other | | | | <input checked="" type="radio"/> Regular (Standard Turnaround Times - Business Days) | | | | | | | | | | | | | | | | | | |
| Contact: Lisa Bowron | | <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Digital <input type="checkbox"/> Fax | | | | <input type="radio"/> Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT | | | | | | | | | | | | | | | | | | |
| Address: 101 - 1025 Hillside Ave. | | Email 1: lbowron@minnow.ca | | | | <input type="radio"/> Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT | | | | | | | | | | | | | | | | | | |
| Victoria, BC | | Email 2: pstecko@minnow.ca | | | | <input type="radio"/> Same Day or Weekend Emergency - Contact ALS to Confirm TAT | | | | | | | | | | | | | | | | | | |
| Phone: (250)595-1627 x21 Fax: (250) 595-1625 | | Email 3: | | | | Analysis Request | | | | | | | | | | | | | | | | | | |
| Invoice To Same as Report? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | | Client / Project Information | | | | Please indicate below Filtered, Preserved or both (F, P, F/P) | | | | | | | | | | | | | | | | | | |
| Hardcopy of Invoice with Report? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | | Job #: Minnow Project | | | | Moisture (%) | High Resolution ICP-MIS scan | Mercury in Tissue by CVAFS | **See Complete Quote #Q51327 | | | | | | | | Number of Containers | | | | | | | |
| Company: Minto Explorations Ltd | | PO / AFE: | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Cindy Keehn | | LSD: | | | | | | | | | | | | | | | | | | | | | | |
| Address: Suite 2100 - 510 West Georgia St., Vancouver, BC | | Quote #: Q51327 | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 604-684-8894 Fax: 604-688-2180 | | ALS Contact: <u>Jerry Selam-Worku Holzbecher</u> | | | | Sampler: Lisa Bowron | | | | | | | | | | | | | | | | | | |
| Sample # | Sample Identification (This description will appear on the report) | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | | |
| | LMC-4 | | 21-Sep-17 | | Tissue | X | X | X | | | | X | | | | | | | | | | | | 1 |
| | LMC-5 | | 21-Sep-17 | | | X | X | X | | | | X | | | | | | | | | | | | 1 |
| | LBC-5 | | 22-Sept-17 | | | X | X | X | | | | X | | | | | | | | | | | | 1 |
| | LBC-4 | | 22-Sept-17 | | | X | X | X | | | | X | | | | | | | | | | | | 1 |
| | LBC-3 | | 22-Sep-17 | | | X | X | X | | | | X | | | | | | | | | | | | 1 |
| | LWC-5 | | 23-Sep-17 | | | X | X | X | | | | X | | | | | | | | | | | | 1 |
| | LWC-4 | | 23-Sep-17 | | | X | X | X | | | | X | | | | | | | | | | | | 1 |
| | LWC-3 | | 23-Sep-17 | | | X | X | X | | | | X | | | | | | | | | | | | 1 |
| | LWC-3x | | 23-Sep-17 | | | X | X | X | | | | X | | | | | | | | | | | | 1 |
| | LWC-2 | | 24-Sep-17 | | | X | X | X | | | | X | | | | | | | | | | | | 1 |
| | LWC-1 | | 24-Sep-17 | | | X | X | X | | | | X | | | | | | | | | | | | 1 |
| | LBC-2 | | 25-Sep-17 | | | X | X | X | | | | X | | | | | | | | | | | | 1 |
| Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details | | | | | | | | | | | | | | | | | | | | | | | | |
| Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs. Periphyton samples. | | | | | | | | | | | | | | | | | | | | | | | | |
| Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. | | | | | | | | | | | | | | | | | | | | | | | | |
| By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab. | | | | | | | | | | | | | | | | | | | | | | | | |
| Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses. | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT, RELEASE (client use) | | | | | SHIPMENT, RECEPTION (lab use only) | | | | | SHIPMENT, VERIFICATION (lab use only) | | | | | | | | | | | | | | |
| Released by: <u>Lisa Bowron</u> | Date (dd-mmm-yy): <u>27-Sep-17</u> | Time (hh-mm): | Received by: <u>(Signature)</u> | Date: <u>Sept 28/17</u> | Time: <u>12:15</u> | Temperature: <u>1 °C</u> | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF | | | | | | | | | | | | | | |

Lucie Sept 28/17. 10:25 A.M 3 °C.



| | | |
|---|---|---|
| Report To | Report Format / Distribution | Service Requested (Rush for routine analysis subject to availability) |
| Company: Minnow Environmental Inc. | <input checked="" type="checkbox"/> Standard <input type="checkbox"/> Other | <input checked="" type="radio"/> Regular (Standard Turnaround Times - Business Days) |
| Contact: Lisa Bowron | <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Digital <input type="checkbox"/> Fax | <input type="radio"/> Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT |
| Address: 101 - 1025 Hillside Ave. Victoria, BC | Email 1: lbowron@minnow.ca Email 2: pstecko@minnow.ca | <input type="radio"/> Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT |
| Phone: (250)595-1627 x21 Fax: (250) 595-1625 | Email 3: | <input type="radio"/> Same Day or Weekend Emergency - Contact ALS to Confirm TAT |

| | | | | | | | | | | | | | | |
|---|-------------------------------------|---|-----------------------------|----------------------------|--------------------------------|--|--|--|--|--|--|--|--|----------------------|
| Invoice To Same as Report? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Client / Project Information | Analysis Request | | | | | | | | | | | | |
| Hardcopy of Invoice with Report? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Job #: Minnow Project | Please indicate below Filtered, Preserved or both (F, P, F/P) | | | | | | | | | | | | |
| Company: Minto Explorations Ltd | PO / AFE: | Moisture (%) | High Resolution ICP-MS scan | Mercury in Tissue by CVAFS | ***See Complete Quote #Q051327 | | | | | | | | | Number of Containers |
| Contact: Cindy Keehn | LSD: | | | | | | | | | | | | | |
| Address: Suite 2100 - 510 West Georgia St., Vancouver, BC | | | | | | | | | | | | | | |
| Phone: 604-684-8894 Fax: 604-688-2180 | Quote #: Q51327 | | | | | | | | | | | | | |

| | | |
|------------------------------------|--|----------------------|
| Lab Work Order # (lab use only) | ALS Contact: Jerry Soliman / Holzebecher | Sampler: Lisa Bowron |
|------------------------------------|--|----------------------|

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Moisture (%) | High Resolution ICP-MS scan | Mercury in Tissue by CVAFS | ***See Complete Quote #Q051327 | | | | | | | | | | Number of Containers |
|----------|---|---------------------|-----------------|-------------|--------------|-----------------------------|----------------------------|--------------------------------|--|--|--|--|--|--|--|--|--|----------------------|
| | LBC-1 | 25-Sep-17 | | Tissue | X | X | 6 | | | | | | | | | | | 1 |
| | LMC-3 | 26-Sep-17 | | | X | X | X | | | | | | | | | | | 1 |
| | LMC-2 | 26-Sep-17 | | | X | X | X | | | | | | | | | | | 1 |
| | LMC-1 | 26-Sep-17 | | | 6 | 5 | X | | | | | | | | | | | 1 |

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs. Periphyton samples.
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

| | | | | | | | | | | |
|-------------------------------|-----------------------------|--------------------|-----------------------------------|-----------------|-------------|--------------------------------------|--------------|-------|---------------|------------------------------|
| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | SHIPMENT VERIFICATION (lab use only) | | | Observations: | |
| Released by: Lisa Bowron | Date (dd-mmm-yy): 27-Sep-17 | Time (hh-mm): 4:20 | Received by: (Signature) | Date: Sep 27/17 | Time: 12:15 | Temperature: / °C | Verified by: | Date: | Time: | Yes / No ? If Yes add SIF |

Carrie Sep 28/17 10:25 AM 20C

APPENDIX D
PERIPHYTON COMMUNITY DATA

Tables
Laboratory Reports

APPENDIX D
PERIPHYTON COMMUNITY DATA

Tables

Table D.1: Density (cells/cm²) of Periphyton Community Sampled at Lower Wolverine Creek and Lower Minto Creek, Minto Mine WUL, 2017

| Sample Location | | Lower Wolverine Creek (Reference) | | | | | Lower Minto Creek (Exposed) | | | | |
|------------------------------------|---|--------------------------------------|--------|--------|--------|--------|--------------------------------|--------|--------|--------|--------|
| | | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 |
| Sample Date | | | | | | | | | | | |
| Group | Genera and species | | | | | | | | | | |
| Cyanophyte | Phormidium autumnale Agardh | 1,507 | - | - | 345 | - | 345 | 2,756 | 144 | - | 574 |
| | Heteroleibeinia profunda Komarek | - | - | - | - | - | 20,844 | 4,479 | 6,460 | 38,760 | 42,205 |
| | Homoeothrix varians Komarek & Kalina | - | - | - | - | - | 15,159 | - | 5,168 | 42,205 | 8,900 |
| | Pseudoanabaena sp. | - | - | - | - | 3,445 | - | - | - | - | - |
| | Chamaesiphon incrustans Smith | - | - | - | - | - | 4,479 | 1,723 | 1,436 | 57,709 | 24,691 |
| Chlorophyte | Closteriopsis sp. | - | - | 431 | - | - | - | - | - | - | - |
| | Stigeoclonium sp. | - | - | 3,445 | - | - | - | - | - | - | - |
| | Ulothrix zonata Kutzing | - | 2,584 | - | - | 2,153 | - | - | - | - | - |
| Diatoms | Cymbella lapponica | - | - | - | 689 | - | - | - | - | - | - |
| | Achnanthes minutissima Kutzing | 2,584 | 1,507 | 6,460 | 3,962 | 8,398 | 6,718 | 20,844 | 17,227 | 2,297 | 20,385 |
| | Eucoconeis sp. | - | - | - | - | 215 | - | - | - | - | - |
| | Diatoma mesodon Grun. | 215 | 646 | 646 | - | - | - | - | - | - | - |
| | Encyonema silesiacum (Bleisch) D.G. Mann | 215 | 1,938 | 1,938 | 1,206 | 1,723 | 1,895 | 2,756 | 1,148 | - | - |
| | Navicula radiosa Kutzing | - | - | - | - | - | - | 172 | - | - | 287 |
| | Cocconies disculus Schum. | 431 | 646 | - | - | 431 | 172 | - | - | 1,723 | - |
| | Anomoenies vitrea Ross | 1,077 | 1,077 | 646 | 345 | - | 1,895 | 1,034 | 1,148 | 287 | - |
| | Navicula exigua (Greg.) Muller | - | - | - | - | 646 | 1,206 | 3,101 | 1,436 | 1,723 | - |
| | Fragilaria capucina Grunow | 9,475 | 14,858 | 17,011 | 12,920 | 11,843 | 3,962 | 4,307 | 5,312 | 1,723 | 287 |
| | Diatoma vulgare Bory | 24,978 | 26,270 | 24,548 | 22,739 | 29,716 | - | - | - | - | - |
| | Gomphonema minutum | 2,369 | 215 | 215 | 345 | 215 | 172 | 2,239 | 144 | 1,148 | 7,465 |
| | Navicula pupula Kutzing | - | - | - | - | - | - | - | 861 | - | - |
| | Meridion circulare Agardh | 646 | 861 | 431 | 689 | - | - | - | 574 | - | - |
| | Cymbella minuta Kutzing | - | - | - | - | - | 345 | 1,034 | 861 | 6,891 | - |
| | Synedra ulna (Nitzsch) Ehrenberg | - | 431 | - | - | - | - | - | - | - | 287 |
| | Cymbella prostrata (Berkeley) Cleve | - | - | - | 172 | - | - | - | - | - | - |
| | Frustulia rhomboides (Ehrenberg) de Toni | - | 215 | - | - | - | - | - | - | - | - |
| | Nitzschia filiformis (W. Smith) Hustedt | - | 431 | - | 172 | 1,077 | - | 2,584 | 861 | - | 574 |
| | Didymosphenia geminata Schmidt | - | - | 215 | - | - | - | - | - | - | 287 |
| Nitzschia palea (Kutzing) W. Smith | 646 | 1,292 | 431 | - | 1,292 | 1,206 | 3,618 | 2,010 | 1,148 | 287 | |
| Hannaea arcus Patrick | - | - | - | 345 | - | - | - | - | - | - | |
| Red Algae | Audouinella / Chantransia stage. Red alga | - | - | - | - | - | 12,575 | 14,643 | 7,178 | - | 2,871 |

Table D.2: Biomass ($\mu\text{g}/\text{cm}^2$) of Periphyton Community Sampled at Lower Wolverine Creek and Lower Minto Creek, Minto Mine WUL, 2017

| Sample Location | | Lower Wolverine Creek (Reference) | | | | | Lower Minto Creek (Exposed) | | | | |
|------------------------------------|---|--------------------------------------|-------|-------|-------|-------|--------------------------------|-------|-------|-------|-------|
| | | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 |
| Sample Date | | | | | | | | | | | |
| Group | Genera and species | | | | | | | | | | |
| Cyanophyte | Phormidium autumnale Agardh | 6.0 | - | - | 1.3 | - | 0.92 | 7.5 | 0.43 | - | 1.4 |
| | Heteroleibeinia profunda Komarek | - | - | - | - | - | 2.6 | 0.48 | 0.69 | 3.5 | 5.2 |
| | Homoeothrix varians Komarek & Kalina | - | - | - | - | - | 6.9 | - | 2.4 | 20 | 4.3 |
| | Pseudoanabaena sp. | - | - | - | - | 0.025 | - | - | - | - | - |
| | Chamaesiphon incrustans Smith | - | - | - | - | - | 0.12 | 0.048 | 0.040 | 2.2 | 0.75 |
| Chlorophyte | Closteriopsis sp. | - | - | 4.2 | - | - | - | - | - | - | - |
| | Stigeoclonium sp. | - | - | 3.8 | - | - | - | - | - | - | - |
| | Ulothrix zonata Kutzing | - | 32 | - | - | 27 | - | - | - | - | - |
| Diatoms | Cymbella lapponica | - | - | - | 1.7 | - | - | - | - | - | - |
| | Achnanthes minutissima Kutzing | 0.19 | 0.12 | 0.51 | 0.32 | 0.67 | 0.53 | 1.7 | 1.3 | 0.18 | 1.6 |
| | Eucoconeis sp. | - | - | - | - | 0.99 | - | - | - | - | - |
| | Diatoma mesodon Grun. | 0.90 | 2.7 | 2.7 | - | - | - | - | - | - | - |
| | Encyonema silesiacum (Bleisch) D.G. Mann | 0.25 | 2.3 | 2.3 | 1.4 | 2.0 | 2.2 | 3.5 | 1.4 | - | - |
| | Navicula radiosa Kutzing | - | - | - | - | - | - | 0.32 | - | - | 0.49 |
| | Cocconies disculus Schum. | 0.69 | 0.99 | - | - | 0.69 | 0.27 | - | - | 2.7 | - |
| | Anomoenies vitrea Ross | 0.37 | 0.37 | 0.21 | 0.11 | - | 0.63 | 0.33 | 0.38 | 0.097 | - |
| | Navicula exigua (Greg.) Muller | - | - | - | - | 0.31 | 0.53 | 2.9 | 0.84 | 0.97 | - |
| | Fragilaria capucina Grunow | 12 | 20 | 22 | 7.6 | 16 | 5.1 | 5.5 | 6.6 | 2.1 | 0.33 |
| | Diatoma vulgare Bory | 5.9 | 6.2 | 5.9 | 5.6 | 7.0 | - | - | - | - | - |
| | Gomphonema minutum | 1.1 | 0.097 | 0.094 | 0.15 | 0.094 | 0.078 | 0.55 | 0.070 | 0.52 | 3.4 |
| | Navicula pupula Kutzing | - | - | - | - | - | - | - | 1.2 | - | - |
| | Meridion circulare Agardh | 0.69 | 0.90 | 0.46 | 0.74 | - | - | - | 0.93 | - | - |
| | Cymbella minuta Kutzing | - | - | - | - | - | 0.13 | 0.37 | 0.32 | 2.1 | - |
| | Synedra ulna (Nitzsch) Ehrenberg | - | 1.9 | - | - | - | - | - | - | - | 0.70 |
| | Cymbella prostrata (Berkeley) Cleve | - | - | - | 2.9 | - | - | - | - | - | - |
| | Frustulia rhomboides (Ehrenberg) de Toni | - | 1.0 | - | - | - | - | - | - | - | - |
| | Nitzschia filiformis (W. Smith) Hustedt | - | 0.052 | - | 0.01 | 0.076 | - | 0.25 | 0.081 | - | 0.069 |
| | Didymosphenia geminata Schmidt | - | - | 8.6 | - | - | - | - | - | - | 11 |
| Nitzschia palea (Kutzing) W. Smith | 1.6 | 3.4 | 1.1 | - | 3.1 | 2.0 | 5.7 | 2.8 | 2.1 | 0.52 | |
| Hannaea arcus Patrick | - | - | - | 0.21 | - | - | - | - | - | - | |
| Red Algae | Audouinella / Chantransia stage. Red alga | - | - | - | - | - | 8.8 | 11 | 4.8 | - | 2.1 |

Table D.3: Summary Statistics for Periphyton Density (cells/cm²) Collected at Lower Wolverine Creek and Lower Minto Creek Stations, Minto Mine WUL, 2017

| Sample Location | | Lower Wolverine Creek (Reference) | | | | | Lower Minto Creek (Exposed) | | | | |
|------------------------------------|---|--------------------------------------|--------|---------|---------|--------------------|--------------------------------|--------|---------|---------|--------------------|
| | | Mean | Median | Minimum | Maximum | Standard Deviation | Mean | Median | Minimum | Maximum | Standard Deviation |
| Group | Genera and species | | | | | | | | | | |
| Cyanophyte | Phormidium autumnale Agardh | 926 | 926 | 345 | 1,507 | - | 955 | 459 | 144 | 2,756 | 1,214 |
| | Heteroleibeinia profunda Komarek | - | - | - | - | - | 22,550 | 20,844 | 4,479 | 42,205 | 17,589 |
| | Homoeothrix varians Komarek & Kalina | - | - | - | - | - | 17,858 | 12,030 | 5,168 | 42,205 | 16,746 |
| | Pseudoanabaena sp. | 3,445 | 3,445 | 3,445 | 3,445 | - | - | - | - | - | - |
| | Chamaesiphon incrustans Smith | - | - | - | - | - | 18,007 | 4,479 | 1,436 | 57,709 | 24,206 |
| Chlorophyte | Closteriopsis sp. | 431 | 431 | 431 | 431 | - | - | - | - | - | - |
| | Stigeoclonium sp. | 3,445 | 3,445 | 3,445 | 3,445 | - | - | - | - | - | - |
| | Ulothrix zonata Kutzing | 2,369 | 2,369 | 2,153 | 2,584 | - | - | - | - | - | - |
| Diatoms | Cymbella lapponica | 689 | 689 | 689 | 689 | - | - | - | - | - | - |
| | Achnanthes minutissima Kutzing | 4,582 | 3,962 | 1,507 | 8,398 | 2,825 | 13,494 | 17,227 | 2,297 | 20,844 | 8,466 |
| | Eucocconeis sp. | 215 | 215 | 215 | 215 | - | - | - | - | - | - |
| | Diatoma mesodon Grun. | 502 | 646 | 215 | 646 | 249 | - | - | - | - | - |
| | Encyonema silesiacum (Bleisch) D.G. Mann | 1,404 | 1,723 | 215 | 1,938 | 729 | 1,933 | 1,895 | 1,148 | 2,756 | 805 |
| | Navicula radiosa Kutzing | - | - | - | - | - | 230 | 230 | 172 | 287 | - |
| | Cocconies disculus Schum. | 502 | 431 | 431 | 646 | 124 | 947 | 947 | 172 | 1,723 | - |
| | Anomoenies vitrea Ross | 786 | 861 | 345 | 1,077 | 358 | 1,091 | 1,091 | 287 | 1,895 | 658 |
| | Navicula exigua (Greg.) Muller | 646 | 646 | 646 | 646 | - | 1,866 | 1,579 | 1,206 | 3,101 | 850 |
| | Fragilaria capucina Grunow | 13,221 | 12,920 | 9,475 | 17,011 | 2,875 | 3,118 | 3,962 | 287 | 5,312 | 2,055 |
| | Diatoma vulgare Bory | 25,650 | 24,978 | 22,739 | 29,716 | 2,601 | - | - | - | - | - |
| | Gomphonema minutum | 672 | 215 | 215 | 2,369 | 950 | 2,234 | 1,148 | 144 | 7,465 | 3,048 |
| | Navicula pupula Kutzing | - | - | - | - | - | 861 | 861 | 861 | 861 | - |
| | Meridion circulare Agardh | 657 | 668 | 431 | 861 | 177 | 574 | 574 | 574 | 574 | - |
| | Cymbella minuta Kutzing | - | - | - | - | - | 2,283 | 947 | 345 | 6,891 | 3,086 |
| | Synedra ulna (Nitzsch) Ehrenberg | 431 | 431 | 431 | 431 | - | 287 | 287 | 287 | 287 | - |
| | Cymbella prostrata (Berkeley) Cleve | 172 | 172 | 172 | 172 | - | - | - | - | - | - |
| | Frustulia rhomboides (Ehrenberg) de Toni | 215 | 215 | 215 | 215 | - | - | - | - | - | - |
| | Nitzschia filiformis (W. Smith) Hustedt | 560 | 431 | 172 | 1,077 | 466 | 1,340 | 861 | 574 | 2,584 | 1,087 |
| | Didymosphenia geminata Schmidt | 215 | 215 | 215 | 215 | - | 287 | 287 | 287 | 287 | - |
| Nitzschia palea (Kutzing) W. Smith | 915 | 969 | 431 | 1,292 | 444 | 1,654 | 1,206 | 287 | 3,618 | 1,256 | |
| Hannaea arcus Patrick | 345 | 345 | 345 | 345 | - | - | - | - | - | - | |
| Red Algae | Audouinella / Chantransia stage. Red alga | - | - | - | - | - | 9,317 | 9,877 | 2,871 | 14,643 | 5,326 |

Table D.4: Summary Statistics for Periphyton Biomass ($\mu\text{g}/\text{cm}^2$) Collected at Lower Wolverine Creek and Lower Minto Creek Stations, Minto Mine WUL, 2017

| Sample Location | | Lower Wolverine Creek (Reference) | | | | | Lower Minto Creek (Exposed) | | | | |
|------------------------------------|---|--------------------------------------|--------|---------|---------|--------------------|--------------------------------|--------|---------|---------|--------------------|
| | | Mean | Median | Minimum | Maximum | Standard Deviation | Mean | Median | Minimum | Maximum | Standard Deviation |
| Group | Genera and species | | | | | | | | | | |
| Cyanophyte | Phormidium autumnale Agardh | 3.6 | 3.6 | 1.3 | 6.0 | - | 2.6 | 1.2 | 0.43 | 7.5 | 3.3 |
| | Heteroleibeinia profunda Komarek | - | - | - | - | - | 2.5 | 2.6 | 0.48 | 5.2 | 2.0 |
| | Homoeothrix varians Komarek & Kalina | - | - | - | - | - | 8.5 | 5.6 | 2.4 | 20 | 8.1 |
| | Pseudoanabaena sp. | 0.025 | 0.025 | 0.025 | 0.025 | - | - | - | - | - | - |
| | Chamaesiphon incrustans Smith | - | - | - | - | - | 0.64 | 0.12 | 0.040 | 2.2 | 0.94 |
| Chlorophyte | Closteriopsis sp. | 4.2 | 4.2 | 4.2 | 4.2 | - | - | - | - | - | - |
| | Stigeoclonium sp. | 3.8 | 3.8 | 3.8 | 3.8 | - | - | - | - | - | - |
| | Ulothrix zonata Kutzing | 30 | 30 | 27 | 32 | - | - | - | - | - | - |
| Diatoms | Cymbella lapponica | 1.7 | 1.7 | 1.7 | 1.7 | - | - | - | - | - | - |
| | Achnanthes minutissima Kutzing | 0.36 | 0.32 | 0.12 | 0.67 | 0.23 | 1.1 | 1.3 | 0.18 | 1.7 | 0.67 |
| | Eucocconeis sp. | 0.99 | 0.99 | 0.99 | 0.99 | - | - | - | - | - | - |
| | Diatoma mesodon Grun. | 2.1 | 2.7 | 0.90 | 2.7 | 1.0 | - | - | - | - | - |
| | Encyonema silesiacum (Bleisch) D.G. Mann | 1.7 | 2.0 | 0.25 | 2.3 | 0.86 | 2.4 | 2.2 | 1.4 | 3.5 | 1.0 |
| | Navicula radiosa Kutzing | - | - | - | - | - | 0.40 | 0.40 | 0.32 | 0.49 | - |
| | Cocconies disculus Schum. | 0.79 | 0.69 | 0.69 | 0.99 | 0.18 | 1.5 | 1.5 | 0.27 | 2.7 | - |
| | Anomoenies vitrea Ross | 0.26 | 0.29 | 0.11 | 0.37 | 0.13 | 0.36 | 0.36 | 0.097 | 0.63 | 0.22 |
| | Navicula exigua (Greg.) Muller | 0.31 | 0.31 | 0.31 | 0.31 | - | 1.3 | 0.91 | 0.53 | 2.9 | 1.1 |
| | Fragilaria capucina Grunow | 15 | 16 | 7.6 | 22 | 5.7 | 3.9 | 5.1 | 0.33 | 6.6 | 2.6 |
| | Diatoma vulgare Bory | 6.1 | 5.9 | 5.6 | 7.0 | 0.55 | - | - | - | - | - |
| | Gomphonema minutum | 0.30 | 0.097 | 0.094 | 1.1 | 0.43 | 0.92 | 0.52 | 0.070 | 3.4 | 1.4 |
| | Navicula pupula Kutzing | - | - | - | - | - | 1.2 | 1.2 | 1.2 | 1.2 | - |
| | Meridion circulare Agardh | 0.70 | 0.72 | 0.46 | 0.90 | 0.18 | 0.93 | 0.93 | 0.93 | 0.93 | - |
| | Cymbella minuta Kutzing | - | - | - | - | - | 0.73 | 0.35 | 0.13 | 2.1 | 0.92 |
| | Synedra ulna (Nitzsch) Ehrenberg | 1.9 | 1.9 | 1.9 | 1.9 | - | 0.70 | 0.70 | 0.70 | 0.70 | - |
| | Cymbella prostrata (Berkeley) Cleve | 2.9 | 2.9 | 2.9 | 2.9 | - | - | - | - | - | - |
| | Frustulia rhomboides (Ehrenberg) de Toni | 1.0 | 1.0 | 1.0 | 1.0 | - | - | - | - | - | - |
| | Nitzschia filiformis (W. Smith) Hustedt | 0.047 | 0.052 | 0.012 | 0.076 | 0.032 | 0.13 | 0.081 | 0.069 | 0.25 | 0.10 |
| | Didymosphenia geminata Schmidt | 8.6 | 8.6 | 8.6 | 8.6 | - | 11 | 11 | 11 | 11 | - |
| Nitzschia palea (Kutzing) W. Smith | 2.3 | 2.4 | 1.1 | 3.4 | 1.1 | 2.6 | 2.1 | 0.52 | 5.7 | 1.9 | |
| Hannaea arcus Patrick | 0.21 | 0.21 | 0.21 | 0.21 | - | - | - | - | - | - | |
| Red Algae | Audouinella / Chantransia stage. Red alga | - | - | - | - | - | 6.8 | 6.8 | 2.1 | 11 | 4.1 |

Table D.5: Presence/Absence of Periphyton Taxa at Lower Wolverine Creek and Lower Minto Creek, Minto Mine WUL, 2017

| Sample Location | | Lower Wolverine Creek (Reference) | | | | | Lower Minto Creek (Exposed) | | | | |
|------------------------------------|---|--------------------------------------|-----------|-----------|-----------|-----------|--------------------------------|-----------|-----------|-----------|-----------|
| | | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 |
| Group | Genera and species | | | | | | | | | | |
| Cyanophyte | Phormidium autumnale Agardh | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| | Heteroleibeinia profunda Komarek | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| | Homoeothrix varians Komarek & Kalina | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| | Pseudoanabaena sp. | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | Chamaesiphon incrustans Smith | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| Chlorophyte | Closteriopsis sp. | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Stigeoclonium sp. | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Ulothrix zonata Kutzing | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Diatoms | Cymbella lapponica | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Achnanthes minutissima Kutzing | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Eucocconeis sp. | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | Diatoma mesodon Grun. | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Encyonema silesiacum (Bleisch) D.G. Mann | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| | Navicula radiosa Kutzing | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| | Cocconies disculus Schum. | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| | Anomoenies vitrea Ross | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| | Navicula exigua (Greg.) Muller | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Fragilaria capucina Grunow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Diatoma vulgare Bory | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| | Gomphonema minutum | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Navicula pupula Kutzing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | Meridion circulare Agardh | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| | Cymbella minuta Kutzing | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| | Synedra ulna (Nitzsch) Ehrenberg | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Cymbella prostrata (Berkeley) Cleve | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Frustulia rhomboides (Ehrenberg) de Toni | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Nitzschia filiformis (W. Smith) Hustedt | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| | Didymosphenia geminata Schmidt | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Nitzschia palea (Kutzing) W. Smith | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Hannaea arcus Patrick | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Red Algae | Audouinella / Chantransia stage. Red alga | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| Total | | 11 | 14 | 12 | 12 | 12 | 14 | 14 | 16 | 11 | 13 |

APPENDIX D
PERIPHYTON COMMUNITY DATA

Laboratory Reports

PERIPHYTON COMMUNITY ANALYSIS

PROVIDED BY:

PLANKTON R US INC.

(WINNIPEG, MB)

Epilithic algal density (cells/cm²) for **Minto WUL Monitoring 2017 - (Project 1739)**
 (for Lisa Minnow Environmental Inc.)

R = QAQC recount

| Project | Location | Date | Cyanobacteria | Chlorophyte | Diatom | Red Algae | Total |
|---------|----------|-----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | | | cells/cm ² | cells/cm ² | cells/cm ² | cells/cm ² | cells/cm ² |
| 1739 | LMC - 1 | 26-Sep-17 | 40827 | 0 | 17571 | 12575 | 70973 |
| 1739 | LMC - 2 | 26-Sep-17 | 8958 | 0 | 41688 | 14643 | 65289 |
| 1739 | LMC - 3 | 26-Sep-17 | 13207 | 0 | 31582 | 7178 | 51967 |
| 1739 | LMC - 4 | 21-Sep-17 | 138674 | 0 | 16939 | 0 | 155613 |
| 1739 | LMC - 5 | 21-Sep-17 | 76371 | 0 | 29859 | 2871 | 109101 |
| 1739 | LMC - 5R | 21-Sep-17 | 79242 | 0 | 28424 | 4594 | 112260 |
| 1739 | LWC - 1 | 24-Sep-17 | 1507 | 0 | 42636 | 0 | 44143 |
| 1739 | LWC - 2 | 24-Sep-17 | 0 | 2584 | 50388 | 0 | 52972 |
| 1739 | LWC - 3 | 23-Sep-17 | 0 | 3876 | 52541 | 0 | 56417 |
| 1739 | LWC - 4 | 23-Sep-17 | 345 | 0 | 43583 | 0 | 43928 |
| 1739 | LWC - 5 | 23-Sep-17 | 3445 | 2153 | 55556 | 0 | 61154 |

Epilithic algal biomass ($\mu\text{g}/\text{cm}^2$) for **Minto WUL Monitoring 2017 - (Project 1739)**
 (for Lisa Minnow Environmental Inc.)

R = QAQC recount

| Project | Location | Date | Cyanobacteria | Chlorophyte | Diatom | Red Algae | Total |
|---------|----------|-----------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| | | | $\mu\text{g}/\text{cm}^2$ | $\mu\text{g}/\text{cm}^2$ | $\mu\text{g}/\text{cm}^2$ | $\mu\text{g}/\text{cm}^2$ | $\mu\text{g}/\text{cm}^2$ |
| 1739 | LMC - 1 | 26-Sep-17 | 10.46 | 0 | 11.43 | 8.85 | 30.74 |
| 1739 | LMC - 2 | 26-Sep-17 | 8.01 | 0 | 21.01 | 11.29 | 40.30 |
| 1739 | LMC - 3 | 26-Sep-17 | 3.54 | 0 | 15.84 | 4.81 | 24.19 |
| 1739 | LMC - 4 | 21-Sep-17 | 26.15 | 0 | 10.78 | 0 | 36.93 |
| 1739 | LMC - 5 | 21-Sep-17 | 11.65 | 0 | 18.60 | 2.12 | 32.37 |
| 1739 | LMC - 5R | 21-Sep-17 | 14.59 | 0 | 18.98 | 3.39 | 36.96 |
| 1739 | LWC - 1 | 24-Sep-17 | 5.97 | 0 | 23.82 | 0 | 29.79 |
| 1739 | LWC - 2 | 24-Sep-17 | 0 | 32.47 | 39.81 | 0 | 72.28 |
| 1739 | LWC - 3 | 23-Sep-17 | 0 | 8.01 | 43.67 | 0 | 51.68 |
| 1739 | LWC - 4 | 23-Sep-17 | 1.28 | 0 | 20.71 | 0 | 21.99 |
| 1739 | LWC - 5 | 23-Sep-17 | 0.03 | 27.06 | 30.68 | 0 | 57.76 |

Epilithic algal species data for Minto WUL Monitoring 2017 - (Project 1739) (for Lisa Minnow Environmental Inc.)

** 1st number in species code = group 1=cyanophyte 2=chlorophyte 5=diatoms 8= red algae
 ** total daily biomass is sum of all species on a date

| Project | Location | Date | Species Code | Speceis name | density cells/cm ² | biomass µg/cm ² | length µ | width µ | cell volume µ ³ |
|---------|----------|-----------|--------------|---|-------------------------------|----------------------------|----------|---------|----------------------------|
| 1739 | LMC - 1 | 26-Sep-17 | 1122 | Phormidium autumnale Agardh | 345 | 0.92 | 94.00 | 6.00 | 2657.80 |
| 1739 | LMC - 1 | 26-Sep-17 | 1131 | Heteroleibeinia profunda Komarek | 20844 | 2.55 | 39.00 | 2.00 | 122.50 |
| 1739 | LMC - 1 | 26-Sep-17 | 1223 | Chamaesiphon incrustans Smith | 4479 | 0.12 | 5.90 | 3.00 | 27.80 |
| 1739 | LMC - 1 | 26-Sep-17 | 1239 | Homoeothrix varians Komarek & Kalina | 15159 | 6.87 | 60.00 | 3.10 | 452.90 |
| 1739 | LMC - 1 | 26-Sep-17 | 5311 | Cymbella minuta Kutzing | 345 | 0.13 | 15.10 | 8.00 | 379.50 |
| 1739 | LMC - 1 | 26-Sep-17 | 5702 | Achnanthes minutissima Kutzing | 6718 | 0.53 | 19.00 | 4.00 | 79.60 |
| 1739 | LMC - 1 | 26-Sep-17 | 5836 | Encyonema silesiacum (Bleisch) D.G. Mann | 1895 | 2.23 | 30.00 | 10.00 | 1178.10 |
| 1739 | LMC - 1 | 26-Sep-17 | 5873 | Gomphonema minutum | 172 | 0.08 | 27.00 | 8.00 | 452.40 |
| 1739 | LMC - 1 | 26-Sep-17 | 5874 | Nitzschia palea (Kutzing) W. Smith | 1206 | 1.96 | 62.00 | 10.00 | 1623.20 |
| 1739 | LMC - 1 | 26-Sep-17 | 5875 | Cocconies disculus Schum. | 172 | 0.27 | 30.00 | 14.00 | 1539.40 |
| 1739 | LMC - 1 | 26-Sep-17 | 5882 | Anomoenies vitrea Ross | 1895 | 0.63 | 35.00 | 6.00 | 329.90 |
| 1739 | LMC - 1 | 26-Sep-17 | 5910 | Navicula exigua (Greg.) Muller | 1206 | 0.53 | 26.00 | 8.00 | 435.60 |
| 1739 | LMC - 1 | 26-Sep-17 | 5916 | Fragilaria capucina Grunow | 3962 | 5.08 | 136.00 | 6.00 | 1281.80 |
| 1739 | LMC - 1 | 26-Sep-17 | 8001 | Audouinella / Chantransia stage. Red alga | 12575 | 8.85 | 21.00 | 8.00 | 703.70 |
| 1739 | LMC - 2 | 26-Sep-17 | 1122 | Phormidium autumnale Agardh | 2756 | 7.48 | 96.00 | 6.00 | 2714.30 |
| 1739 | LMC - 2 | 26-Sep-17 | 1131 | Heteroleibeinia profunda Komarek | 4479 | 0.48 | 34.00 | 2.00 | 106.80 |
| 1739 | LMC - 2 | 26-Sep-17 | 1223 | Chamaesiphon incrustans Smith | 1723 | 0.05 | 5.90 | 3.00 | 27.80 |
| 1739 | LMC - 2 | 26-Sep-17 | 5311 | Cymbella minuta Kutzing | 1034 | 0.37 | 14.40 | 8.00 | 361.90 |
| 1739 | LMC - 2 | 26-Sep-17 | 5702 | Achnanthes minutissima Kutzing | 20844 | 1.66 | 19.00 | 4.00 | 79.60 |
| 1739 | LMC - 2 | 26-Sep-17 | 5836 | Encyonema silesiacum (Bleisch) D.G. Mann | 2756 | 3.46 | 32.00 | 10.00 | 1256.60 |
| 1739 | LMC - 2 | 26-Sep-17 | 5857 | Nitzschia filiformis (W. Smith) Hustedt | 2584 | 0.25 | 41.00 | 3.00 | 96.60 |
| 1739 | LMC - 2 | 26-Sep-17 | 5870 | Navicula radiosa Kutzing | 172 | 0.32 | 71.00 | 10.00 | 1858.80 |
| 1739 | LMC - 2 | 26-Sep-17 | 5873 | Gomphonema minutum | 2239 | 0.55 | 26.00 | 6.00 | 245.00 |
| 1739 | LMC - 2 | 26-Sep-17 | 5874 | Nitzschia palea (Kutzing) W. Smith | 3618 | 5.68 | 60.00 | 10.00 | 1570.80 |
| 1739 | LMC - 2 | 26-Sep-17 | 5882 | Anomoenies vitrea Ross | 1034 | 0.33 | 34.00 | 6.00 | 320.40 |
| 1739 | LMC - 2 | 26-Sep-17 | 5910 | Navicula exigua (Greg.) Muller | 3101 | 2.86 | 55.00 | 8.00 | 921.50 |
| 1739 | LMC - 2 | 26-Sep-17 | 5916 | Fragilaria capucina Grunow | 4307 | 5.52 | 136.00 | 6.00 | 1281.80 |
| 1739 | LMC - 2 | 26-Sep-17 | 8001 | Audouinella / Chantransia stage. Red alga | 14643 | 11.29 | 23.00 | 8.00 | 770.70 |
| 1739 | LMC - 3 | 26-Sep-17 | 1122 | Phormidium autumnale Agardh | 144 | 0.43 | 106.00 | 6.00 | 2997.10 |
| 1739 | LMC - 3 | 26-Sep-17 | 1131 | Heteroleibeinia profunda Komarek | 6460 | 0.69 | 34.00 | 2.00 | 106.80 |
| 1739 | LMC - 3 | 26-Sep-17 | 1223 | Chamaesiphon incrustans Smith | 1436 | 0.04 | 5.90 | 3.00 | 27.80 |
| 1739 | LMC - 3 | 26-Sep-17 | 1239 | Homoeothrix varians Komarek & Kalina | 5168 | 2.38 | 61.00 | 3.10 | 460.40 |
| 1739 | LMC - 3 | 26-Sep-17 | 5311 | Cymbella minuta Kutzing | 861 | 0.32 | 14.90 | 8.00 | 374.50 |
| 1739 | LMC - 3 | 26-Sep-17 | 5702 | Achnanthes minutissima Kutzing | 17227 | 1.32 | 18.30 | 4.00 | 76.70 |
| 1739 | LMC - 3 | 26-Sep-17 | 5836 | Encyonema silesiacum (Bleisch) D.G. Mann | 1148 | 1.40 | 31.00 | 10.00 | 1217.40 |
| 1739 | LMC - 3 | 26-Sep-17 | 5857 | Nitzschia filiformis (W. Smith) Hustedt | 861 | 0.08 | 40.00 | 3.00 | 94.20 |
| 1739 | LMC - 3 | 26-Sep-17 | 5873 | Gomphonema minutum | 144 | 0.07 | 29.00 | 8.00 | 485.90 |
| 1739 | LMC - 3 | 26-Sep-17 | 5874 | Nitzschia palea (Kutzing) W. Smith | 2010 | 2.79 | 53.00 | 10.00 | 1387.50 |
| 1739 | LMC - 3 | 26-Sep-17 | 5882 | Anomoenies vitrea Ross | 1148 | 0.38 | 35.00 | 6.00 | 329.90 |
| 1739 | LMC - 3 | 26-Sep-17 | 5887 | Navicula pupula Kutzing | 861 | 1.15 | 51.00 | 10.00 | 1335.20 |
| 1739 | LMC - 3 | 26-Sep-17 | 5910 | Navicula exigua (Greg.) Muller | 1436 | 0.84 | 35.00 | 8.00 | 586.40 |
| 1739 | LMC - 3 | 26-Sep-17 | 5916 | Fragilaria capucina Grunow | 5312 | 6.56 | 131.00 | 6.00 | 1234.60 |
| 1739 | LMC - 3 | 26-Sep-17 | 5986 | Meridion circulare Agardh | 574 | 0.93 | 62.00 | 10.00 | 1623.20 |
| 1739 | LMC - 3 | 26-Sep-17 | 8001 | Audouinella / Chantransia stage. Red alga | 7178 | 4.81 | 20.00 | 8.00 | 670.20 |
| 1739 | LMC - 4 | 21-Sep-17 | 1131 | Heteroleibeinia profunda Komarek | 38760 | 3.53 | 29.00 | 2.00 | 91.10 |
| 1739 | LMC - 4 | 21-Sep-17 | 1223 | Chamaesiphon incrustans Smith | 57709 | 2.23 | 6.40 | 3.40 | 38.70 |
| 1739 | LMC - 4 | 21-Sep-17 | 1239 | Homoeothrix varians Komarek & Kalina | 42205 | 20.39 | 64.00 | 3.10 | 483.10 |
| 1739 | LMC - 4 | 21-Sep-17 | 5311 | Cymbella minuta Kutzing | 6891 | 2.10 | 15.00 | 7.20 | 305.40 |
| 1739 | LMC - 4 | 21-Sep-17 | 5702 | Achnanthes minutissima Kutzing | 2297 | 0.18 | 18.60 | 4.00 | 77.90 |
| 1739 | LMC - 4 | 21-Sep-17 | 5873 | Gomphonema minutum | 1148 | 0.52 | 27.00 | 8.00 | 452.40 |
| 1739 | LMC - 4 | 21-Sep-17 | 5874 | Nitzschia palea (Kutzing) W. Smith | 1148 | 2.07 | 69.00 | 10.00 | 1806.40 |
| 1739 | LMC - 4 | 21-Sep-17 | 5875 | Cocconies disculus Schum. | 1723 | 2.74 | 31.00 | 14.00 | 1590.70 |
| 1739 | LMC - 4 | 21-Sep-17 | 5882 | Anomoenies vitrea Ross | 287 | 0.10 | 36.00 | 6.00 | 339.30 |
| 1739 | LMC - 4 | 21-Sep-17 | 5910 | Navicula exigua (Greg.) Muller | 1723 | 0.97 | 33.60 | 8.00 | 563.00 |
| 1739 | LMC - 4 | 21-Sep-17 | 5916 | Fragilaria capucina Grunow | 1723 | 2.09 | 129.00 | 6.00 | 1215.80 |
| 1739 | LMC - 5 | 21-Sep-17 | 1122 | Phormidium autumnale Agardh | 574 | 1.40 | 86.00 | 6.00 | 2431.60 |
| 1739 | LMC - 5 | 21-Sep-17 | 1131 | Heteroleibeinia profunda Komarek | 42205 | 5.21 | 39.30 | 2.00 | 123.50 |
| 1739 | LMC - 5 | 21-Sep-17 | 1223 | Chamaesiphon incrustans Smith | 24691 | 0.75 | 6.40 | 3.00 | 30.20 |
| 1739 | LMC - 5 | 21-Sep-17 | 1239 | Homoeothrix varians Komarek & Kalina | 8900 | 4.30 | 64.00 | 3.10 | 483.10 |
| 1739 | LMC - 5 | 21-Sep-17 | 5523 | Synedra ulna (Nitzsch) Ehrenberg | 287 | 0.70 | 260.00 | 6.00 | 2450.40 |
| 1739 | LMC - 5 | 21-Sep-17 | 5702 | Achnanthes minutissima Kutzing | 20385 | 1.62 | 19.00 | 4.00 | 79.60 |
| 1739 | LMC - 5 | 21-Sep-17 | 5857 | Nitzschia filiformis (W. Smith) Hustedt | 574 | 0.07 | 51.00 | 3.00 | 120.20 |
| 1739 | LMC - 5 | 21-Sep-17 | 5870 | Navicula radiosa Kutzing | 287 | 0.49 | 65.00 | 10.00 | 1701.70 |
| 1739 | LMC - 5 | 21-Sep-17 | 5873 | Gomphonema minutum | 7465 | 3.38 | 27.00 | 8.00 | 452.40 |
| 1739 | LMC - 5 | 21-Sep-17 | 5874 | Nitzschia palea (Kutzing) W. Smith | 287 | 0.52 | 69.00 | 10.00 | 1806.40 |
| 1739 | LMC - 5 | 21-Sep-17 | 5880 | Didymosphenia geminata Schmidt | 287 | 11.49 | 118.00 | 36.00 | 40036.50 |
| 1739 | LMC - 5 | 21-Sep-17 | 5916 | Fragilaria capucina Grunow | 287 | 0.33 | 121.00 | 6.00 | 1140.40 |
| 1739 | LMC - 5 | 21-Sep-17 | 8001 | Audouinella / Chantransia stage. Red alga | 2871 | 2.12 | 22.00 | 8.00 | 737.20 |
| 1739 | LMC - 5R | 21-Sep-17 | 1122 | Phormidium autumnale Agardh | 1148 | 2.79 | 86.00 | 6.00 | 2431.60 |
| 1739 | LMC - 5R | 21-Sep-17 | 1131 | Heteroleibeinia profunda Komarek | 44789 | 5.53 | 39.30 | 2.00 | 123.50 |
| 1739 | LMC - 5R | 21-Sep-17 | 1223 | Chamaesiphon incrustans Smith | 23256 | 0.70 | 6.40 | 3.00 | 30.20 |
| 1739 | LMC - 5R | 21-Sep-17 | 1239 | Homoeothrix varians Komarek & Kalina | 10049 | 5.57 | 61.00 | 3.40 | 553.80 |
| 1739 | LMC - 5R | 21-Sep-17 | 5702 | Achnanthes minutissima Kutzing | 18375 | 1.46 | 19.00 | 4.00 | 79.60 |
| 1739 | LMC - 5R | 21-Sep-17 | 5857 | Nitzschia filiformis (W. Smith) Hustedt | 861 | 0.10 | 51.00 | 3.00 | 120.20 |
| 1739 | LMC - 5R | 21-Sep-17 | 5873 | Gomphonema minutum | 6604 | 2.99 | 27.00 | 8.00 | 452.40 |
| 1739 | LMC - 5R | 21-Sep-17 | 5874 | Nitzschia palea (Kutzing) W. Smith | 574 | 1.04 | 69.00 | 10.00 | 1806.40 |
| 1739 | LMC - 5R | 21-Sep-17 | 5875 | Cocconies disculus Schum. | 861 | 1.37 | 31.00 | 14.00 | 1590.70 |
| 1739 | LMC - 5R | 21-Sep-17 | 5880 | Didymosphenia geminata Schmidt | 287 | 11.49 | 118.00 | 36.00 | 40036.50 |
| 1739 | LMC - 5R | 21-Sep-17 | 5882 | Anomoenies vitrea Ross | 574 | 0.19 | 36.00 | 6.00 | 339.30 |
| 1739 | LMC - 5R | 21-Sep-17 | 5916 | Fragilaria capucina Grunow | 287 | 0.33 | 121.00 | 6.00 | 1140.40 |
| 1739 | LMC - 5R | 21-Sep-17 | 8001 | Audouinella / Chantransia stage. Red alga | 4594 | 3.39 | 22.00 | 8.00 | 737.20 |
| 1739 | LWC - 1 | 24-Sep-17 | 1122 | Phormidium autumnale Agardh | 1507 | 5.97 | 140.00 | 6.00 | 3958.40 |
| 1739 | LWC - 1 | 24-Sep-17 | 5702 | Achnanthes minutissima Kutzing | 2584 | 0.19 | 18.00 | 4.00 | 75.40 |
| 1739 | LWC - 1 | 24-Sep-17 | 5836 | Encyonema silesiacum (Bleisch) D.G. Mann | 215 | 0.25 | 30.00 | 10.00 | 1178.10 |
| 1739 | LWC - 1 | 24-Sep-17 | 5860 | Diatoma vulgare Bory | 24978 | 5.88 | 25.00 | 6.00 | 235.60 |
| 1739 | LWC - 1 | 24-Sep-17 | 5873 | Gomphonema minutum | 2369 | 1.07 | 27.00 | 8.00 | 452.40 |
| 1739 | LWC - 1 | 24-Sep-17 | 5874 | Nitzschia palea (Kutzing) W. Smith | 646 | 1.62 | 96.00 | 10.00 | 2513.30 |
| 1739 | LWC - 1 | 24-Sep-17 | 5875 | Cocconies disculus Schum. | 431 | 0.69 | 31.00 | 14.00 | 1590.70 |
| 1739 | LWC - 1 | 24-Sep-17 | 5882 | Anomoenies vitrea Ross | 1077 | 0.37 | 36.00 | 6.00 | 339.30 |
| 1739 | LWC - 1 | 24-Sep-17 | 5890 | Diatoma mesodon Grun. | 215 | 0.90 | 40.00 | 20.00 | 4188.80 |
| 1739 | LWC - 1 | 24-Sep-17 | 5916 | Fragilaria capucina Grunow | 9475 | 12.14 | 136.00 | 6.00 | 1281.80 |

Epilithic algal species data for Minto WUL Monitoring 2017 - (Project 1739) (for Lisa Minnow Environmental Inc.)

** 1st number in species code = group 1=cyanophyte 2=chlorophyte 5=diatoms 8= red algae

** total daily biomass is sum of all species on a date

| Project | Location | Date | Species Code | Species name | density cells/cm ² | biomass µg/cm ² | length µ | width µ | cell volume µ ³ |
|---------|----------|-----------|--------------|--|----------------------------------|-------------------------------|-------------|------------|-------------------------------|
| 1739 | LWC - 1 | 24-Sep-17 | 5986 | Meridion circulare Agardh | 646 | 0.69 | 41.00 | 10.00 | 1073.40 |
| 1739 | LWC - 2 | 24-Sep-17 | 2511 | Ulothrix zonata Kutzing | 2584 | 32.47 | 40.00 | 20.00 | 12566.40 |
| 1739 | LWC - 2 | 24-Sep-17 | 5523 | Synedra ulna (Nitzsch) Ehrenberg | 431 | 1.88 | 260.00 | 8.00 | 4356.30 |
| 1739 | LWC - 2 | 24-Sep-17 | 5547 | Frustulia rhomboides (Ehrenberg) de Toni | 215 | 1.05 | 86.00 | 12.00 | 4863.20 |
| 1739 | LWC - 2 | 24-Sep-17 | 5702 | Achnanthes minutissima Kutzing | 1507 | 0.12 | 19.00 | 4.00 | 79.60 |
| 1739 | LWC - 2 | 24-Sep-17 | 5836 | Encyonema silesiacum (Bleisch) D.G. Mann | 1938 | 2.28 | 30.00 | 10.00 | 1178.10 |
| 1739 | LWC - 2 | 24-Sep-17 | 5857 | Nitzschia filiformis (W. Smith) Hustedt | 431 | 0.05 | 51.00 | 3.00 | 120.20 |
| 1739 | LWC - 2 | 24-Sep-17 | 5860 | Diatoma vulgare Bory | 26270 | 6.24 | 25.20 | 6.00 | 237.50 |
| 1739 | LWC - 2 | 24-Sep-17 | 5873 | Gomphonema minutum | 215 | 0.10 | 27.00 | 8.00 | 452.40 |
| 1739 | LWC - 2 | 24-Sep-17 | 5874 | Nitzschia palea (Kutzing) W. Smith | 1292 | 3.38 | 100.00 | 10.00 | 2618.00 |
| 1739 | LWC - 2 | 24-Sep-17 | 5875 | Cocconies disculus Schum. | 646 | 0.99 | 30.00 | 14.00 | 1539.40 |
| 1739 | LWC - 2 | 24-Sep-17 | 5882 | Anomoenies vitrea Ross | 1077 | 0.37 | 36.00 | 6.00 | 339.30 |
| 1739 | LWC - 2 | 24-Sep-17 | 5890 | Diatoma mesodon Grun. | 646 | 2.71 | 40.00 | 20.00 | 4188.80 |
| 1739 | LWC - 2 | 24-Sep-17 | 5916 | Fragilaria capucina Grunow | 14858 | 19.74 | 141.00 | 6.00 | 1328.90 |
| 1739 | LWC - 2 | 24-Sep-17 | 5986 | Meridion circulare Agardh | 861 | 0.90 | 40.00 | 10.00 | 1047.20 |
| 1739 | LWC - 3 | 23-Sep-17 | 2234 | Closteriopsis sp. | 431 | 4.22 | 111.00 | 15.00 | 9807.70 |
| 1739 | LWC - 3 | 23-Sep-17 | 2954 | Stigeoclonium sp. | 3445 | 3.79 | 14.00 | 10.00 | 1099.60 |
| 1739 | LWC - 3 | 23-Sep-17 | 5702 | Achnanthes minutissima Kutzing | 6460 | 0.51 | 19.00 | 4.00 | 79.60 |
| 1739 | LWC - 3 | 23-Sep-17 | 5836 | Encyonema silesiacum (Bleisch) D.G. Mann | 1938 | 2.28 | 30.00 | 10.00 | 1178.10 |
| 1739 | LWC - 3 | 23-Sep-17 | 5860 | Diatoma vulgare Bory | 24548 | 5.85 | 25.30 | 6.00 | 238.40 |
| 1739 | LWC - 3 | 23-Sep-17 | 5873 | Gomphonema minutum | 215 | 0.09 | 26.00 | 8.00 | 435.60 |
| 1739 | LWC - 3 | 23-Sep-17 | 5874 | Nitzschia palea (Kutzing) W. Smith | 431 | 1.13 | 100.00 | 10.00 | 2618.00 |
| 1739 | LWC - 3 | 23-Sep-17 | 5880 | Didymosphenia geminata Schmidt | 215 | 8.62 | 118.00 | 36.00 | 40036.50 |
| 1739 | LWC - 3 | 23-Sep-17 | 5882 | Anomoenies vitrea Ross | 646 | 0.21 | 34.00 | 6.00 | 320.40 |
| 1739 | LWC - 3 | 23-Sep-17 | 5890 | Diatoma mesodon Grun. | 646 | 2.71 | 40.00 | 20.00 | 4188.80 |
| 1739 | LWC - 3 | 23-Sep-17 | 5916 | Fragilaria capucina Grunow | 17011 | 21.80 | 136.00 | 6.00 | 1281.80 |
| 1739 | LWC - 3 | 23-Sep-17 | 5986 | Meridion circulare Agardh | 431 | 0.46 | 41.00 | 10.00 | 1073.40 |
| 1739 | LWC - 4 | 23-Sep-17 | 1122 | Phormidium autumnale Agardh | 345 | 1.28 | 131.00 | 6.00 | 3703.90 |
| 1739 | LWC - 4 | 23-Sep-17 | 5702 | Achnanthes minutissima Kutzing | 3962 | 0.32 | 19.30 | 4.00 | 80.80 |
| 1739 | LWC - 4 | 23-Sep-17 | 5836 | Encyonema silesiacum (Bleisch) D.G. Mann | 1206 | 1.42 | 30.00 | 10.00 | 1178.10 |
| 1739 | LWC - 4 | 23-Sep-17 | 5857 | Nitzschia filiformis (W. Smith) Hustedt | 172 | 0.01 | 51.00 | 2.30 | 70.60 |
| 1739 | LWC - 4 | 23-Sep-17 | 5860 | Diatoma vulgare Bory | 22739 | 5.57 | 26.00 | 6.00 | 245.00 |
| 1739 | LWC - 4 | 23-Sep-17 | 5865 | Cymbella prostrata (Berkeley) Cleve | 172 | 2.91 | 89.00 | 22.00 | 16915.90 |
| 1739 | LWC - 4 | 23-Sep-17 | 5871 | Cymbella lapponica | 689 | 1.70 | 94.00 | 10.00 | 2460.90 |
| 1739 | LWC - 4 | 23-Sep-17 | 5873 | Gomphonema minutum | 345 | 0.15 | 26.00 | 8.00 | 435.60 |
| 1739 | LWC - 4 | 23-Sep-17 | 5882 | Anomoenies vitrea Ross | 345 | 0.11 | 33.00 | 6.00 | 311.00 |
| 1739 | LWC - 4 | 23-Sep-17 | 5916 | Fragilaria capucina Grunow | 12920 | 7.58 | 140.00 | 4.00 | 586.40 |
| 1739 | LWC - 4 | 23-Sep-17 | 5917 | Hannaea arcus Patrick | 345 | 0.21 | 64.00 | 6.00 | 603.20 |
| 1739 | LWC - 4 | 23-Sep-17 | 5986 | Meridion circulare Agardh | 689 | 0.74 | 41.00 | 10.00 | 1073.40 |
| 1739 | LWC - 5 | 23-Sep-17 | 1077 | Pseudoanabaena sp. | 3445 | 0.03 | 2.10 | 2.10 | 7.30 |
| 1739 | LWC - 5 | 23-Sep-17 | 2511 | Ulothrix zonata Kutzing | 2153 | 27.06 | 40.00 | 20.00 | 12566.40 |
| 1739 | LWC - 5 | 23-Sep-17 | 5702 | Achnanthes minutissima Kutzing | 8398 | 0.67 | 19.00 | 4.00 | 79.60 |
| 1739 | LWC - 5 | 23-Sep-17 | 5726 | Eucocconeis sp. | 215 | 0.99 | 40.00 | 21.00 | 4618.10 |
| 1739 | LWC - 5 | 23-Sep-17 | 5836 | Encyonema silesiacum (Bleisch) D.G. Mann | 1723 | 2.03 | 30.00 | 10.00 | 1178.10 |
| 1739 | LWC - 5 | 23-Sep-17 | 5857 | Nitzschia filiformis (W. Smith) Hustedt | 1077 | 0.08 | 51.00 | 2.30 | 70.60 |
| 1739 | LWC - 5 | 23-Sep-17 | 5860 | Diatoma vulgare Bory | 29716 | 7.00 | 25.00 | 6.00 | 235.60 |
| 1739 | LWC - 5 | 23-Sep-17 | 5873 | Gomphonema minutum | 215 | 0.09 | 26.00 | 8.00 | 435.60 |
| 1739 | LWC - 5 | 23-Sep-17 | 5874 | Nitzschia palea (Kutzing) W. Smith | 1292 | 3.08 | 91.00 | 10.00 | 2382.40 |
| 1739 | LWC - 5 | 23-Sep-17 | 5875 | Cocconies disculus Schum. | 431 | 0.69 | 31.00 | 14.00 | 1590.70 |
| 1739 | LWC - 5 | 23-Sep-17 | 5910 | Navicula exigua (Greg.) Muller | 646 | 0.31 | 29.00 | 8.00 | 485.90 |
| 1739 | LWC - 5 | 23-Sep-17 | 5916 | Fragilaria capucina Grunow | 11843 | 15.74 | 141.00 | 6.00 | 1328.90 |

APPENDIX E
BENTHIC INVERTEBRATE COMMUNITY DATA

Figures and Tables

Laboratory Reports

APPENDIX E
BENTHIC INVERTEBRATE COMMUNITY DATA

Figures and Tables

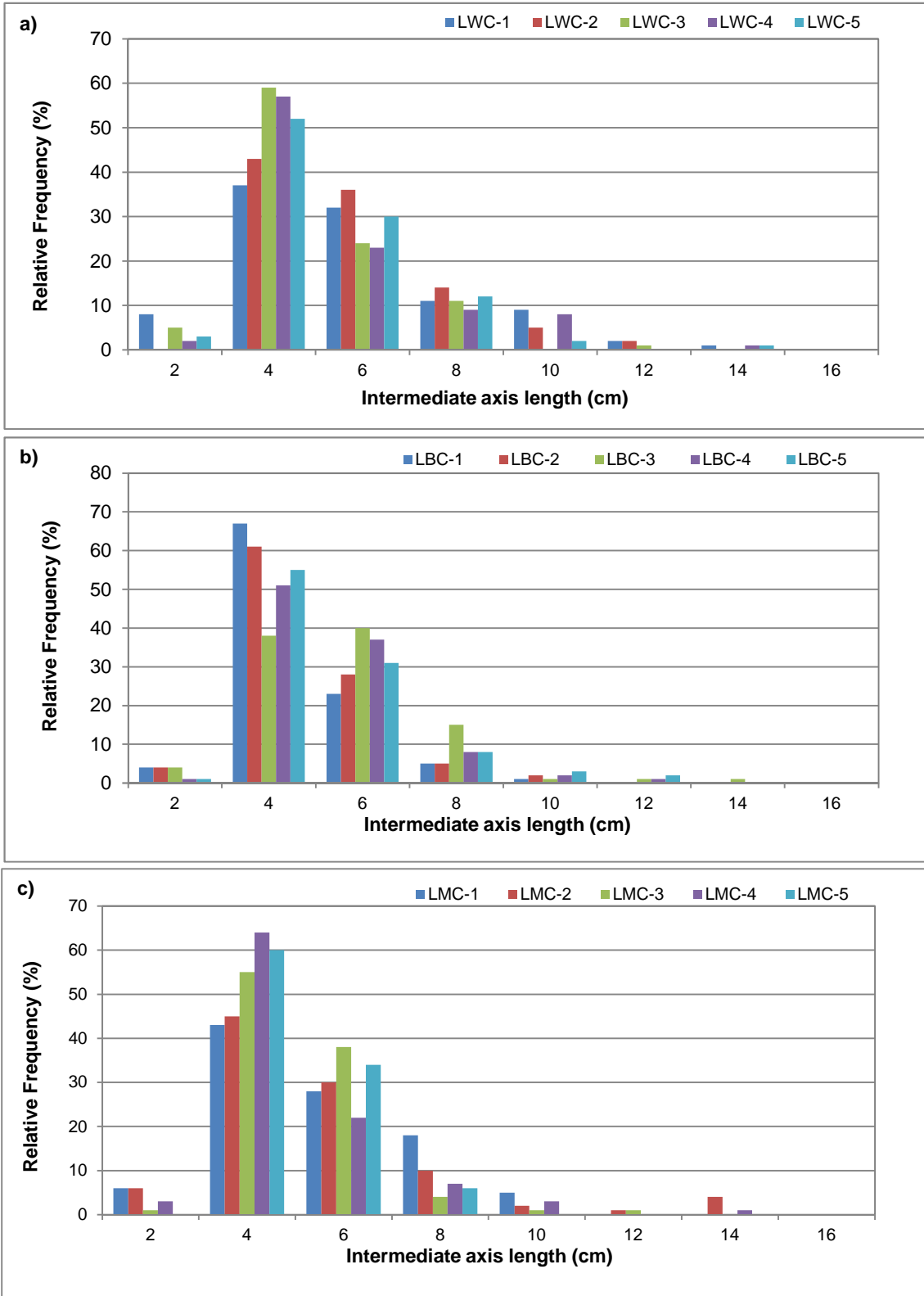


Figure E.1: Intermediate Axis Length of 100 Rocks Measured at Five Benthic Stations in a) Lower Wolverine Creek, b) Lower Big Creek, and c) Lower Minto Creek

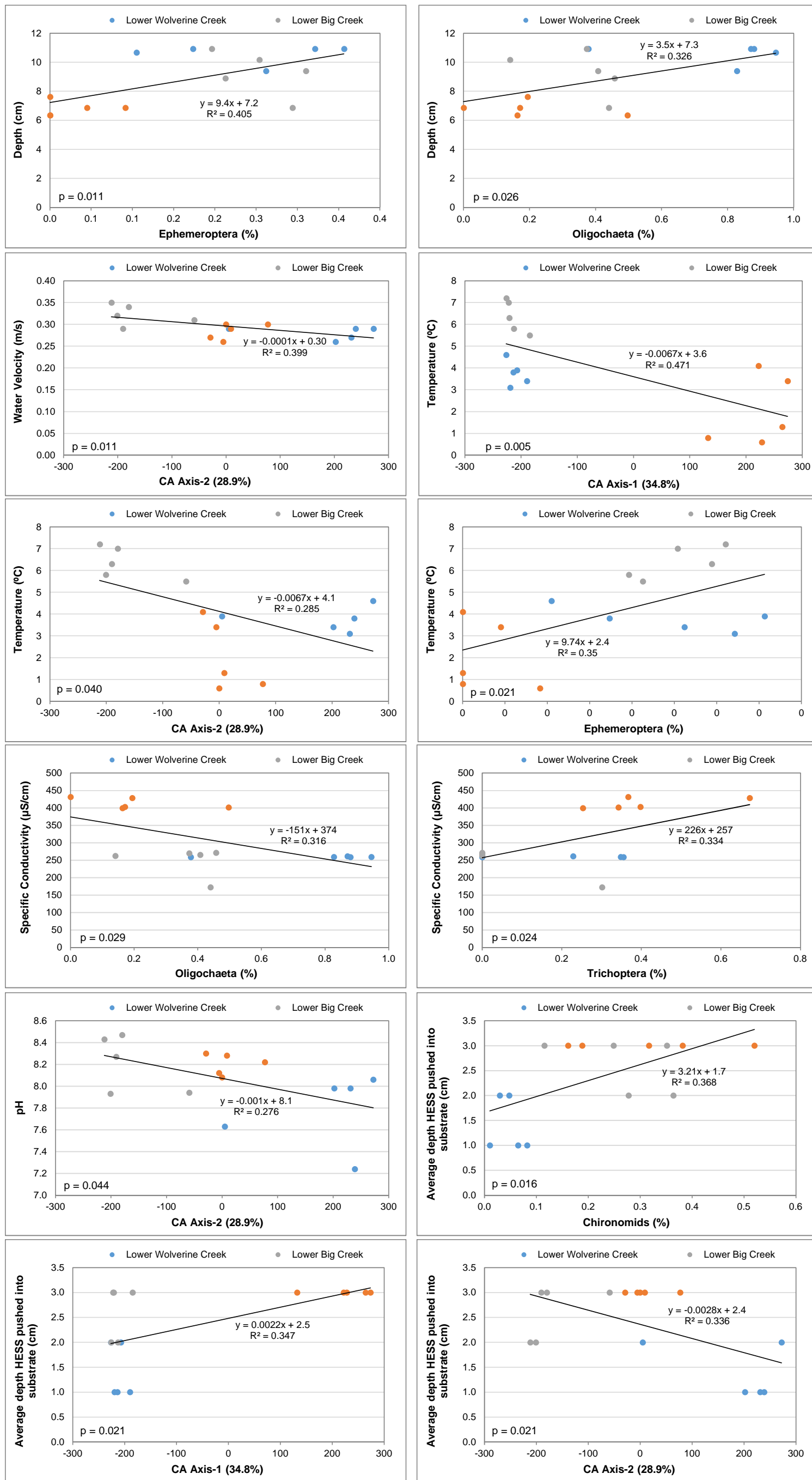


Figure E.2: Scatterplots of Relationships ($p < 0.050$) between Selected Benthic Invertebrate Environmental Measurements and Biological Endpoints, Minto Mine WUL, 2017

Table E.1: Benthic Invertebrates (Organisms per Sample) Collected by Hess Sampler and Screened Through a 500 µm Sieve, Minto Mine WUL, 2017

| Invertebrate | Lower Wolverine Creek (Reference) | | | | | Lower Big Creek (Reference) | | | | | Lower Minto Creek (Exposed) | | | | |
|-------------------------------|--------------------------------------|-------|-------|-------|-------|--------------------------------|-------|-------|-------|-------|--------------------------------|-------|-------|-------|-------|
| | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 | LBC-1 | LBC-2 | LBC-3 | LBC-4 | LBC-5 | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 |
| Phylum: Arthropoda | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Order: Collembola | - | - | - | - | - | - | - | - | - | 3 | - | - | 1 | 1 | 1 |
| Family: Hypogastruridae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| Family: Onychiuridae | - | - | - | - | - | - | - | - | - | - | 20 | 2 | - | - | - |
| Subphylum: Hexapoda | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Class: Insecta | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Order: Ephemeroptera | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Family: Ameletidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Ameletus</i> | - | - | - | - | - | 1 | 1 | 1 | 1 | - | - | - | 1 | - | - |
| Family: Baetidae | 1 | - | - | 3 | 1 | - | 1 | - | 5 | 3 | - | - | 3 | - | - |
| <i>Acentrella</i> | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - |
| <i>Baetis</i> | 1 | - | 1 | 1 | - | 4 | 8 | 5 | - | 3 | - | - | - | - | 1 |
| <i>Baetis tricaudatus</i> | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| Family: Ephemerellidae | 2 | - | - | 2 | - | - | - | 1 | 3 | - | - | - | - | - | - |
| <i>Drunella doddsii</i> | - | - | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| <i>Drunella spinifera</i> | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - |
| <i>Ephemerella</i> | 1 | - | - | - | 1 | - | - | 1 | 1 | - | - | - | - | - | - |
| <i>Ephemerella aurivillii</i> | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| Family: Heptageniidae | 5 | 5 | 1 | 1 | 7 | 8 | 6 | 13 | 3 | 2 | - | - | - | - | - |
| Order: Plecoptera | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Family: Capniidae | 4 | 4 | 4 | 17 | 20 | 69 | 44 | 115 | 144 | 71 | - | - | 7 | 8 | 7 |
| Family: Chloroperlidae | - | - | 1 | 5 | - | - | 2 | - | 7 | - | - | - | - | - | - |
| <i>Sweltsa</i> | - | - | - | - | - | - | - | 3 | 2 | - | - | - | - | - | - |
| Family: Nemouridae | - | 1 | - | - | - | 2 | - | - | - | 1 | 228 | 2 | 133 | 55 | 175 |
| <i>Nemoura</i> | 1 | 2 | - | 1 | 3 | - | - | 2 | 1 | 5 | 106 | 6 | 90 | 16 | 39 |
| <i>Zapada</i> | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - |
| <i>Zapada cinctipes</i> | - | - | - | 3 | 2 | - | - | 3 | - | - | - | - | - | - | - |
| Family: Perlodidae | 1 | - | - | 1 | 2 | - | - | - | - | - | - | - | - | - | 1 |
| <i>Cultus</i> | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| <i>Isoperla</i> | - | - | - | 7 | 9 | - | - | 1 | - | - | - | - | - | - | - |
| <i>Kogotus</i> | 1 | - | - | - | 4 | - | - | - | - | - | - | - | - | - | - |
| Family: Taeniopterygidae | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Taenionema</i> | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| Order: Trichoptera | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - |
| Family: Apataniidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Apatania</i> | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| Family: Glossosomatidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Glossosoma</i> | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| Family: Hydropsychidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Hydropsyche</i> | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| Family: Limnephilidae | - | - | 1 | - | - | - | - | 1 | - | - | 1 | - | 9 | 35 | 4 |
| <i>Dicosmoecus</i> | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 2 | 3 | 5 |
| <i>Ecclisomyia</i> | - | - | - | 1 | 1 | - | - | - | - | - | - | - | - | - | - |
| Family: Rhyacophilidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Rhyacophila</i> | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| Order: Diptera | - | - | - | - | 1 | - | - | - | 1 | - | 1 | 1 | - | - | - |

Notes: Dash represents zero taxa or no taxa identified to that taxonomic level.

Table E.1: Benthic Invertebrates (Organisms per Sample) Collected by Hess Sampler and Screened Through a 500 µm Sieve, Minto Mine WUL, 2017

| Invertebrate | Lower Wolverine Creek (Reference) | | | | | Lower Big Creek (Reference) | | | | | Lower Minto Creek (Exposed) | | | | |
|-------------------------------------|--------------------------------------|-------|-------|-------|-------|--------------------------------|-------|-------|-------|-------|--------------------------------|-------|-------|-------|-------|
| | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 | LBC-1 | LBC-2 | LBC-3 | LBC-4 | LBC-5 | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 |
| Family: Ceratopogonidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Culicoides</i> | - | - | - | - | - | - | - | - | - | - | - | - | 10 | 1 | 2 |
| <i>Monohelea</i> | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| Family: Chironomidae | 1 | 2 | 2 | 1 | 3 | 10 | 14 | 3 | 14 | 4 | - | - | - | - | - |
| Subfamily: Chironominae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Tribe: Chironomini | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Saetheria</i> | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| <i>Stictochironomus</i> | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - |
| Tribe: Tanytarsini | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Micropsectra</i> | - | - | - | - | 7 | - | - | - | 2 | 6 | 1 | - | 6 | 1 | 2 |
| <i>Rheotanytarsus</i> | - | - | - | - | - | 15 | 10 | 8 | 8 | 6 | - | - | - | - | - |
| <i>Stempellina</i> | - | - | - | - | 2 | 1 | - | 1 | - | - | - | - | - | - | - |
| Subfamily: Diamesinae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Tribe: Diamesini | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Diamesa</i> | - | - | - | - | - | 2 | 1 | 3 | 14 | - | - | - | - | - | - |
| <i>Pagastia</i> | - | - | - | - | - | 1 | - | 1 | - | - | - | - | - | - | - |
| <i>Pseudodiamesa</i> | - | - | - | 1 | 5 | - | - | - | - | - | 1 | - | 2 | - | - |
| Subfamily: Orthoclaadiinae | - | - | - | 1 | - | - | - | - | 1 | 1 | - | - | 6 | - | - |
| <i>Brillia</i> | - | 1 | - | - | - | - | - | 1 | - | 1 | 23 | 1 | 1 | - | - |
| <i>Cricotopus</i> | - | - | - | - | - | - | - | - | - | - | 15 | 4 | 2 | 9 | 101 |
| <i>Eukiefferiella</i> | - | - | - | - | - | - | - | 2 | 2 | 1 | 36 | 31 | 104 | 20 | 79 |
| <i>Heterotrissocladius</i> | - | - | - | - | 3 | - | - | - | - | - | - | - | - | - | - |
| <i>Hydrosmittia</i> | - | - | - | - | - | 2 | - | - | 1 | 1 | - | - | - | - | - |
| <i>Krenosmittia</i> | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| <i>Limnophyes</i> | - | - | - | - | - | 2 | - | - | 2 | - | 1 | 1 | 5 | 1 | 1 |
| <i>Metriocnemus</i> | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| <i>Orthocladus</i> | - | 2 | 6 | - | 1 | 34 | 41 | 9 | 41 | 16 | 1 | - | 7 | 2 | - |
| <i>Parakiefferiella</i> | - | - | - | - | - | 1 | - | - | - | 1 | - | - | 15 | 2 | 4 |
| <i>Paraphaenocladus</i> | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| <i>Pseudosmittia</i> | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - |
| <i>Rheocricotopus</i> | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| <i>Rheosmittia</i> | - | - | - | - | - | - | - | - | 5 | 4 | - | - | - | - | - |
| <i>Tvetenia</i> | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| Subfamily: Tanypodinae | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Tribe: Pentaneurini | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Thienemannimyia</i> group | - | - | - | - | 1 | 1 | 2 | - | - | 1 | - | - | 4 | - | - |
| Family: Empididae | - | 1 | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| <i>Chelifera/Metachela</i> | - | - | - | - | 1 | 1 | - | 2 | 3 | - | - | - | - | - | - |
| <i>Clinocera</i> | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| <i>Clinocerinae</i> Unknown Genus A | - | - | 3 | 3 | 3 | 1 | - | 1 | 1 | - | - | - | - | - | - |
| <i>Neoplasta</i> | - | - | 1 | 1 | 3 | 7 | - | 4 | - | 1 | 2 | 2 | 1 | - | 1 |
| <i>Trichoclinocera</i> | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| <i>Wiedemannia</i> | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| Family: Muscidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Limnophora</i> | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |

Notes: Dash represents zero taxa or no taxa identified to that taxonomic level.

Table E.1: Benthic Invertebrates (Organisms per Sample) Collected by Hess Sampler and Screened Through a 500 µm Sieve, Minto Mine WUL, 2017

| Invertebrate | Lower Wolverine Creek (Reference) | | | | | Lower Big Creek (Reference) | | | | | Lower Minto Creek (Exposed) | | | | |
|---|--------------------------------------|-----------|------------|-----------|------------|--------------------------------|------------|------------|------------|------------|--------------------------------|-----------|------------|------------|------------|
| | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 | LBC-1 | LBC-2 | LBC-3 | LBC-4 | LBC-5 | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 |
| Family: Psychodidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Pericoma/Telmatoscopus</i> | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| Family: Simuliidae | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Prosimulium/Helodon</i> | - | - | - | - | - | - | 1 | 1 | - | - | - | - | - | - | - |
| Family: Stratiomyidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Nemotelus</i> | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| Family: Tipulidae | - | - | - | 1 | - | - | - | - | - | - | - | - | 2 | 1 | 1 |
| <i>Antocha</i> | - | - | - | - | - | - | 1 | - | - | - | 3 | - | 1 | 1 | 1 |
| <i>Dicranota</i> | 1 | 1 | - | 1 | 2 | 1 | - | 1 | 9 | 2 | 4 | - | 19 | 11 | 15 |
| <i>Hesperoconopa</i> | - | - | 1 | 1 | - | - | - | - | 7 | - | - | - | - | - | - |
| <i>Rhabdomastix</i> | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Tipula</i> | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| Order: Hemiptera | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| Order: Lepidoptera | - | - | 1 | - | 1 | - | - | 2 | - | - | - | - | - | - | - |
| Order: Hymenoptera | - | 1 | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| Subphylum: Chelicerata | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Class: Arachnida | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Order: Trombidiformes | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Family: Feltriidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Feltria</i> | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| Family: Hygrobatidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Atractides</i> | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - |
| <i>Hygrobates</i> | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Family: Lebertiidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Lebertia</i> | 1 | - | - | - | 1 | 4 | 1 | - | 1 | - | - | - | - | - | - |
| Family: Sperchontidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Sperchon</i> | - | - | - | - | - | - | 2 | - | - | - | 21 | 3 | 26 | 11 | 49 |
| Order: Sarcopiformes | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Order: Oribatida | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| Phylum: Mollusca | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Class: Bivalvia | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Order: Veneroidea | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Family: Pisidiidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Pisidium</i> | 1 | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| Phylum: Annelida | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Subphylum: Clitellata | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Class: Oligochaeta | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Order: Lumbriculida | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Family: Lumbriculidae | 75 | 50 | 244 | 9 | 277 | 4 | 30 | 43 | 33 | 37 | 13 | 18 | 14 | 5 | - |
| <i>Rhynchelmis</i> | - | - | - | - | - | - | 1 | 4 | 14 | - | - | - | - | 2 | - |
| Order: Tubificida | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Family: Enchytraeidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Enchytraeus</i> | - | - | - | - | - | 1 | 16 | 3 | - | - | - | - | - | - | - |
| Family: Naididae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| <i>Nais</i> | - | - | - | - | - | 25 | 2 | 7 | 7 | 4 | - | - | - | - | - |
| Subfamily: Tubificinae with hair chaetae | - | 1 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| Subfamily: Tubificinae without hair chaetae | - | - | - | - | - | 1 | - | - | - | - | 10 | - | - | - | 4 |
| Totals: | 97 | 73 | 273 | 63 | 368 | 202 | 187 | 243 | 338 | 177 | 490 | 73 | 480 | 186 | 498 |

Notes: Dash represents zero taxa or no taxa identified to that taxonomic level.

Table E.2: Benthic Invertebrate Community Metrics by Station for Samples Collected by Hess Sampler, Minto Mine WUL, 2017

| Area | Station | Density (organisms/m ²) | Number of Taxa | BC Distance to LWC Median | BC Distance to LBC Median | BC Distance to Combined Reference Median | Simpson's Diversity ^a | Simpson's Evenness ^a | Ephemeroptera (%) | Plecoptera (%) | Trichoptera (%) | EPT (%) | Chironomids (%) | Oligochaeta (%) | CA Axis-1 (34.8%) | CA Axis-2 (28.9%) |
|-----------------------------------|---------|-------------------------------------|----------------|---------------------------|---------------------------|--|----------------------------------|---------------------------------|-------------------|----------------|-----------------|---------|-----------------|-----------------|-------------------|-------------------|
| Lower Wolverine Creek (Reference) | LWC-1 | 97 | 13 | 0.91 | 0.90 | 0.89 | 0.40 | 0.13 | 10 | 7.2 | 0 | 18 | 1.0 | 77 | -220 | 231 |
| | LWC-2 | 73 | 12 | 0.89 | 0.89 | 0.80 | 0.52 | 0.17 | 6.8 | 9.6 | 0 | 16 | 8.2 | 68 | -190 | 202 |
| | LWC-3 | 273 | 16 | 0.94 | 0.93 | 0.90 | 0.20 | 0.078 | 1.1 | 2.6 | 1.5 | 5.1 | 2.9 | 89 | -227 | 272 |
| | LWC-4 | 63 | 16 | 0.90 | 0.79 | 0.65 | 0.87 | 0.48 | 13 | 56 | 1.6 | 70 | 4.8 | 14 | -207 | 4.7 |
| | LWC-5 | 366 | 25 | 0.92 | 0.88 | 0.86 | 0.42 | 0.069 | 3.0 | 11 | 0.27 | 14 | 6.5 | 76 | -214 | 239 |
| Lower Big Creek (Reference) | LBC-1 | 202 | 26 | 0.94 | 0.24 | 0.66 | 0.82 | 0.21 | 6.4 | 36 | 0 | 42 | 35 | 2.0 | -222 | -180 |
| | LBC-2 | 187 | 19 | 0.96 | 0.23 | 0.67 | 0.83 | 0.30 | 9.6 | 25 | 0 | 34 | 36 | 17 | -226 | -212 |
| | LBC-3 | 243 | 27 | 0.95 | 0.30 | 0.70 | 0.73 | 0.14 | 8.6 | 51 | 0.82 | 60 | 12 | 19 | -221 | -191 |
| | LBC-4 | 338 | 27 | 0.93 | 0.34 | 0.76 | 0.77 | 0.16 | 3.8 | 46 | 0 | 49 | 28 | 14 | -213 | -201 |
| | LBC-5 | 177 | 22 | 0.87 | 0.37 | 0.56 | 0.78 | 0.21 | 4.5 | 44 | 0 | 48 | 25 | 21 | -185 | -59 |
| Lower Minto Creek (Exposed) | LMC-1 | 490 | 17 | 0.26 | 0.98 | 0.89 | 0.52 | 0.12 | 0 | 68 | 0.41 | 69 | 16 | 2.7 | 264 | 8.5 |
| | LMC-2 | 73 | 11 | 0.68 | 0.98 | 0.63 | 0.73 | 0.34 | 0 | 11 | 1.4 | 12 | 52 | 25 | 132 | 77 |
| | LMC-3 | 480 | 28 | 0.20 | 0.94 | 0.83 | 0.73 | 0.13 | 0.83 | 48 | 2.5 | 51 | 32 | 2.9 | 228 | -0.39 |
| | LMC-4 | 186 | 16 | 0.43 | 0.89 | 0.70 | 0.79 | 0.29 | 0 | 42 | 20 | 63 | 19 | 3.8 | 222 | -29 |
| | LMC-5 | 498 | 20 | 0.24 | 0.96 | 0.87 | 0.74 | 0.19 | 0.20 | 45 | 1.8 | 47 | 38 | 0 | 274 | -5.7 |

^a Calculated as recommended by Environment Canada 2012.

Table E.3: Statistical Comparisons of Benthic Invertebrate Community Characteristics Among Areas, Minto Mine WUL, 2017

| Endpoint | Overall 3-group Comparison | | | Post-hoc comparisons | | | Observed Effect Size (Group 1 - Group 2) /SD pooled |
|--|----------------------------|----------------|--------------|----------------------|---------|--------------|---|
| | Data Transformation | Test | Test p-value | Groups | | Test P-value | |
| | | | | Group 1 | Group 2 | | |
| Density (Individuals/m ²) | none | ANOVA | 0.208 | LMC | LWC | - | 1.3 |
| | | | | | LBC | - | 0.86 |
| | | | | LWC | LBC | - | 0.41 |
| Number of Taxa | none | ANOVA | 0.080 | LMC | LWC | 0.813 | 0.42 |
| | | | | | LBC | 0.213 | -1.2 |
| | | | | LWC | LBC | 0.078 | 1.6 |
| EPT (%) | none | ANOVA | 0.161 | LMC | LWC | - | 1.3 |
| | | | | | LBC | - | 0.079 |
| | | | | LWC | LBC | - | 1.2 |
| Chironomids (%) | none | ANOVA | 0.003 | LMC | LWC | 0.004 | 2.8 |
| | | | | | LBC | 0.800 | 0.44 |
| | | | | LWC | LBC | 0.013 | 2.3 |
| Oligochaeta (%) | square root | ANOVA | 0.001 | LMC | LWC | 0.001 | -3.4 |
| | | | | | LBC | 0.389 | -0.93 |
| | | | | LWC | LBC | 0.010 | -2.4 |
| BC Distance to LWC Median | - | Kruskal-Wallis | 0.006 | LMC | LWC | 0.028 | - |
| | | | | | LBC | 0.002 | - |
| | | | | LWC | LBC | 0.358 | - |
| BC Distance to LBC Median | none | ANOVA | <0.001 | LMC | LWC | 0.105 | 1.5 |
| | | | | | LBC | <0.001 | 13 |
| | | | | LWC | LBC | <0.001 | -12 |
| BC Distance to Combined Reference Median | none | ANOVA | 0.077 | LMC | LWC | 0.847 | -0.4 |
| | | | | | LBC | 0.192 | 1.3 |
| | | | | LWC | LBC | 0.078 | -1.7 |
| Simpson's Diversity | - | Kruskal-Wallis | 0.105 | LMC | LWC | - | - |
| | | | | | LBC | - | - |
| | | | | LWC | LBC | - | - |
| Simpson's Evenness | log | ANOVA | 0.555 | LMC | LWC | - | 0.67 |
| | | | | | LBC | - | 0.022 |
| | | | | LWC | LBC | - | 0.65 |
| CA Axis-1 (34.8%) | - | Kruskal-Wallis | 0.009 | LMC | LWC | 0.011 | - |
| | | | | | LBC | 0.006 | - |
| | | | | LWC | LBC | 0.832 | - |
| CA Axis-2 (28.9%) | none | ANOVA | <0.001 | LMC | LWC | 0.007 | -2.6 |
| | | | | | LBC | 0.007 | 2.6 |
| | | | | LWC | LBC | <0.001 | -5.2 |

Highlighted values indicate significance at the $p < 0.10$ level.

Effect size magnitude > 2 relative to both reference areas.


Note: Observed effect size = (group 1 mean - group 2 mean)/pooled standard deviation.

Table E.4: Correspondence Analysis Axes Results and Station Scores Using Benthic Invertebrate Abundances at the Lowest Practical Level of Taxonomic Resolution

| | CA Axis-1 (34.8%) | CA Axis-2 (28.9%) |
|-----------------------------|-------------------|-------------------|
| Eigenvalue | 0.843 | 0.700 |
| Relative Inertia (%) | 34.8 | 28.9 |
| Monte Carlo p-value | 0.001 | 0.001 |
| LWC-1 | -220 | 231 |
| LWC-2 | -190 | 202 |
| LWC-3 | -227 | 272 |
| LWC-4 | -207 | 4.7 |
| LWC-5 | -214 | 239 |
| LBC-1 | -222 | -180 |
| LBC-2 | -226 | -212 |
| LBC-3 | -221 | -191 |
| LBC-4 | -213 | -201 |
| LBC-5 | -185 | -59 |
| LMC-1 | 264 | 8.5 |
| LMC-2 | 132 | 77 |
| LMC-3 | 228 | -0.39 |
| LMC-4 | 222 | -29 |
| LMC-5 | 274 | -5.7 |

Table E.5: Pearson Correlation of Station Correspondence Analysis (CA) Axes Scores with Benthic Taxa

| Invertebrate | CA Axis-1 (34.8%) | | CA Axis-2 (28.9%) | |
|---|-------------------|---------|-------------------|---------|
| | Pearson r-value | p-value | Pearson r-value | p-value |
| <i>Collembola</i> | 0.094 | 0.740 | -0.136 | 0.629 |
| <i>Ameletus</i> | -0.217 | 0.436 | -0.735 | 0.002 |
| <i>Baetis</i> | -0.496 | 0.060 | -0.535 | 0.040 |
| <i>Ephemerella</i> | -0.345 | 0.208 | -0.194 | 0.489 |
| <i>Heptageniidae</i> | -0.650 | 0.009 | -0.258 | 0.353 |
| <i>Capniidae</i> | -0.475 | 0.074 | -0.705 | 0.003 |
| <i>Chloroperlidae</i> | -0.289 | 0.297 | -0.067 | 0.813 |
| <i>Nemoura</i> | 0.829 | 0.000 | -0.033 | 0.907 |
| <i>Zapada cinctipes</i> | -0.336 | 0.220 | -0.056 | 0.844 |
| <i>Isoperla</i> | -0.286 | 0.301 | 0.281 | 0.311 |
| <i>Dicosmoecus</i> | 0.601 | 0.018 | -0.073 | 0.796 |
| <i>Culicoides</i> | 0.502 | 0.056 | -0.030 | 0.916 |
| <i>Micropsectra</i> | 0.087 | 0.759 | 0.122 | 0.666 |
| <i>Rheotanytarsus</i> | -0.471 | 0.077 | -0.766 | 0.001 |
| <i>Stempellina</i> | -0.334 | 0.223 | 0.058 | 0.836 |
| <i>Diamesa</i> | -0.271 | 0.328 | -0.492 | 0.063 |
| <i>Pseudodiamesa</i> | -0.033 | 0.908 | 0.358 | 0.190 |
| <i>Subfamily Orthocladiinae</i> | 0.265 | 0.339 | -0.109 | 0.698 |
| <i>Brillia</i> | 0.432 | 0.108 | 0.000 | 1.000 |
| <i>Cricotopus</i> | 0.556 | 0.031 | -0.029 | 0.918 |
| <i>Eukiefferiella</i> | 0.828 | 0.000 | -0.029 | 0.919 |
| <i>Hydrosmittia</i> | -0.321 | 0.244 | -0.481 | 0.069 |
| <i>Limnophyes</i> | 0.457 | 0.086 | -0.302 | 0.273 |
| <i>Orthocladius</i> | -0.432 | 0.108 | -0.694 | 0.004 |
| <i>Parakiefferiella</i> | 0.517 | 0.049 | -0.067 | 0.814 |
| <i>Thienemannimyia group</i> | 0.082 | 0.771 | -0.228 | 0.414 |
| <i>Chelifera/Metachela</i> | -0.380 | 0.162 | -0.464 | 0.081 |
| <i>Clinocerinae Unknown Genus A</i> | -0.492 | 0.062 | 0.306 | 0.267 |
| <i>Neoplasta</i> | -0.148 | 0.598 | -0.253 | 0.363 |
| <i>Antocha</i> | 0.717 | 0.003 | -0.151 | 0.592 |
| <i>Dicranota</i> | 0.692 | 0.004 | -0.166 | 0.555 |
| <i>Hesperoconopa</i> | -0.254 | 0.362 | -0.290 | 0.294 |
| <i>Lepidoptera</i> | -0.343 | 0.210 | 0.064 | 0.821 |
| <i>Lebertia</i> | -0.384 | 0.158 | -0.302 | 0.274 |
| <i>Sperchon</i> | 0.813 | 0.000 | -0.054 | 0.848 |
| <i>Lumbriculidae</i> | -0.342 | 0.212 | 0.731 | 0.002 |
| <i>Rhynchelmis</i> | -0.323 | 0.240 | -0.653 | 0.008 |
| <i>Enchytraeus</i> | -0.254 | 0.361 | -0.451 | 0.091 |
| <i>Nais</i> | -0.341 | 0.214 | -0.545 | 0.036 |
| <i>Tubificinae without hair chaetae</i> | 0.555 | 0.032 | -0.043 | 0.878 |

 Indicates absolute r-values > 0.50.

 Indicates p-value < 0.05.

Table E.6: Intermediate Axis Length and Embeddedness of 100 Rocks Washed during Hess Sampling at Benthic Invertebrate Stations, Minto Mine WUL, 2017

| Rock Number | Lower Wolverine Creek (Reference) | | | | | | | | | |
|----------------|--------------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|
| | LWC-1 | | LWC-2 | | LWC-3 | | LWC-4 | | LWC-5 | |
| | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) |
| 1 | 11.7 | | 7.0 | | 4.2 | | 8.2 | | 13.7 | |
| 2 | 8.2 | | 4.0 | | 5.8 | | 9.0 | | 3.5 | |
| 3 | 5.2 | | 4.2 | | 5.0 | | 4.2 | | 4.2 | |
| 4 | 12.7 | | 3.6 | | 7.5 | | 9.1 | | 4.7 | |
| 5 | 4.5 | | 7.1 | | 7.6 | | 7.2 | | 8.1 | |
| 6 | 7.2 | | 9.8 | | 3.9 | | 3.7 | | 5.0 | |
| 7 | 2.7 | | 5.0 | | 5.3 | | 6.7 | | 4.5 | |
| 8 | 3.9 | | 4.1 | | 3.7 | | 4.3 | | 7.3 | |
| 9 | 4.0 | | 11.2 | | 6.4 | | 6.3 | | 2.6 | |
| 10 | 8.2 | 0 | 5.3 | 0 | 7.0 | 0 | 4.5 | 0 | 7.2 | 0 |
| 11 | 9.3 | | 5.2 | | 5.4 | | 3.2 | | 5.1 | |
| 12 | 5.4 | | 4.8 | | 4.1 | | 2.5 | | 4.2 | |
| 13 | 7.3 | | 4.6 | | 3.4 | | 2.0 | | 6.0 | |
| 14 | 3.4 | | 4.2 | | 5.4 | | 3.0 | | 4.1 | |
| 15 | 3.6 | | 4.7 | | 4.0 | | 10.0 | | 7.1 | |
| 16 | 4.4 | | 5.0 | | 3.2 | | 2.4 | | 4.5 | |
| 17 | 4.6 | | 7.4 | | 2.2 | | 2.6 | | 3.1 | |
| 18 | 2.3 | | 5.1 | | 4.5 | | 2.2 | | 5.0 | |
| 19 | 3.5 | | 5.8 | | 2.0 | | 3.4 | | 5.2 | |
| 20 | 4.4 | 25 | 10.1 | 25 | 2.6 | 50 | 4.8 | 0 | 6.5 | 0 |
| 21 | 3.0 | | 5.0 | | 2.1 | | 3.7 | | 4.7 | |
| 22 | 4.2 | | 5.7 | | 2.4 | | 5.5 | | 9.1 | |
| 23 | 5.0 | | 6.2 | | 3.2 | | 2.2 | | 5.1 | |
| 24 | 8.6 | | 4.3 | | 3.0 | | 5.7 | | 7.0 | |
| 25 | 3.7 | | 3.2 | | 2.3 | | 3.6 | | 4.4 | |
| 26 | 3.3 | | 3.0 | | 2.0 | | 2.8 | | 7.2 | |
| 27 | 3.5 | | 3.9 | | 3.0 | | 3.3 | | 2.4 | |
| 28 | 5.6 | | 2.8 | | 3.6 | | 3.5 | | 2.9 | |
| 29 | 4.2 | | 4.1 | | 4.1 | | 4.5 | | 3.1 | |
| 30 | 4.6 | 50 | 2.2 | 50 | 2.3 | 0 | 6.6 | 0 | 2.5 | 50 |
| 31 | 4.6 | | 8.0 | | 3.8 | | 4.4 | | 4.0 | |
| 32 | 6.7 | | 4.9 | | 5.2 | | 3.7 | | 4.0 | |
| 33 | 4.9 | | 6.6 | | 4.1 | | 12.1 | | 4.7 | |
| 34 | 2.5 | | 4.6 | | 2.3 | | 3.6 | | 6.6 | |
| 35 | 1.9 | | 6.0 | | 3.2 | | 3.5 | | 3.9 | |
| 36 | 3.3 | | 4.3 | | 3.0 | | 2.1 | | 3.5 | |
| 37 | 7.4 | | 3.7 | | 2.3 | | 2.3 | | 3.9 | |
| 38 | 3.2 | | 4.8 | | 3.7 | | 2.6 | | 3.4 | |
| 39 | 3.5 | | 5.3 | | 10.4 | | 3.0 | | 2.1 | |
| 40 | 5.5 | 0 | 2.2 | 0 | 4.2 | 25 | 3.7 | 0 | 3.5 | 0 |
| 41 | 3.8 | | 8.2 | | 6.2 | | 2.4 | | 7.5 | |
| 42 | 2.4 | | 4.2 | | 3.3 | | 7.0 | | 4.7 | |
| 43 | 4.1 | | 3.8 | | 7.4 | | 2.5 | | 7.3 | |
| 44 | 2.8 | | 3.6 | | 6.7 | | 3.0 | | 3.2 | |
| 45 | 8.1 | | 5.2 | | 4.3 | | 2.7 | | 4.6 | |
| 46 | 4.5 | | 5.6 | | 6.5 | | 4.6 | | 3.0 | |
| 47 | 5.0 | | 6.5 | | 3.1 | | 4.1 | | 5.1 | |
| 48 | 6.0 | | 3.1 | | 4.6 | | 3.1 | | 6.1 | |
| 49 | 8.8 | | 2.3 | | 4.1 | | 1.9 | | 7.2 | |
| 50 | 2.0 | 0 | 6.8 | | 7.2 | 0 | 9.7 | 25 | 4.3 | 0 |
| 51 | 10.1 | | 9.7 | | 3.4 | | 2.8 | | 4.5 | |
| 52 | 6.6 | | 7.1 | | 4.9 | | 2.2 | | 5.9 | |
| 53 | 4.8 | | 3.2 | | 2.1 | | 5.3 | | 3.6 | |
| 54 | 5.6 | | 2.1 | | 3.4 | | 2.8 | | 3.2 | |
| 55 | 1.9 | | 3.8 | | 1.9 | | 7.5 | | 2.4 | |
| 56 | 2.1 | | 9.7 | | 5.2 | | 7.5 | | 3.3 | |
| 57 | 1.9 | | 2.6 | | 2.9 | | 3.5 | | 2.7 | |
| 58 | 2.8 | | 6.6 | | 2.7 | | 5.0 | | 3.2 | |
| 59 | 3.7 | | 3.2 | | 3.6 | | 7.2 | | 6.6 | |
| 60 | 5.5 | 25 | 3.8 | 0 | 3.1 | 25 | 3.0 | 0 | 6.0 | 25 |
| 61 | 3.7 | | 6.7 | | 2.3 | | 4.2 | | 4.4 | |
| 62 | 3.6 | | 4.6 | | 2.5 | | 3.2 | | 5.4 | |
| 63 | 3.8 | | 5.9 | | 3.2 | | 2.6 | | 5.1 | |
| 64 | 2.2 | | 7.8 | | 2.0 | | 2.3 | | 4.6 | |
| 65 | 4.5 | | 5.3 | | 2.0 | | 2.5 | | 5.5 | |
| 66 | 2.0 | | 4.9 | | 3.2 | | 2.5 | | 5.5 | |
| 67 | 3.6 | | 4.9 | | 2.7 | | 2.5 | | 3.0 | |
| 68 | 1.9 | | 5.0 | | 3.0 | | 6.9 | | 3.8 | |
| 69 | 2.0 | | 7.7 | | 2.9 | | 3.2 | | 3.0 | |
| 70 | 3.7 | 25 | 6.9 | 25 | 4.2 | 75 | 4.2 | 0 | 3.8 | 0 |
| 71 | 4.5 | | 3.1 | | 4.0 | | 3.3 | | 3.1 | |
| 72 | 2.2 | | 2.3 | | 5.1 | | 4.0 | | 3.9 | |
| 73 | 3.1 | | 4.0 | | 3.7 | | 4.0 | | 4.6 | |
| 74 | 2.2 | | 3.5 | | 5.4 | | 2.1 | | 3.6 | |
| 75 | 1.9 | | 3.2 | | 2.7 | | 8.1 | | 2.0 | |
| 76 | 8.3 | | 2.7 | | 3.0 | | 9.1 | | 2.1 | |
| 77 | 6.7 | | 2.5 | | 4.7 | | 5.5 | | 2.7 | |
| 78 | 5.0 | | 4.3 | | 3.8 | | 5.8 | | 2.5 | |
| 79 | 7.6 | | 5.2 | | 2.8 | | 4.6 | | 3.6 | |
| 80 | 4.9 | 0 | 9.7 | 0 | 3.4 | 0 | 3.7 | 25 | 2.6 | 0 |
| 81 | 2.3 | | 2.7 | | 3.0 | | 8.5 | | 3.5 | |
| 82 | 5.0 | | 4.6 | | 6.6 | | 5.1 | | 2.8 | |
| 83 | 6.8 | | 3.3 | | 4.2 | | 2.1 | | 2.6 | |
| 84 | 10.0 | | 3.4 | | 2.3 | | 2.9 | | 2.8 | |
| 85 | 6.6 | | 3.3 | | 3.0 | | 6.0 | | 2.7 | |
| 86 | 2.2 | | 3.5 | | 2.7 | | 4.0 | | 3.9 | |
| 87 | 8.6 | | 2.7 | | 3.6 | | 3.3 | | 2.6 | |
| 88 | 5.1 | | 3.6 | | 2.2 | | 2.3 | | 2.0 | |
| 89 | 5.6 | | 4.8 | | 4.1 | | 5.8 | | 2.3 | |
| 90 | 6.2 | 0 | 2.5 | 25 | 2.6 | 0 | 3.1 | 0 | 2.5 | 25 |
| 91 | 5.6 | | 3.3 | | 2.9 | | 3.0 | | 2.0 | |
| 92 | 5.1 | | 4.5 | | 6.7 | | 3.3 | | 3.5 | |
| 93 | 4.3 | | 3.7 | | 5.0 | | 4.1 | | 3.0 | |
| 94 | 4.2 | | 3.0 | | 3.3 | | 2.9 | | 3.0 | |
| 95 | 2.5 | | 3.0 | | 2.9 | | 3.9 | | 5.0 | |
| 96 | 2.5 | | 3.7 | | 3.8 | | 3.5 | | 2.5 | |
| 97 | 3.6 | | 3.4 | | 2.9 | | 3.3 | | 3.2 | |
| 98 | 3.0 | | 3.3 | | 2.6 | | 4.7 | | 2.6 | |
| 99 | 6.6 | | 3.3 | | 3.1 | | 3.5 | | 3.3 | |
| 100 | 3.8 | 25 | 4.0 | 25 | 2.2 | 0 | 4.7 | 0 | 2.6 | 25 |
| Minimum | 1.9 | | 2.1 | | 1.9 | | 1.9 | | 2.0 | |
| Maximum | 12.7 | | 11.2 | | 10.4 | | 12.1 | | 13.7 | |
| Mean | 4.8 | | 4.8 | | 3.9 | | 4.3 | | 4.3 | |
| Geometric mean | 4.3 | | 4.5 | | 3.6 | | 3.9 | | 4.0 | |
| Median | 4.4 | 13 | 4.3 | 25 | 3.4 | 0 | 3.7 | 0 | 3.9 | 0 |

Note: intermediate axis length is the second longest axis on a rock. Embeddedness refers to how deeply the rock is surrounded or buried by other substrate.

Table E.6: Intermediate Axis Length and Embeddedness of 100 Rocks Washed during Hess Sampling at Benthic Invertebrate Stations, Minto Mine WUL, 2017

| Rock Number | Lower Big Creek (Reference) | | | | | | | | | |
|----------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|
| | LBC-1 | | LBC-2 | | LBC-3 | | LBC-4 | | LBC-5 | |
| | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) |
| 1 | 6.9 | | 7.0 | | 7.0 | | 5.2 | | 7.1 | |
| 2 | 7.3 | | 5.7 | | 4.9 | | 4.4 | | 5.5 | |
| 3 | 8.9 | | 5.6 | | 2.1 | | 3.0 | | 5.3 | |
| 4 | 2.6 | | 5.9 | | 6.9 | | 3.3 | | 3.5 | |
| 5 | 2.4 | | 4.5 | | 4.2 | | 2.6 | | 5.0 | |
| 6 | 5.8 | | 4.9 | | 2.6 | | 4.1 | | 4.2 | |
| 7 | 5.5 | | 5.4 | | 6.5 | | 5.0 | | 3.5 | |
| 8 | 3.9 | | 3.6 | | 6.4 | | 2.1 | | 3.6 | |
| 9 | 2.0 | | 8.2 | | 3.7 | | 2.6 | | 7.4 | |
| 10 | 3.6 | 0 | 2.3 | 25 | 5.4 | 0 | 3.0 | 0 | 3.5 | 0 |
| 11 | 5.2 | | 3.3 | | 13.3 | | 4.4 | | 3.8 | |
| 12 | 3.3 | | 5.2 | | 6.7 | | 3.6 | | 5.2 | |
| 13 | 4.4 | | 2.0 | | 4.3 | | 4.1 | | 3.5 | |
| 14 | 2.0 | | 2.6 | | 6.0 | | 5.1 | | 9.3 | |
| 15 | 5.0 | | 3.7 | | 3.5 | | 5.1 | | 3.2 | |
| 16 | 3.7 | | 8.5 | | 6.0 | | 3.6 | | 4.3 | |
| 17 | 4.0 | | 4.6 | | 5.6 | | 2.7 | | 4.2 | |
| 18 | 3.4 | | 2.6 | | 2.7 | | 6.5 | | 4.3 | |
| 19 | 3.1 | | 2.2 | | 2.7 | | 4.7 | | 3.2 | |
| 20 | 3.7 | 50 | 2.7 | 25 | 6.6 | 0 | 4.6 | 50 | 3.5 | 25 |
| 21 | 6.7 | | 6.0 | | 4.3 | | 5.2 | | 2.9 | |
| 22 | 3.1 | | 3.9 | | 7.4 | | 2.7 | | 3.4 | |
| 23 | 3.5 | | 3.3 | | 8.9 | | 4.1 | | 2.2 | |
| 24 | 2.5 | | 3.1 | | 5.7 | | 2.5 | | 4.4 | |
| 25 | 5.2 | | 2.9 | | 4.7 | | 2.5 | | 3.8 | |
| 26 | 3.6 | | 4.3 | | 3.7 | | 10.1 | | 2.0 | |
| 27 | 2.2 | | 3.6 | | 3.0 | | 5.0 | | 3.6 | |
| 28 | 5.2 | | 3.8 | | 4.6 | | 2.3 | | 2.4 | |
| 29 | 2.9 | | 5.5 | | 3.2 | | 4.5 | | 2.8 | |
| 30 | 7.9 | 25 | 2.0 | 0 | 5.2 | 25 | 3.0 | 0 | 2.3 | 25 |
| 31 | 3.3 | | 5.0 | | 4.5 | | 2.6 | | 4.5 | |
| 32 | 4.5 | | 5.2 | | 5.5 | | 2.5 | | 4.2 | |
| 33 | 3.6 | | 2.5 | | 7.7 | | 3.1 | | 6.2 | |
| 34 | 3.7 | | 3.1 | | 5.0 | | 3.8 | | 5.6 | |
| 35 | 3.0 | | 4.5 | | 5.1 | | 2.6 | | 10.4 | |
| 36 | 3.1 | | 3.6 | | 5.0 | | 5.3 | | 2.7 | |
| 37 | 3.5 | | 4.2 | | 7.4 | | 2.5 | | 6.5 | |
| 38 | 3.2 | | 3.5 | | 2.6 | | 3.8 | | 4.8 | |
| 39 | 6.6 | | 3.1 | | 4.1 | | 5.4 | | 7.6 | |
| 40 | 3.2 | 0 | 3.3 | 0 | 3.4 | 0 | 4.5 | 25 | 5.8 | 0 |
| 41 | 3.3 | | 4.3 | | 5.2 | | 4.2 | | 3.2 | |
| 42 | 4.2 | | 5.5 | | 4.3 | | 5.1 | | 5.0 | |
| 43 | 3.4 | | 2.8 | | 4.8 | | 5.0 | | 4.2 | |
| 44 | 5.0 | | 3.1 | | 2.7 | | 2.8 | | 3.2 | |
| 45 | 3.5 | | 2.6 | | 6.1 | | 4.0 | | 5.5 | |
| 46 | 2.8 | | 5.3 | | 4.5 | | 3.0 | | 3.3 | |
| 47 | 3.1 | | 3.6 | | 2.8 | | 3.0 | | 4.1 | |
| 48 | 3.7 | | 4.8 | | 2.1 | | 2.8 | | 3.3 | |
| 49 | 4.9 | | 7.8 | | 4.3 | | 2.6 | | 2.3 | |
| 50 | 3.1 | | 2.9 | 25 | 4.0 | 0 | 9.9 | 0 | 4.1 | 0 |
| 51 | 2.6 | | 3.0 | | 3.5 | | 3.9 | | 10.1 | |
| 52 | 3.5 | | 4.0 | | 2.5 | | 4.2 | | 5.5 | |
| 53 | 3.6 | | 3.8 | | 2.2 | | 3.1 | | 6.9 | |
| 54 | 4.5 | | 4.2 | | 6.2 | | 2.7 | | 3.1 | |
| 55 | 4.5 | | 5.0 | | 4.2 | | 2.9 | | 5.8 | |
| 56 | 4.9 | | 2.5 | | 2.7 | | 3.7 | | 8.5 | |
| 57 | 3.1 | | 4.5 | | 5.4 | | 2.7 | | 4.1 | |
| 58 | 4.9 | | 3.0 | | 5.6 | | 3.1 | | 2.2 | |
| 59 | 2.6 | | 2.5 | | 7.0 | | 4.0 | | 3.4 | |
| 60 | 5.3 | 0 | 2.5 | 25 | 5.0 | 50 | 3.8 | 0 | 5.5 | 25 |
| 61 | 3.0 | | 2.6 | | 5.6 | | 3.5 | | 3.0 | |
| 62 | 3.4 | | 2.7 | | 5.1 | | 7.1 | | 3.8 | |
| 63 | 4.5 | | 3.6 | | 4.2 | | 6.2 | | 4.7 | |
| 64 | 3.0 | | 3.5 | | 5.7 | | 2.8 | | 4.1 | |
| 65 | 5.1 | | 6.2 | | 3.0 | | 3.5 | | 3.6 | |
| 66 | 1.3 | | 3.9 | | 7.6 | | 6.2 | | 2.6 | |
| 67 | 3.7 | | 3.6 | | 5.3 | | 9.3 | | 2.9 | |
| 68 | 2.1 | | 3.0 | | 5.1 | | 7.6 | | 2.6 | |
| 69 | 2.8 | | 3.6 | | 4.2 | | 3.7 | | 4.9 | |
| 70 | 2.7 | 0 | 3.5 | 0 | 3.4 | 0 | 2.8 | 25 | 2.3 | 25 |
| 71 | 3.1 | | 2.8 | | 6.2 | | 1.9 | | 8.5 | |
| 72 | 4.1 | | 3.7 | | 5.6 | | 3.5 | | 3.9 | |
| 73 | 5.1 | | 3.0 | | 2.2 | | 7.7 | | 2.8 | |
| 74 | 3.0 | | 2.5 | | 3.4 | | 4.0 | | 3.3 | |
| 75 | 3.9 | | 2.5 | | 2.6 | | 7.0 | | 2.9 | |
| 76 | 4.2 | | 3.2 | | 4.7 | | 3.1 | | 3.2 | |
| 77 | 2.8 | | 2.3 | | 3.0 | | 3.3 | | 2.7 | |
| 78 | 2.6 | | 5.0 | | 6.0 | | 5.1 | | 2.6 | |
| 79 | 2.5 | | 3.2 | | 2.0 | | 2.6 | | 2.8 | |
| 80 | 3.3 | 25 | 3.2 | 0 | 2.4 | 0 | 5.2 | 0 | 2.6 | 0 |
| 81 | 2.4 | | 2.7 | | 2.4 | | 6.5 | | 2.5 | |
| 82 | 3.0 | | 3.3 | | 1.9 | | 3.1 | | 4.0 | |
| 83 | 2.0 | | 3.1 | | 2.0 | | 4.6 | | 2.5 | |
| 84 | 4.0 | | 5.5 | | 3.1 | | 5.5 | | 2.5 | |
| 85 | 4.2 | | 2.0 | | 4.3 | | 4.3 | | 2.2 | |
| 86 | 3.3 | | 3.4 | | 3.5 | | 4.9 | | 4.7 | |
| 87 | 2.6 | | 2.0 | | 2.2 | | 5.8 | | 4.6 | |
| 88 | 3.0 | | 2.9 | | 6.2 | | 3.5 | | 6.5 | |
| 89 | 2.4 | | 2.6 | | 2.0 | | 3.5 | | 6.1 | |
| 90 | 2.5 | 0 | 3.2 | 25 | 3.2 | 0 | 3.1 | 0 | 3.6 | 0 |
| 91 | 2.2 | | 4.7 | | 4.0 | | 4.2 | | 3.3 | |
| 92 | 3.3 | | 3.9 | | 3.4 | | 5.2 | | 5.6 | |
| 93 | 3.5 | | 6.5 | | 3.5 | | 4.4 | | 4.5 | |
| 94 | 2.6 | | 4.7 | | 3.1 | | 4.6 | | 2.3 | |
| 95 | 2.6 | | 2.5 | | 3.3 | | 4.4 | | 4.3 | |
| 96 | 4.4 | | 4.1 | | 10.5 | | 4.5 | | 2.3 | |
| 97 | 2.7 | | 3.8 | | 4.5 | | 4.5 | | 2.8 | |
| 98 | 2.7 | | 2.4 | | 5.5 | | 4.8 | | 2.7 | |
| 99 | 3.4 | | 5.0 | | 3.7 | | 3.7 | | 2.7 | |
| 100 | 2.7 | 50 | 6.4 | 50 | 3.6 | 25 | 4.1 | 50 | 2.8 | 0 |
| Minimum | 1.3 | | 2.0 | | 1.9 | | 1.9 | | 2.0 | |
| Maximum | 8.9 | | 8.5 | | 13.3 | | 10.1 | | 10.4 | |
| Mean | 3.7 | | 3.9 | | 4.6 | | 4.2 | | 4.2 | |
| Geometric mean | 3.5 | | 3.7 | | 4.2 | | 3.9 | | 3.9 | |
| Median | 3.4 | 0 | 3.6 | 25 | 4.3 | 0 | 4.0 | 0 | 3.6 | 0 |

Note: intermediate axis length is the second longest axis on a rock. Embeddedness refers to how deeply the rock is surrounded or buried by other substrate.

Table E.6: Intermediate Axis Length and Embeddedness of 100 Rocks Washed during Hess Sampling at Benthic Invertebrate Stations, Minto Mine WUL, 2017

| Rock Number | Lower Minto Creek (Exposed) | | | | | | | | | |
|----------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|-------------------------------|------------------|
| | LMC-1 | | LMC-2 | | LMC-3 | | LMC-4 | | LMC-5 | |
| | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) | Intermediate Axis Length (cm) | Embeddedness (%) |
| 1 | 8.0 | | 16.9 | | 5.8 | | 12.2 | | 2.9 | |
| 2 | 4.7 | | 13.2 | | 3.3 | | 7.2 | | 3.4 | |
| 3 | 3.3 | | 7.4 | | 4.8 | | 3.0 | | 3.5 | |
| 4 | 6.7 | | 10.6 | | 7.0 | | 4.5 | | 5.1 | |
| 5 | 3.6 | | 5.5 | | 7.1 | | 4.3 | | 3.6 | |
| 6 | 5.0 | | 5.1 | | 3.4 | | 4.2 | | 6.2 | |
| 7 | 8.0 | | 3.9 | | 3.8 | | 4.0 | | 3.7 | |
| 8 | 8.1 | | 3.1 | | 4.9 | | 3.0 | | 4.8 | |
| 9 | 2.5 | | 13.8 | | 4.9 | | 3.7 | | 4.7 | |
| 10 | 6.6 | 25 | 5.5 | 0 | 2.4 | 0 | 3.3 | 0 | 2.2 | 0 |
| 11 | 3.9 | | 3.7 | | 3.9 | | 4.8 | | 2.7 | |
| 12 | 5.4 | | 4.0 | | 4.5 | | 3.8 | | 4.8 | |
| 13 | 4.7 | | 5.2 | | 7.1 | | 9.1 | | 6.1 | |
| 14 | 5.7 | | 5.6 | | 4.9 | | 2.6 | | 5.7 | |
| 15 | 3.1 | | 3.9 | | 6.0 | | 2.4 | | 4.6 | |
| 16 | 1.9 | | 3.0 | | 5.1 | | 5.7 | | 4.7 | |
| 17 | 3.2 | | 6.0 | | 2.5 | | 4.0 | | 4.9 | |
| 18 | 6.8 | | 4.2 | | 2.3 | | 1.9 | | 5.3 | |
| 19 | 3.4 | | 3.6 | | 2.9 | | 2.4 | | 5.7 | |
| 20 | 6.4 | 50 | 4.4 | 50 | 2.5 | 0 | 9.8 | 25 | 3.0 | 25 |
| 21 | 2.5 | | 3.3 | | 6.8 | | 3.6 | | 3.4 | |
| 22 | 3.5 | | 4.6 | | 4.9 | | 4.3 | | 3.1 | |
| 23 | 6.1 | | 2.4 | | 2.6 | | 3.1 | | 3.2 | |
| 24 | 7.5 | | 7.0 | | 3.6 | | 3.3 | | 5.2 | |
| 25 | 3.8 | | 3.1 | | 5.1 | | 7.3 | | 3.0 | |
| 26 | 3.5 | | 2.6 | | 3.9 | | 9.0 | | 4.7 | |
| 27 | 6.0 | | 7.0 | | 4.1 | | 4.3 | | 5.2 | |
| 28 | 5.1 | | 8.6 | | 2.8 | | 2.0 | | 4.4 | |
| 29 | 7.2 | | 4.1 | | 5.1 | | 3.7 | | 2.9 | |
| 30 | 4.2 | 0 | 8.2 | 0 | 3.6 | 0 | 4.0 | 25 | 7.5 | 0 |
| 31 | 3.4 | | 4.7 | | 5.4 | | 2.6 | | 3.9 | |
| 32 | 5.0 | | 6.3 | | 3.6 | | 6.2 | | 3.6 | |
| 33 | 5.7 | | 5.7 | | 3.3 | | 4.5 | | 5.5 | |
| 34 | 3.1 | | 5.2 | | 5.3 | | 3.5 | | 4.0 | |
| 35 | 4.1 | | 4.4 | | 10.2 | | 2.7 | | 5.3 | |
| 36 | 3.1 | | 1.9 | | 4.2 | | 3.5 | | 5.0 | |
| 37 | 7.1 | | 2.9 | | 2.0 | | 3.7 | | 3.5 | |
| 38 | 3.2 | | 2.3 | | 2.8 | | 2.0 | | 3.6 | |
| 39 | 2.5 | | 2.1 | | 3.7 | | 2.5 | | 4.8 | |
| 40 | 2.0 | 25 | 2.3 | 25 | 4.7 | 0 | 3.6 | 50 | 4.3 | 25 |
| 41 | 2.7 | | 3.8 | | 4.2 | | 2.8 | | 2.7 | |
| 42 | 4.2 | | 3.3 | | 4.6 | | 2.9 | | 5.3 | |
| 43 | 5.5 | | 4.2 | | 4.6 | | 6.0 | | 3.0 | |
| 44 | 4.2 | | 3.1 | | 5.7 | | 4.0 | | 5.7 | |
| 45 | 4.1 | | 2.6 | | 3.3 | | 2.9 | | 2.3 | |
| 46 | 8.9 | | 1.9 | | 3.7 | | 3.5 | | 3.2 | |
| 47 | 3.5 | | 3.9 | | 2.2 | | 2.6 | | 3.7 | |
| 48 | 7.1 | | 3.8 | | 3.6 | | 4.1 | | 8.0 | |
| 49 | 4.3 | | 3.5 | | 5.6 | | 7.9 | | 4.1 | |
| 50 | 2.0 | 25 | 3.5 | 25 | 3.5 | 25 | 2.5 | 50 | 2.6 | 25 |
| 51 | 4.0 | | 4.9 | | 4.0 | | 4.1 | | 4.1 | |
| 52 | 3.1 | | 3.0 | | 3.3 | | 3.2 | | 3.2 | |
| 53 | 4.9 | | 2.0 | | 3.8 | | 5.0 | | 3.2 | |
| 54 | 2.9 | | 4.2 | | 4.1 | | 3.0 | | 4.0 | |
| 55 | 4.7 | | 4.6 | | 4.5 | | 2.5 | | 4.5 | |
| 56 | 5.2 | | 5.2 | | 4.1 | | 4.0 | | 5.1 | |
| 57 | 7.1 | | 2.6 | | 5.6 | | 4.4 | | 3.1 | |
| 58 | 6.1 | | 3.8 | | 4.6 | | 3.1 | | 5.2 | |
| 59 | 4.0 | | 2.2 | | 2.4 | | 3.3 | | 4.0 | |
| 60 | 6.5 | 50 | 3.0 | 0 | 4.4 | 0 | 2.8 | 0 | 5.5 | 0 |
| 61 | 4.5 | | 3.2 | | 3.6 | | 2.6 | | 4.6 | |
| 62 | 3.9 | | 2.4 | | 3.0 | | 4.1 | | 4.0 | |
| 63 | 1.9 | | 4.6 | | 4.0 | | 3.3 | | 3.5 | |
| 64 | 6.3 | | 3.9 | | 2.6 | | 3.0 | | 3.6 | |
| 65 | 3.0 | | 2.6 | | 2.2 | | 4.5 | | 4.1 | |
| 66 | 7.5 | | 2.0 | | 2.2 | | 7.6 | | 3.6 | |
| 67 | 9.5 | | 1.9 | | 6.0 | | 6.2 | | 2.8 | |
| 68 | 4.8 | | 1.9 | | 8.8 | | 3.8 | | 2.7 | |
| 69 | 7.1 | | 3.1 | | 3.9 | | 2.2 | | 3.3 | |
| 70 | 3.4 | 25 | 3.9 | 25 | 3.4 | 25 | 3.5 | 50 | 5.2 | 25 |
| 71 | 3.2 | | 3.3 | | 5.4 | | 3.2 | | 4.2 | |
| 72 | 3.0 | | 2.6 | | 4.9 | | 3.4 | | 2.8 | |
| 73 | 3.1 | | 2.9 | | 4.3 | | 2.6 | | 3.7 | |
| 74 | 3.0 | | 3.2 | | 3.8 | | 3.2 | | 4.5 | |
| 75 | 3.6 | | 2.8 | | 4.7 | | 4.2 | | 3.1 | |
| 76 | 4.4 | | 3.7 | | 4.2 | | 3.0 | | 4.6 | |
| 77 | 8.7 | | 6.0 | | 2.6 | | 6.6 | | 4.0 | |
| 78 | 3.7 | | 3.5 | | 2.9 | | 3.7 | | 3.9 | |
| 79 | 4.4 | | 5.0 | | 4.1 | | 3.4 | | 3.1 | |
| 80 | 3.7 | 0 | 3.6 | 50 | 4.2 | 0 | 4.2 | 25 | 3.2 | 25 |
| 81 | 3.5 | | 5.1 | | 2.1 | | 5.4 | | 2.6 | |
| 82 | 2.9 | | 4.0 | | 2.9 | | 3.3 | | 3.5 | |
| 83 | 2.4 | | 4.1 | | 3.7 | | 4.0 | | 3.1 | |
| 84 | 2.7 | | 3.5 | | 4.0 | | 2.7 | | 3.4 | |
| 85 | 1.9 | | 5.5 | | 2.9 | | 3.3 | | 2.9 | |
| 86 | 1.9 | | 8.0 | | 4.3 | | 4.8 | | 3.5 | |
| 87 | 2.8 | | 6.5 | | 3.5 | | 3.0 | | 3.0 | |
| 88 | 5.4 | | 7.8 | | 4.0 | | 3.8 | | 3.7 | |
| 89 | 6.0 | | 6.0 | | 3.1 | | 5.3 | | 3.3 | |
| 90 | 3.8 | 0 | 6.0 | 25 | 3.2 | 50 | 4.4 | 25 | 3.4 | 25 |
| 91 | 3.4 | | 13.1 | | 3.5 | | 2.7 | | 2.5 | |
| 92 | 8.0 | | 12.5 | | 2.9 | | 2.8 | | 4.8 | |
| 93 | 5.4 | | 7.0 | | 2.4 | | 2.8 | | 2.8 | |
| 94 | 4.0 | | 5.1 | | 2.7 | | 3.7 | | 6.7 | |
| 95 | 8.2 | | 6.2 | | 4.7 | | 4.5 | | 3.7 | |
| 96 | 5.7 | | 4.8 | | 3.4 | | 3.7 | | 2.2 | |
| 97 | 5.0 | | 17.0 | | 4.0 | | 3.2 | | 4.0 | |
| 98 | 4.0 | | 6.3 | | 5.0 | | 2.9 | | 6.6 | |
| 99 | 4.0 | | 4.8 | | 3.1 | | 2.5 | | 2.9 | |
| 100 | 2.5 | 0 | 3.8 | 0 | 3.0 | 0 | 3.0 | 0 | 2.9 | 50 |
| Minimum | 1.9 | | 1.9 | | 2.0 | | 1.9 | | 2.2 | |
| Maximum | 9.5 | | 17.0 | | 10.2 | | 12.2 | | 8.0 | |
| Mean | 4.6 | | 4.9 | | 4.1 | | 4.0 | | 4.0 | |
| Geometric mean | 4.3 | | 4.3 | | 3.9 | | 3.7 | | 3.9 | |
| Median | 4.1 | 25 | 4.0 | 25 | 3.9 | 0 | 3.6 | 25 | 3.7 | 25 |

Note: intermediate axis length is the second longest axis on a rock. Embeddedness refers to how deeply the rock is surrounded or buried by other substrate.

APPENDIX E
BENTHIC INVERTEBRATE COMMUNITY DATA

Laboratory Reports

BENTHIC INVERTEBRATE COMMUNITY ANALYSIS

PROVIDED BY:

CORDILLERA CONSULTING

(SUMMERLAND, BC)

| Site: | LMC | LMC | LMC | LMC | LMC | LBC | LBC | LBC | LBC | LBC | LWC | LWC | LWC | LWC | LWC |
|--------------------------------|------------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|------------|-----------|------------|
| Sample: | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 | LBC-1 | LBC-2 | LBC-3 | LBC-4 | LBC-5 | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 |
| Sample Collection Date: | 26-Sep-17 | 26-Sep-17 | 26-Sep-17 | 21-Sep-17 | 21-Sep-17 | 22-Sep-17 | 22-Sep-17 | 22-Sep-17 | 22-Sep-17 | 22-Sep-17 | 24-Sep-17 | 24-Sep-17 | 23-Sep-17 | 23-Sep-17 | 23-Sep-17 |
| CC#: | CC181283 | CC181284 | CC181285 | CC181286 | CC181287 | CC181288 | CC181289 | CC181290 | CC181291 | CC181292 | CC181293 | CC181294 | CC181295 | CC181296 | CC181297 |
| Sieve Size: | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 |
| SubSample %: | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Class: Arachnida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Trombidiformes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Feltriidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Feltria</i> | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Hygrobatidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Atractides</i> | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Hygrobates</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Family: Lebertiidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Lebertia</i> | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| Family: Sperchontidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Sperchon</i> | 21 | 3 | 26 | 11 | 49 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Sarcoptiformes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Oribatida | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Phylum: Mollusca | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Bivalvia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Veneroida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Pisidiidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Pisidium</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| Phylum: Annelida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subphylum: Clitellata | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Oligochaeta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Lumbriculida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Lumbriculidae | 13 | 18 | 14 | 5 | 0 | 4 | 30 | 43 | 33 | 37 | 75 | 50 | 244 | 9 | 277 |
| <i>Rhynchelmis</i> | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 4 | 14 | 0 | 0 | 0 | 0 | 0 | 0 |
| Order: Tubificida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Enchytraeidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Enchytraeus</i> | 0 | 0 | 0 | 0 | 0 | 1 | 16 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Family: Naididae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Nais</i> | 0 | 0 | 0 | 0 | 0 | 25 | 2 | 7 | 7 | 4 | 0 | 0 | 0 | 0 | 0 |
| Subfamily: Tubificinae with ha | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Subfamily: Tubificinae without | 10 | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>All others</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals: | 490 | 73 | 480 | 186 | 498 | 202 | 187 | 243 | 339 | 177 | 97 | 73 | 273 | 63 | 368 |

| Site: | LMC | LMC | LMC | LMC | LMC | LBC | LBC | LBC | LBC | LBC | LWC | LWC | LWC | LWC | LWC |
|---------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Sample: | LMC-1 | LMC-2 | LMC-3 | LMC-4 | LMC-5 | LBC-1 | LBC-2 | LBC-3 | LBC-4 | LBC-5 | LWC-1 | LWC-2 | LWC-3 | LWC-4 | LWC-5 |
| Sample Collection Date: | 26-Sep-17 | 26-Sep-17 | 26-Sep-17 | 21-Sep-17 | 21-Sep-17 | 22-Sep-17 | 22-Sep-17 | 22-Sep-17 | 22-Sep-17 | 22-Sep-17 | 24-Sep-17 | 24-Sep-17 | 23-Sep-17 | 23-Sep-17 | 23-Sep-17 |
| CC#: | CC181283 | CC181284 | CC181285 | CC181286 | CC181287 | CC181288 | CC181289 | CC181290 | CC181291 | CC181292 | CC181293 | CC181294 | CC181295 | CC181296 | CC181297 |
| Sieve Size: | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 |
| SubSample %: | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Taxa present but not included: | | | | | | | | | | | | | | | |
| <i>Terrestrials</i> | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Phylum: Arthropoda | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subphylum: Crustacea | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Ostracoda | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Class: Maxillipoda | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Copepoda | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Phylum: Nemata | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| Phylum: Platyhelminthes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Class: Turbellaria | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals: | 3 | 1 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 2 |

Project: Minto WUL 2017

Minnow Environmental (BC), Lisa Bowron

Sue Salter

suesalter@cordilleraconsulting.ca

250-494-7553

Site - LBC, Sample - LBC-4, CC# - CC181291, Percent sampled = 100%, Sieve size = 500

| | | | |
|------------------------------|------------------|------------|----------------|
| Rheotanytarsus | Larvae | 8 | |
| Stictochironomus | Larvae | 2 | |
| Micropsectra | Larvae | 2 | |
| Chironomidae | Pupa | 14 | |
| Diptera | Pupa | 1 | |
| Eukiefferiella | Larvae | 2 | |
| Limnophyes | Larvae | 2 | |
| Orthoclaadiinae | Juvenile/Damaged | 1 | |
| Diamesa | Larvae | 14 | |
| Orthocladus | Larvae | 41 | |
| Rheosmittia | Larvae | 5 | |
| Tvetenia | Larvae | 1 | |
| Chelifera/ Metachela | Larvae | 3 | |
| Wiedemannia | Larvae | 1 | |
| Hesperoconopa | Larvae | 7 | |
| Dicranota | Larvae | 9 | |
| Ameletus | Larvae | 1 | |
| Baetidae | Juvenile/Damaged | 5 | |
| Heptageniidae | Juvenile/Damaged | 3 | |
| Ephemerellidae | Juvenile/Damaged | 3 | |
| Ephemerella | Larvae | 1 | |
| Sweltsa | Larvae | 2 | |
| Capniidae | Juvenile/Damaged | 144 | |
| Chloroperlidae | Juvenile/Damaged | 7 | |
| Lebertia | Adult | 1 | |
| Lumbriculidae | None | 33 | |
| Nemoura | Larvae | 1 | |
| All others | None | 1 | 1 fish present |
| Rhynchelmis | None | 14 | |
| Nais | None | 7 | |
| Pisidium | None | 1 | |
| Hydrosmittia | Larvae | 1 | |
| Clinocerinae Unknown Genus A | Larvae | 1 | |
| Total: | | 339 | |

Project: Minto WUL 2017

Minnow Environmental (BC), Lisa Bowron

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250-494-7553

Total Recovered Total from Sample Percent Efficiency

Site - QC, Sample - QC 1, CC# - CC181286, Percent sampled = 100%, Sieve size = 500

| | | | |
|----------------|----------|------------|------------|
| Trombidiformes | 1 | | |
| Total: | 1 | 186 | 99% |

Site - QC, Sample - QC 2, CC# - CC181294, Percent sampled = 100%, Sieve size = 500

| | | | |
|------------------------|----------|-----------|-------------|
| No Invertebrates Found | 0 | | |
| Total: | 0 | 73 | 100% |

Appendix L – Minto Creek Fish Monitoring Program Review and Recommendations



Minto Mine
Fisheries Monitoring Program
2017 Summary Report

January 2018

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1 Introduction

Minto Explorations Ltd. (MEL), a wholly owned subsidiary of Capstone Mining Corp., owns and operates the Minto Mine, a high-grade copper mine, located approximately 240 km northwest of Whitehorse, Yukon Territory (Figure 1). The project is located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R6A, and is centered at approximately 62°37'N latitude and 137°15'W longitude. The Minto Mine commenced commercial operation in October 2007 and is permitted to conduct mining and milling operations at a rate of 4,200 tonnes of ore per day (tpd). Some of the Minto ore deposits (copper/gold/silver) currently being mined are located in the upper reaches of the Minto Creek watershed approximately 12 km to the west of the Minto Creek confluence with the Yukon River (Figure 2). MEL is required, under the terms of its water use license #QZ14-031 (Amendment 1), to conduct an aquatic environmental monitoring program, of which, this fisheries monitoring program in Minto Creek is a component. This current report provides details of the monitoring conducted during the open water season in 2017 and the results of the work undertaken. This program was carried out under DFO Scientific Collection Licence number XR 154 2017.



Figure 1: Project Location

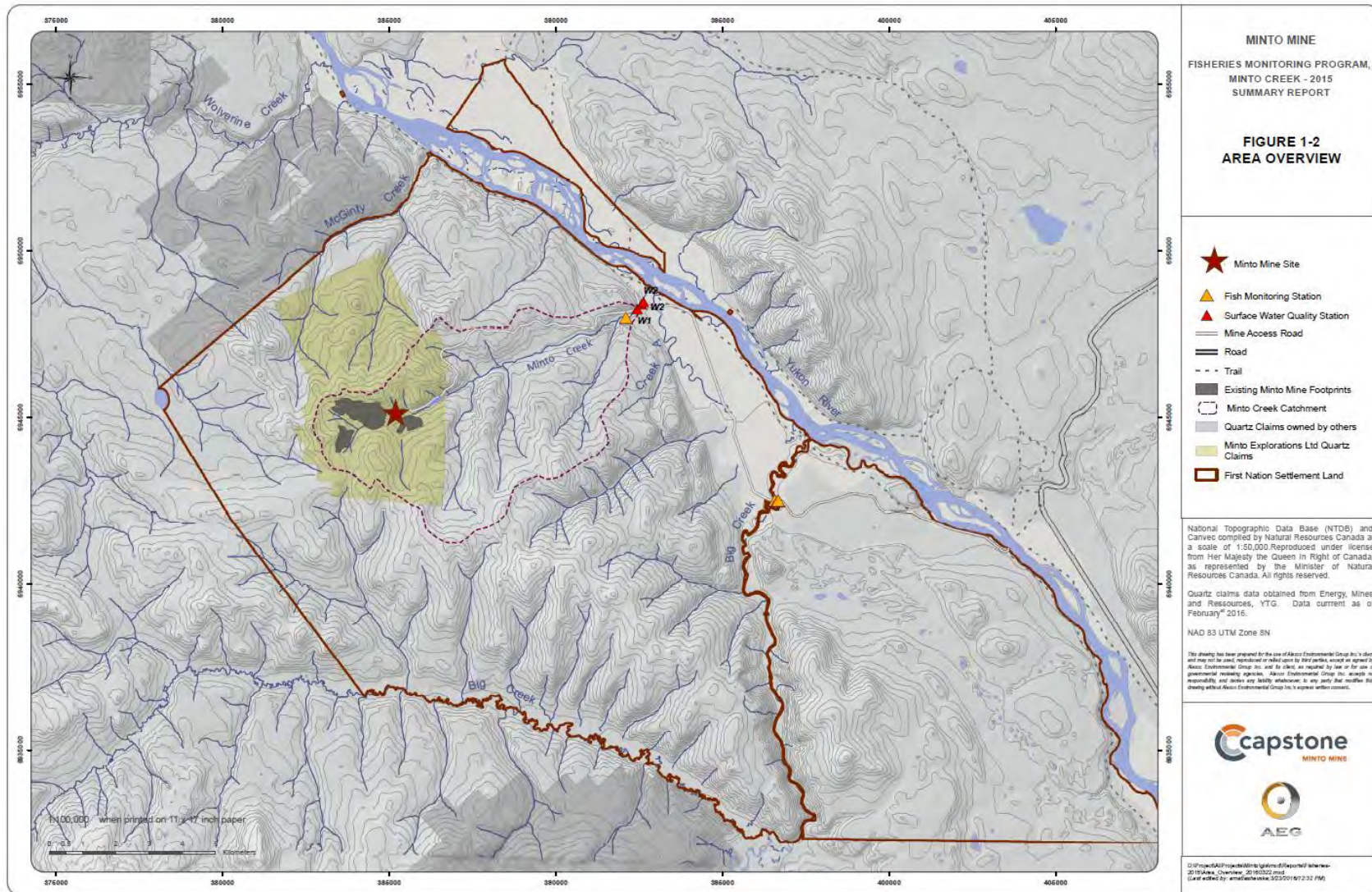


Figure 2: Project Overview

2 Previous Studies

Numerous studies on fisheries and fish habitat have been conducted over the recent history of the Minto Mine. These studies are summarized chronologically in Table 1, below.

Table 1: Minto Creek Fish Investigations

| Year | Months | Purpose of Study | Conducted by |
|-----------|------------------------------|---|-------------------------------------|
| 1994 | June, August, September | Baseline Collection | Hallam Knight Piesold (HKP) |
| 2006 | September | Baseline Collection | Access Consulting Group (ACG) |
| 2007 | May, June, August, September | Environmental Effects Monitoring Study Design Development | ACG / Minnow Environmental (Minnow) |
| 2008 | June, September | Environmental Effects Monitoring, Cycle I | ACG / Minnow |
| 2009 | June, July | Monitoring | ACG |
| 2009 | September, October | Fish Re-location | ACG |
| 2010 | June - October | Juvenile Chinook Salmon Mark-recapture program, compliance Monitoring | ACG |
| 2011 | July - October | Environmental Effects Monitoring Cycle II, Compliance Monitoring | ACG, Minnow |
| 2011 | July, August | EEM Cycle II – Growth Trials | ACG, Minnow |
| 2012 | May - September | Compliance Monitoring Se in tissue study | ACG, MEL (Minto Exploration Ltd.) |
| 2013-2015 | May - October | Compliance Monitoring | ACG/AEG, MEL |
| 2016 | June - September | Compliance Monitoring | MEL, AEG |
| 2017 | June – September | Compliance Monitoring | MEL |

Attempts to collect fish in lower Minto Creek while conducting the Phase 1 Metal Mining Effluent Regulation, Environmental Effects Monitoring (EEM) study in 2008 resulted in the capture of no fish during the month of June and very few fish during the month of September. This is consistent with the findings of previous fish investigations conducted in the creek (HKP 1994; R&D 2006, 2007). Fish use of Minto Creek is transient and likely short-lived, as has been found in other non-natal chinook rearing creeks (Walker 1976; Scrivener et al. 1994).

The majority of fish using the system are juvenile chinook salmon (*Onchoryhnchus tshawytscha*), as determined by the above investigations. Other species that have been found in the creek in low numbers include round whitefish (*Prosopium cylindraceum*), Arctic grayling (*Thymallus arcticus*), Slimy sculpin (*Cottus cognatus*) and Burbot (*Lota lota*). Of these, only slimy sculpin have been captured on a regular basis.

Juvenile chinook salmon (JCS) have never been encountered in the creek before July and their numbers tend to peak in late August or early September. Moreover, the mark-recapture investigation conducted in 2010 on JCS indicates that use of the creek is transient. The majority of JCS using the system stay in the creek for about two to three weeks or less.

A summary of past fish sampling results in Minto Creek is presented in Table 2.

Table 2: Summary of Fish captures in Minto Creek between 2008 and 2016

| Year | Method | Effort | Summary Statistics | Units | Juvenile Chinook Salmon | All Other Species |
|-------|----------------------------|------------|--------------------|----------|-------------------------|-------------------|
| 2008 | Backpack Electrofishing | 796 secs | Catch | # | 1 | 0 |
| | | | CPUE | Fish/min | 0.075 | 0 |
| | Baited Gee Minnow Trapping | 28.6 days | Catch | # | 18 | 0 |
| | | | CPUE | Fish/day | 0.63 | 0 |
| 2009* | Baited Gee Minnow Trapping | 28.6 days | Catch | # | 136 | 142 |
| | | | CPUE | Fish/day | 4.76 | 4.97 |
| 2010 | Baited Gee Minnow Trapping | 145.9 days | Catch | # | 2293 | 2307 |
| | | | CPUE | Fish/day | 15.72 | 15.81 |
| 2011 | Baited Gee Minnow Trapping | 71 days | Catch | # | 12 | 29 |
| | | | CPUE | Fish/day | 0.17 | 0.41 |
| 2012 | Backpack Electrofishing | 1051 secs | Catch | # | 0 | 4 |
| | | | CPUE | Fish/min | 0 | 0.23 |
| | Baited Gee Minnow Trapping | 43 days | Catch | # | 3 | 6 |
| | | | CPUE | Fish/day | 0.07 | 0.14 |
| 2013 | Backpack Electrofishing | 3402 secs | Catch | # | 0 | 4 |
| | | | CPUE | Fish/min | 0 | 0.07 |
| | Baited Gee Minnow Trapping | 62.5 days | Catch | # | 121 | 7 |
| | | | CPUE | Fish/day | 1.94 | 0.11 |
| 2014 | Baited Gee Minnow Trapping | 70.2 days | Catch | # | 151 | 3 |
| | | | CPUE | Fish/day | 2.15 | 0.04 |
| 2015 | Baited Gee Minnow Trapping | 67.3 days | Catch | # | 6 | 0 |
| | | | CPUE | Fish/day | 0.089 | 0 |
| 2016 | Baited Gee Minnow Trapping | 69.3 days | Catch | # | 6 | 0 |
| | | | CPUE | Fish/day | 0.086 | 0 |

JCS presence in Minto creek was observed to be influenced by mine water discharge. During non-discharge periods, and prior to operations (baseline), numbers of JCS and other species of fish in the system were found to be very low. In contrast, during the two major discharge events (2009 and 2010), numbers of JCS were 20 to 30 times higher in the system (see Table 3 below), indicating that they may have been attracted into the system as a likely result of a more consistent temperature and flow regime associated with mine water discharge. Numbers of other species of fish during discharge events did not increase. It is important to note however, that numbers of other species using the system has been consistently very low, prior to mine development and during operations.

Table 3: Maximum Catch per Unit Effort (CPUE) of Juvenile Chinook Salmon in Minto Creek using baited Minnow traps 1994-2017

| Year | Month | JCS – CPUE (#fish/trap-day)* | Minto Creek Conditions |
|------|-------------------|---------------------------------|---|
| 1994 | September | 0 | Pre-development – no discharge |
| 2008 | September | 0.9 | Operational – no discharge |
| 2009 | September/October | 20.0 | Discharge |
| 2010 | August | 30.0 | Discharge |
| 2011 | September | 0.43 | No discharge – high TSS contribution from tributary |
| 2012 | September | 0.19 | No discharge – high TSS contribution from tributary |
| 2013 | October | 5.01 | Operational – no discharge |
| 2014 | September | 5.05 | Operational – no discharge |
| 2015 | July | 0.30 | Operational – no discharge |
| 2016 | July | 0.30 | Operational – no discharge |
| 2017 | June-September | 0.00 | Discharge only during June trapping |

*CPUE calculated for actual 24-hr period (rather than nominal 24-hr period)

Minto Creek does not provide preferred spawning habitat for fish because it completely freezes during winter months with no flow in lower Minto Creek. Accordingly, there is no evidence of spawning in Minto Creek (HKP 1994; R&D 2006, 2007), nor is there traditional knowledge indicating spawning occurring in the system (HKP 1994). Lower Minto Creek is also subject to low or zero flow conditions during periods in the summer when a portion (or all) of the flow sometimes infiltrates the ground, preventing the establishment of resident fish populations in this section of the stream. A natural barrier to fish passage exists at approximately km 1.2 upstream in Minto Creek from the Yukon River, therefore limiting fish use upstream of the barrier. This barrier is largely comprised of organic debris and can be considered to be temporary as it will likely degrade over time, although it has been consistently observed since it was first characterized in 2010. Sampling effort has been applied upstream of the barrier during every sampling event since 2010 and resulted in no fish capture. New temporary barriers may also be established in any given year and could occur both upstream and further downstream of the current barrier location. The canyon located upstream of the current barrier however, is a permanent barrier to fish passage due to its high gradient, thus limiting fish habitat to the lower 2.0 km of the system.

Water temperatures tend to remain cooler in Minto Creek than in the Yukon River. This likely deters fish, in particular JCS, from entering the system until creek temperatures approach or equilibrate with the Yukon River. Minto Creek is subject to large diurnal fluctuations in temperature (up to 5°C or more) throughout the open water season. This daily variation is not ideal for fish and may limit their interest in using the creek for rearing.

Creek bottom substrate is comprised mostly of fines (silt/sand) with limited cobble/gravel sections which are more desirable for fish. In addition, significant input of suspended solids from a tributary in 2011 and 2012 may have further limited the use of the system by JCS during those years.

Bottom substrate at the mouth of Minto Creek and at the Yukon River confluence consists primarily of silt and mud which is not considered suitable substrate for salmonid spawning (grayling, salmon etc.). Aerial surveys for spawning fish were conducted in 2011, 2012, 2013 and 2014, and no adult fish were observed spawning in the vicinity of the Minto Creek/Yukon River confluence. No signs were present during the surveys that this area is used for spawning (such as redds or carcasses).

Starting in 2012, the compliance monitoring program included sampling efforts in Big Creek, which serves as a reference site. The same fish species as in Minto Creek were generally observed in Big Creek, and the CPUE has normally been slightly higher in Big Creek. Table 4 summarizes fish captures in Big Creek from 2012 to 2016.

Table 4: Summary of Fish captures in Big Creek in 2012 to 2016

| Year | Method | Effort | Summary Statistics | Units | Juvenile Chinook Salmon | All Other Species |
|------|----------------------------|-----------|--------------------|----------|-------------------------|-------------------|
| 2012 | Backpack Electrofishing | 273 secs | Catch | # | 1 | 23 |
| | | | CPUE | Fish/min | 0.22 | 5.05 |
| | Baited Gee Minnow Trapping | 11.8 days | Catch | # | 7 | 2 |
| | | | CPUE | Fish/day | 0.59 | 0.17 |
| 2013 | Backpack Electrofishing | 911 secs | Catch | # | 0 | 27 |
| | | | CPUE | Fish/min | 0 | 1.78 |
| | Baited Gee Minnow Trapping | 14.8 days | Catch | # | 19 | 2 |
| | | | CPUE | Fish/day | 1.28 | 0.14 |
| 2014 | Baited Gee Minnow Trapping | 16.4 days | Catch | # | 96 | 3 |
| | | | CPUE | Fish/day | 5.86 | 0.18 |
| 2015 | Baited Gee Minnow Trapping | 17.1 days | Catch | # | 58 | 5 |
| | | | CPUE | Fish/day | 3.39 | 0.15 |
| 2016 | Baited Gee Minnow Trapping | 22.2 | Catch | # | 51 | 11 |
| | | | CPUE | Fish/day | 2.30 | 0.49 |

3 Objectives

The objectives of the 2017 Fisheries Monitoring Program were to monitor, assess and characterize fish usage in Minto Creek during the open water season, and to provide data for the interpretation of the potential role and influence of the Minto Mine on the fish community. The 2017 fisheries program was a continuation of the previous year's components and targeted all species that have previously been encountered, as well as any new species. As part of the monitoring program since 2012, assessments at Big Creek were made concurrently with sampling in Minto Creek, to compare fish use in a neighboring system relative to Minto Creek. Fish monitoring studies were conducted in support of the requirements of Water Use License QZ14-031.

4 Methodology

4.1 Fish Monitoring

Fish monitoring of Minto Creek and Big Creek was conducted monthly during open water season, from June to September 2017, at trapping sites consistent with the 2010 mark-recapture study and the 2011 to 2016 fish monitoring programs (Figure 3). Capture effort included the use of Gee-type Minnow traps with 0.635 cm wire mesh size, baited with Yukon River origin chinook salmon roe. A total of 9 to 20 minnow traps were set during each sampling event in Minto Creek, depending on water levels and availability of pools and backwater areas. Four traps were set during each event in Big Creek, in the vicinity of the Minto access road bridge.

All fish captured were identified, enumerated and measured for fork length or total length (± 1 mm), inspected for abnormalities, and released in the vicinity of their trapping location. JCS were also weighed (± 0.01 g) prior to being released.

Additional supporting information collected included:

- photo-documentation of the creek,
- water level readings at station W1 staff gauge,
- in situ water parameters in Minto Creek, Big Creek and the Yukon River - temperature, dissolved oxygen, conductivity, pH, ORP,
- flow discharge measured at W1, and
- weather conditions at time of sampling.

Continuous temperature loggers (TidbiT) were deployed in the Yukon River and Big Creek for the duration of the project, however ice formation in early October on Big creek had removed the Tidbit from its location and it could not be recovered. A Levellogger recorded continuous temperature and stage in Minto Creek. Supporting variables also included monitoring of the previously identified fish barrier (1.2 km upstream of the Yukon River confluence) and/or any new barriers that may have developed.

Selected photographs documenting field activities and site conditions are presented in Appendix A.

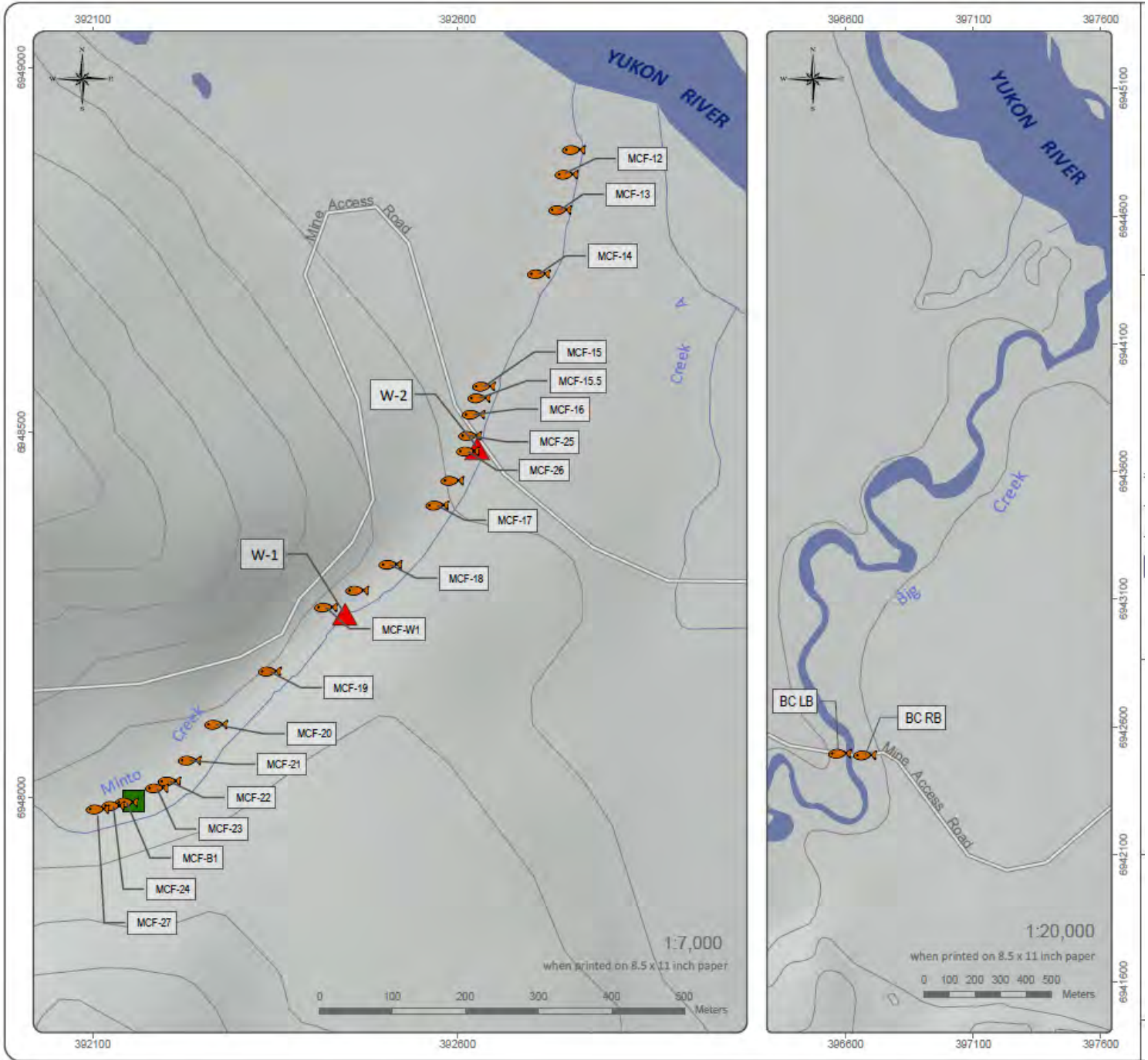


Figure 3: Minto Creek and Big Creek Fisheries Monitoring stations

5 Results

The following sections present the fisheries statistics and effort in Minto Creek and Big Creek between June and September 2017.

5.1 Fish Usage and Distribution

5.1.1 Minto Creek

Minto Creek was assessed monthly between June and September 2017. No fish were captured in Minto Creek in 2017. A portion of Minto Creek was found to be dry during the fish monitoring event in July and August 2017, which could have played an important role in preventing fish movement up and down Minto Creek. The following table (Table 5) presents the effort applied and the summary of fish capture in Minto Creek in 2017.

Table 5: Summary Statistics of Minnow Trapping in Minto Creek

| Month | Effort (trap-hours) | Effort(trap-days) | Juvenile Chinook Salmon (<i>Onchoryhnchus tshawytscha</i>) | |
|-----------|---------------------|-------------------|--|-------|
| | | | Results | CPUE* |
| June | 320 | 13.3 | 0 | 0 |
| July | 140 | 5.8 | 0 | 0 |
| August | 272.4 | 11.4 | 0 | 0 |
| September | 306.6 | 12.8 | 0 | 0 |
| Total | 1039 | 43.3 | 0 | 0 |

* CPUE = fish/trap-day (for actual 24-hr period)

5.1.2 Big Creek

Fisheries sampling effort in Big Creek was initiated in June, and conducted monthly until September, concurrent with sampling in Minto Creek, resulting in the capture of 35 fish, 27 of which were JCS. JCS were captured in all but the June sampling event in 2017, with highest numbers (11) captured in August. In addition, six (6) slimy sculpin and two (2) Burbot were captured during the 2017 sampling season.

The average catch per unit effort for JCS in Big Creek was 0.090 JCS/trap-day and was highest in August (0.165 JCS/trap-day). In comparison, the average JCS CPUE (June to September) in 2016 was higher at 0.747 JCS/trap-day and was as high as 1.288 JCS/trap-day in July 2016. The following table (Table 6) presents the effort undertaken and the resulting fish capture in Big Creek in 2017.

Due to unknown circumstances during the evening of the July 19th sampling session, 1 of the 6 JCS caught in Big Creek was dead upon retrieval (see Appendix A).

Table 6: Summary Statistics of Minnow Trapping in Big Creek in 2017

| Month | Effort (trap-hours) | Effort (trap-days) | Juvenile Chinook Salmon (<i>Onchoryhnchus tshawytscha</i>) | | Slimy Sculpin (<i>Cottus cognatus</i>) | | Burbot (<i>Lota lota</i>) | |
|-----------|---------------------|--------------------|--|-------|--|-------|-----------------------------|-------|
| | | | Results | CPUE* | Results | CPUE* | Results | CPUE* |
| June | 93 | 3.9 | 0 | 0 | 4 | 0.395 | 0 | 0 |
| July | 69 | 2.9 | 6** | 0.087 | 0 | 0 | 1 | 0.015 |
| August | 66.6 | 2.8 | 11 | 0.165 | 1 | 0.015 | 0 | 0 |
| September | 92.4 | 3.9 | 10 | 0.108 | 1 | 0.015 | 1 | 0.011 |
| Total | 320 | 13.5 | 27 | 0.084 | 6 | 0.019 | 2 | 0.006 |

*CPUE = fish/trap-day (for actual 24-hr period)

**One JCS found deceased upon trap retrieval

Figure 4 presents a comparison between monthly JCS capture and CPUE in Minto Creek and Big Creek for 2017.

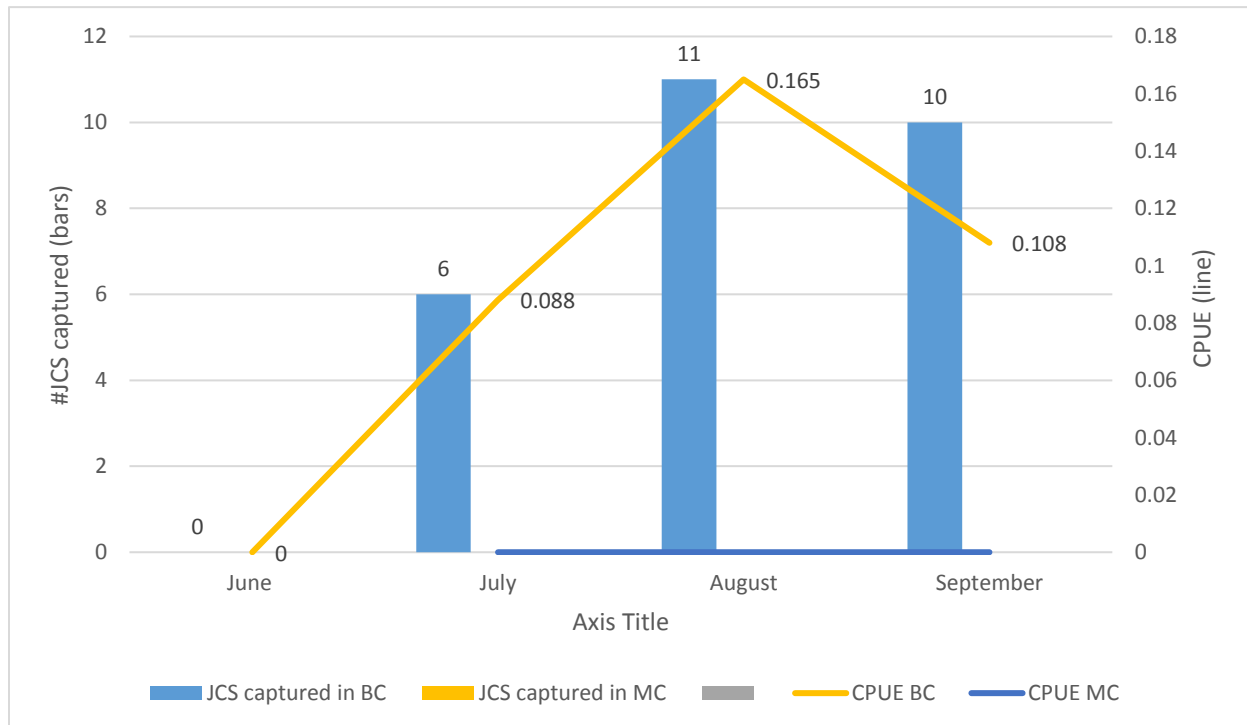


Figure 4: Monthly JCS capture in Minto Creek and Big Creek, 2017

5.2 Fish Metrics

Fork lengths of JCS captured in Big Creek ranged from 48 to 85 mm and their weights ranged from 2.07 to 9.72 g. There was a notable difference between the JCS lengths and widths during each sampling event. The JCS observed in July were smaller than the JCS captured in September. The lengths and weights observed throughout the season were consistent with 0+ aged fish (young of year).

Figure 5 presents the monthly averages for both creeks. Individual results for all fish captured are presented in Appendix B.

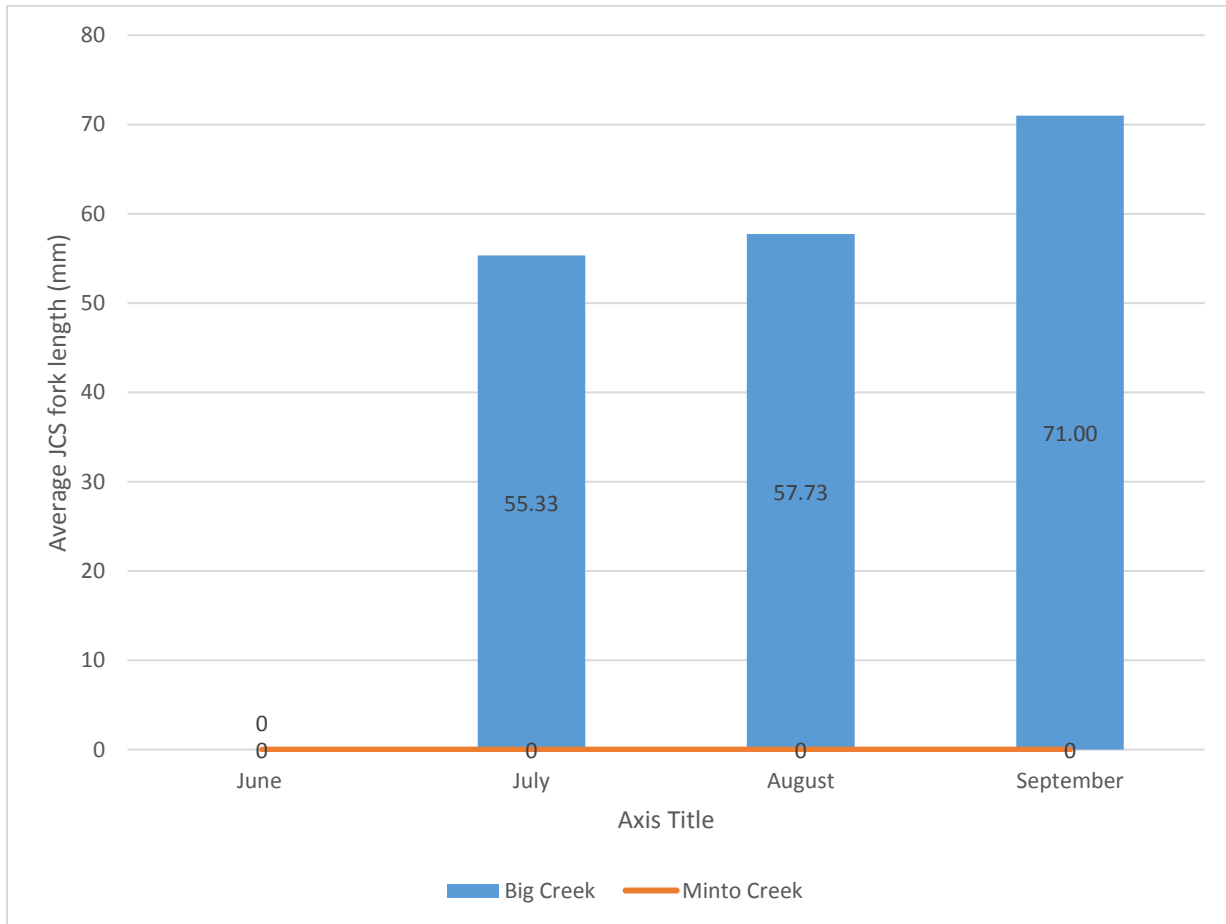


Figure 5: Average JCS length (fork) in Big Creek, 2017

5.3 Water Quality Parameters

In situ data was collected in Minto Creek at station W2, and Big Creek (bridge) during each site visit and results are summarized in Table 7. In situ data was also collected at the Yukon River (W4) during the June, July and September sampling events. In situ parameters were collected with a YSI Professional Plus multimeter, which was calibrated prior to each trip.

Table 7: In situ data from Minto Creek, Big Creek, and Yukon River, 2017

| Site | Date | Time | Temperature (°C) | Dissolved Oxygen (%) | Dissolved Oxygen (m/L) | Specific Conductance (µS/cm) | pH |
|-------------|-----------|-------|------------------|----------------------|------------------------|------------------------------|------|
| Minto Creek | 19-Jul-17 | 15:57 | 9.6 | 94.5 | 10.83 | 359.2 | 7.36 |
| | 16-Aug-17 | 14:50 | 6.7 | 100.6 | 12.27 | 379 | 7.5 |
| | 26-Sep-17 | 9:45 | 1.3 | 87.4 | 12.31 | 360.1 | 7.6 |
| Big Creek | 9-Jun-17 | 14:55 | 13 | 97.6 | 10.34 | 151.8 | 7.12 |
| | 19-Jul-17 | 16:27 | 12.8 | 101.1 | 10.69 | 173 | 7.36 |
| | 16-Aug-17 | 16:55 | 11.8 | 106.3 | 11.61 | 188.6 | 7.69 |
| | 26-Sep-17 | 15:05 | 3.5 | 100.8 | 13.38 | 177.3 | 7.76 |
| Yukon River | 9-Jun-17 | 15:30 | 14.2 | 105.3 | 10.75 | 119.2 | 7.42 |
| | 19-Jul-17 | 17:11 | 15 | 90.9 | 9.13 | 150.5 | 7.16 |
| | 26-Sep-17 | 14:50 | 8.3 | 94.8 | 11.14 | 158.1 | 8.03 |

Tidbit water temperature loggers were deployed in the Yukon River at station W4 (between the barge landing and the mouth of Minto Creek) and in Big Creek (near the bridge) during the open water season, while a continuous logger located at W1 records the water temperature and stage of lower Minto Creek.

Due to ice formation in early October 2017, the Tidbit logger at Big Creek was unable to be retrieved. The water temperature data for Big Creek was collected with a YSI Professional Plus multimeter during each of the sampling events.

Figure 6 presents the two temperature curves. This figure indicates that the temperatures of Minto Creek is generally colder than that of the Yukon River. The average difference in water temperature over this period between the Yukon River and Big Creek was 2.79°C, while the difference between Big Creek and Minto Creek was 5.29°C.

The 2017 data record does not indicate that the water temperature of Minto Creek equilibrated with that of the Yukon River during the 2017 open water season, although this has occasionally been observed to happen for a short period in June in the past. In 2013 for example, the maximum water temperature observed in Minto Creek was 15.7°C in late June, at which time the temperature of the Yukon River was

very similar. In 2014 and 2015 however, the water temperature in Minto Creek did not exceed 10.6°C and 9.7°C respectively, and did not reach equilibrium with the Yukon River. In 2017 the maximum water temperature observed in Minto Creek was 13.1 °C.

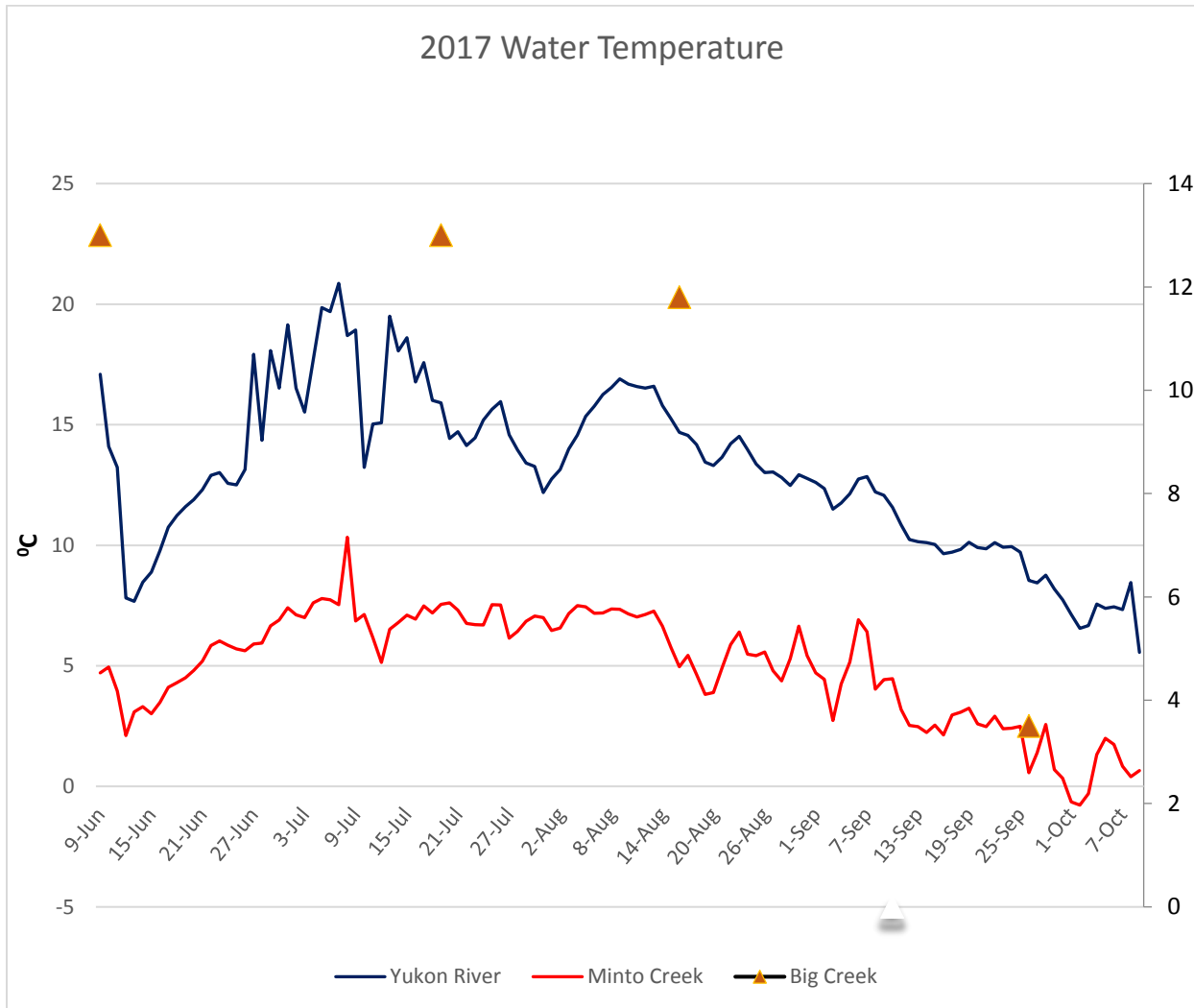


Figure 6: Water Temperature, Minto Creek and Yukon River, 2017

Turbidity in Minto Creek was noted to be higher in June due to a significant rain event. Figure 7 presents Total Suspended Solids (TSS) values measured at W2 from June 6th to September 26th, 2017; the dotted line indicates the decreasing trend.

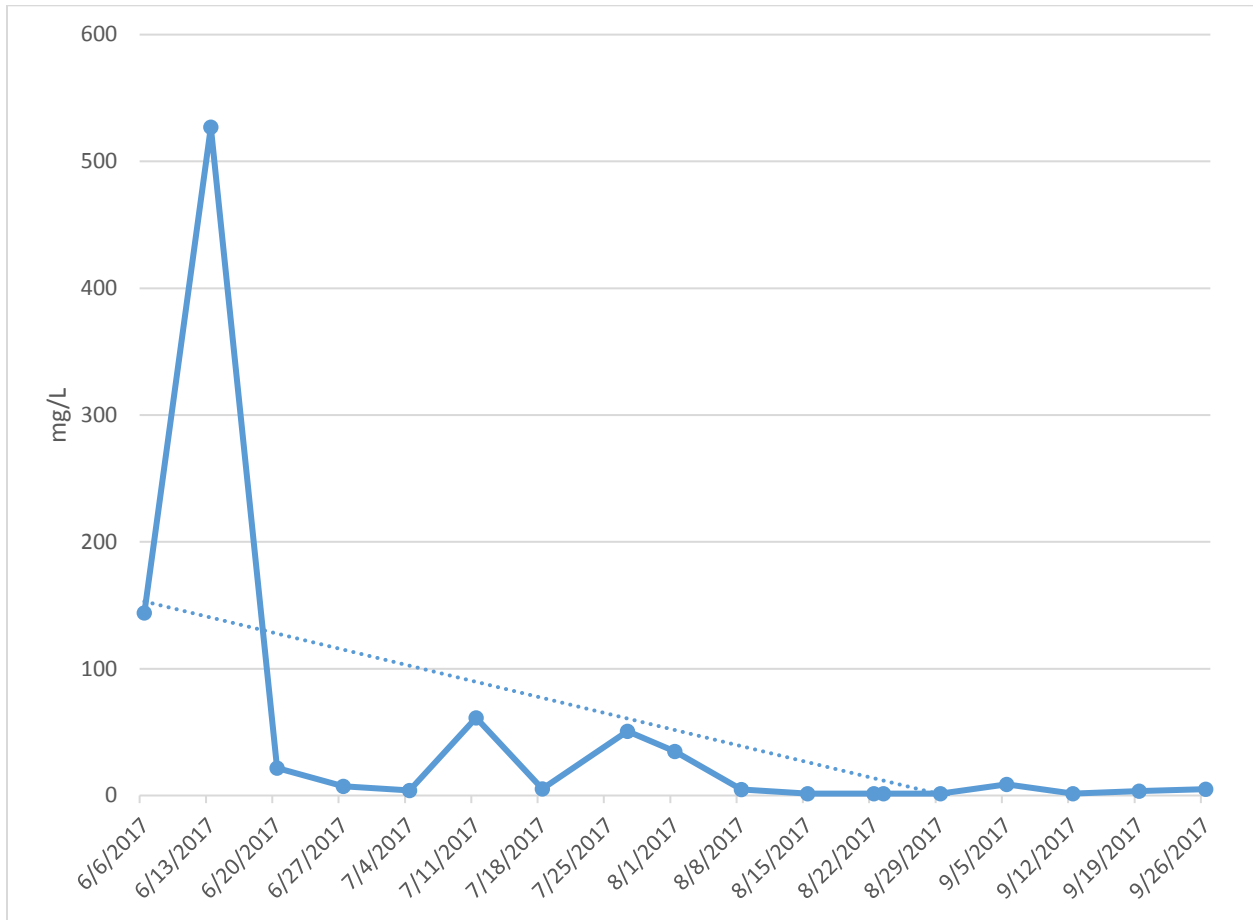


Figure 7: Total Suspended Solids (mg/L) measured at W2 in 2017

W2 TSS records for the open water season from 2011 to 2017 are presented in Figure 8 for comparison.

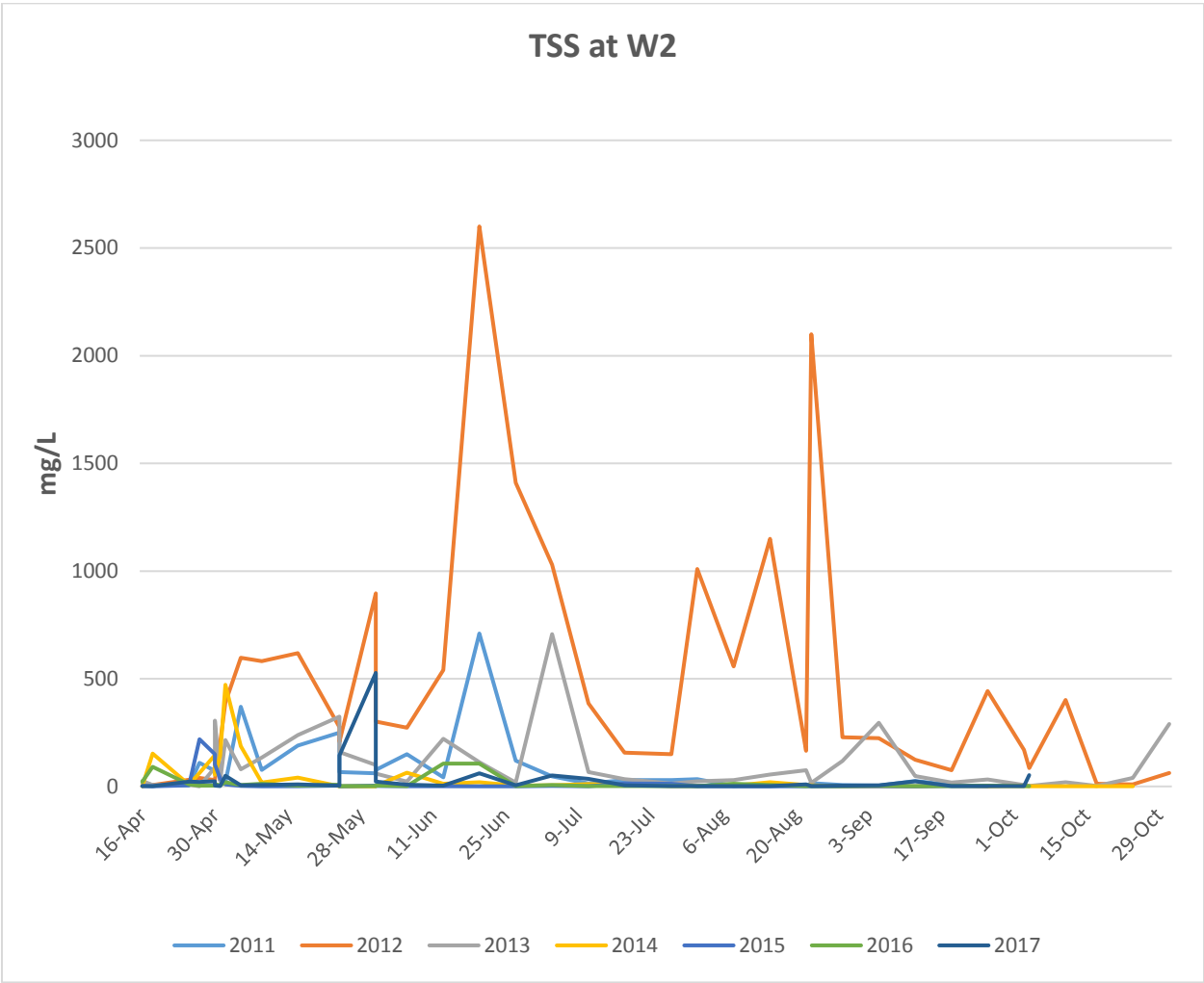


Figure 8: Total Suspended Solids (mg/L) measured at W2 during open water, 2011 to 2017

5.4 Stage and Discharge

The staff gauge located at W1 in Minto Creek was read during each trip, and discharge was measured at W1 with a Marsh McBirney Flo-Mate electromagnetic flow meter or a with a Hach FH950 electromagnetic flow meter. A continuously logging water level recorder is also located at W1.

Water levels and discharge for Minto Creek and Big Creek are presented in Table 8 below, for dates when fisheries surveys occurred. Big Creek values were obtained through the Water Survey of Canada on-line database (Water Survey Canada, 2017) and are subject to change as they have not yet been validated by Water Survey Canada.

Table 8: Stage and Discharge in Minto Creek and Big Creek, 2017

| Date | Time (PDT) | Minto Creek | | Big Creek | |
|-----------|------------|-------------|-------------------------------|-----------|-------------------------------|
| | | Stage (m) | Discharge (m ³ /s) | Stage (m) | Discharge (m ³ /s) |
| 6/9/2017 | 17:00 | 0.270 | 0.040 | 6.329 | 14.8 |
| 7/19/2017 | 15:42 | 0.117 | 0.005 | 6.377 | 17.4 |
| 8/16/2017 | 15:15 | 0.122 | 0.006 | 6.186 | 8.21 |
| 9/26/2017 | 14:18 | 0.146 | 0.009 | 6.166 | 7.43 |

Figure 9 displays the continuous record available from April to early October in Minto Creek.

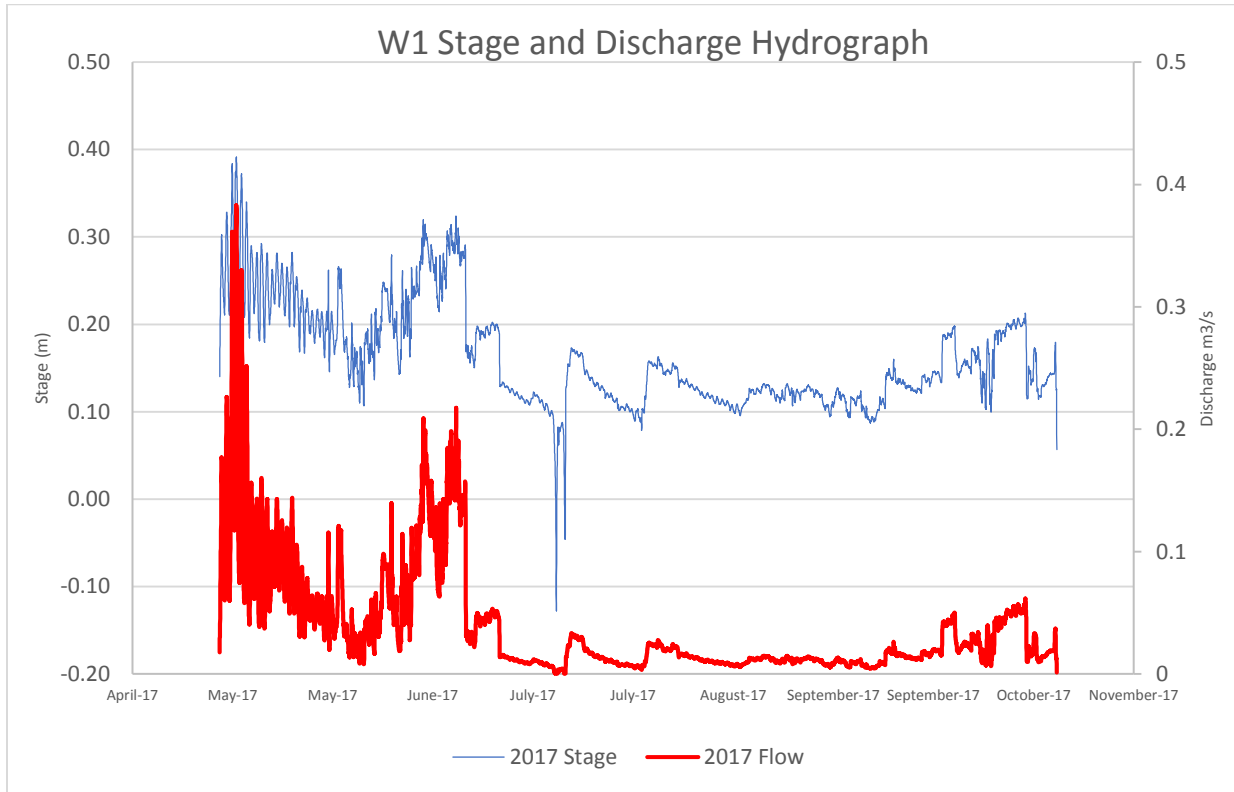


Figure 9 Stage and discharge in Minto Creek at monitoring station W1, 2017

The Big Creek hydrometric station (Water Survey of Canada station ID # 09AH003) is located downstream of the Minto access road bridge, near its confluence with the Yukon River, at the following coordinates: 62° 34' 07" N; 137° 00' 58" W. It records continuous water level and discharge. Figure 10 presents data from June to October 2017.

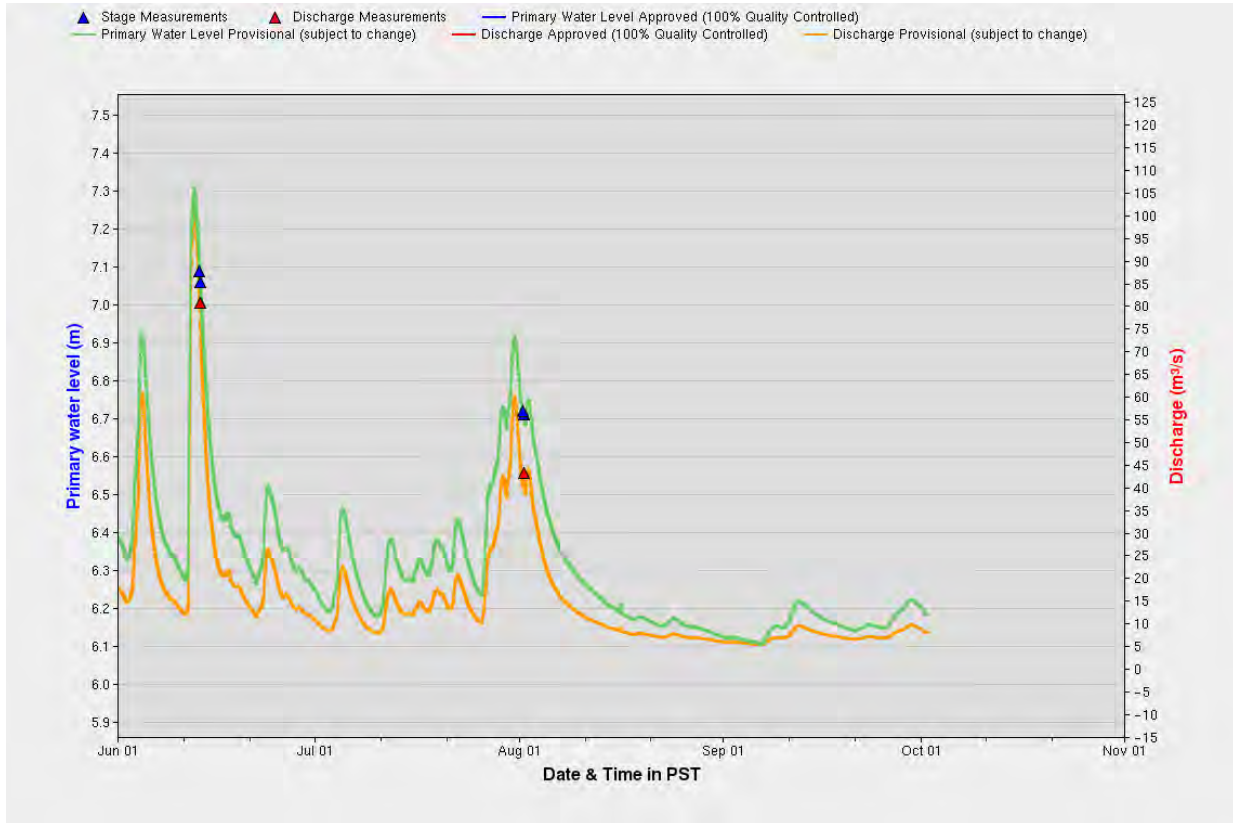


Figure 10: Water Level Discharge in Big Creek 2017 (Source: Water Survey of Canada, 2017)

5.5 Fish Barrier

The fish barrier located approximately 1.2 km upstream of the Yukon River (MCF-B1 on Figure 3), which was documented in previous years, was re-confirmed in 2017. Another fish barrier exists approximately 200m downstream of MCF-B1 at MCF-21. Fish use upstream of the barriers, which consists of a log jam (Figure 11), was assessed by setting traps upstream of it during each sampling event. No fish were captured upstream of the barrier during 2017.



Figure 11: Fish Barrier and Minnow Trap at MCF-B1



Figure 12: Fish barrier at MCF-21

6 Discussion

A section of lower Minto Creek (downstream of MCF-14) was dry during the July and August 2017 sampling events, preventing fish movement up the system. The period which this section of the creek was going dry is unknown, however this could have occurred on other occasions throughout the summer.

In 2017, no JCS were captured in Minto Creek during all sampling events. This may be related in part to the higher water temperatures observed in Big Creek and the lower temperatures observed in Minto Creek during this season. More generally this supports previous findings that JCS do not tend to enter Minto Creek (or Big Creek) until the water temperature has equilibrated with that of the Yukon River or reached a minimum threshold temperature, which was not observed in 2017.

The highest JCS catch per unit effort (CPUE) was observed in August in Big Creek. Figure 12 shows the CPUE trends since 2008 for JCS (Minnow trapping only) in Minto Creek and since 2012 in Big Creek. The average CPUE in Minto Creek has shown some variability since 2008 but has generally been relatively low. One exception is the year 2010 where the average CPUE in Minto Creek was 15.7 JCS/trap-day and some trapping events returned over 400 JCS. Those high numbers are thought to be associated with mine water discharge occurring throughout the open water season in Minto Creek that year (ACG, 2010), the more consistent temperature and flow regimes possibly acting as attractants to fish.

No fish were caught in Minto Creek in 2017. This could be explained by a section of the lower creek going dry in July and August, preventing fish movement up or down the creek, combined with a relatively low temperature profile in 2017. In some years, water temperature of Minto Creek and Yukon River reach equilibrium for a short period in June, however this did not happen from 2014 to 2017. In 2017, Minto Creek's maximum water temperature stayed below 11°C, whereas the Yukon River minimum temperature largely stayed above 11°C throughout the summer. The colder temperature profile of Minto Creek in 2017 may have deterred the movement of JCS into the system.

In Big Creek, the average CPUE for 2017 was the lowest recording since 2012. The CPUE was generally higher in Big Creek than in Minto Creek, except in 2013 where it was the opposite. A higher CPUE in Big Creek than in Minto Creek could be explained by the fact that Big Creek is a larger system, with a higher water temperature, generally providing better rearing conditions for JCS. The CPUE has also been noted as following the same trend within both Minto Creek and Big Creek since 2008.

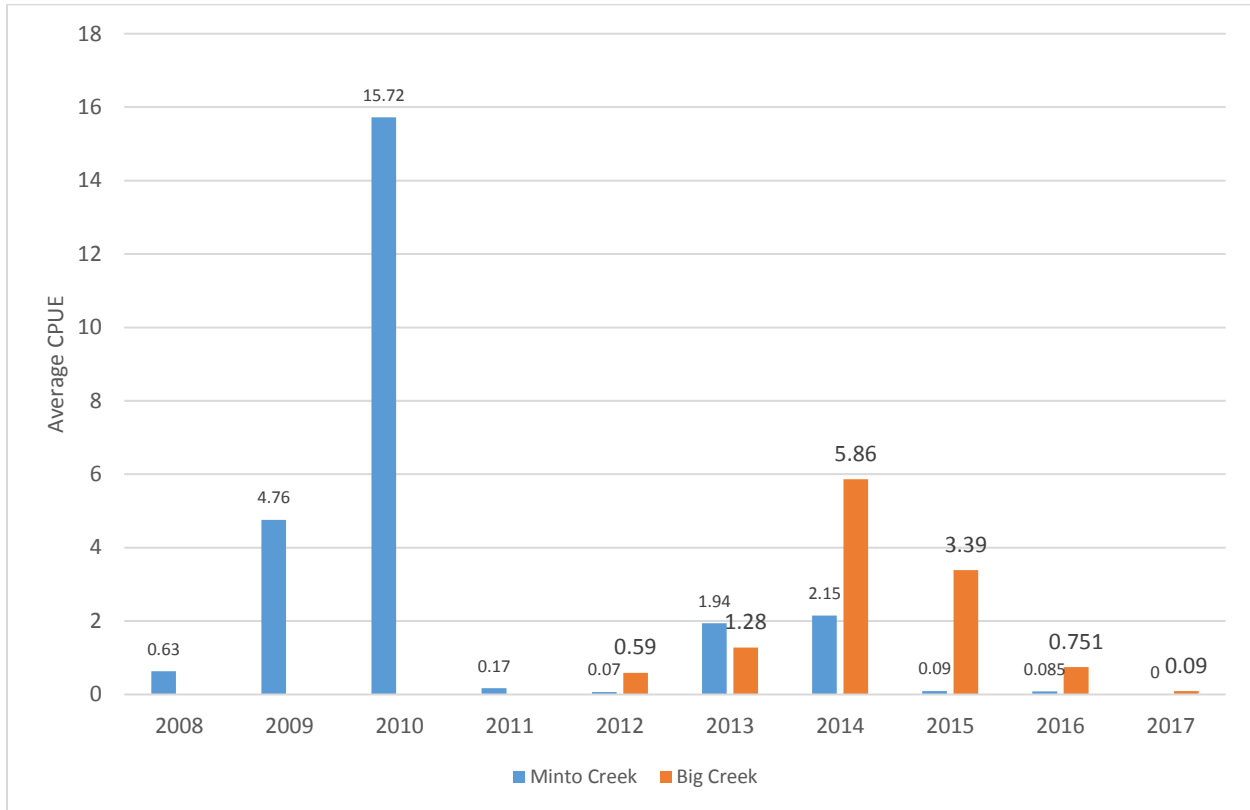


Figure 13: JCS Average CPUE, Minnow Trapping, Minto Creek (2008-2017), and Big Creek (2012-2017)

In 2009 and 2010, the mine was discharging water throughout the open water season into Minto Creek, causing higher and more consistent flow and temperature regimes in lower Minto Creek, conditions which may have been more attractive to JCS. Mine water discharge only occurred during spring freshet from 2012 to 2015 and no discharge occurred in 2011. In 2016 the new permitted discharge rate (Q_{EFF}), as per the WUL QZ14-031, was calculated as follows:

- a) Initial discharge rate: $1/3 (Q_{MC} + Q_{RO}) \geq Q_{EFF-C}$
- b) Rate after discharge has commenced: $1/3 (Q_{MC} + Q_{RO} - Q_{EFF-M}) \geq Q_{EFF-C}$

Where:

Q_{MC} = daily flow rate in Lower Minto Creek (represented by either W1 or MC1),

Q_{RO} = daily flow rate of discharged from the RO

Q_{EFF-M} = measured daily rate of discharge from mine site

Q_{EFF-C} = calculated rate of water discharge from mine site

In 2017 Minto mine was discharging throughout the open water season. However, this year's discharge was at much lower rates than in 2009 and 2010 because of the new discharge formula.

Following a forest fire in 2010, more sediment entered Minto Creek through runoff in 2011 and 2012, thereby increasing turbidity. A small landslide was also documented by Minto personnel in an upstream

tributary in May 2012, likely contributing to high TSS levels observed downstream. The elevated turbidity may have deterred fish from entering Minto Creek. Average TSS values at W2 in 2016 were the lowest since 2011, with the highest being observed in 2012 (see Appendix C for details). Average TSS values at W2 in 2017 were the lowest since 2011, with the highest being observed in 2012 (see Figure 8 for details). Turbidity and TSS did not likely influence fish presence or absence in Minto Creek in 2017 as values remained low throughout the season.

The natural fish barrier identified in Minto Creek in previous years was again confirmed in 2017, as well as a second natural fish barrier 200m downstream. Therefore, the area of usable fish habitat in Minto Creek is limited to the lower 1 km of the creek.

Aerial surveys for spawning fish were carried out in the vicinity of the Minto Creek/Yukon River confluence from 2010 to 2014 and no spawning activity was ever observed or suspected. Bottom substrate in the confluence area consists primarily of silt and mud which is not suitable substrate for salmon spawning.

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http://wateroffice.ec.gc.ca/report/report_e.html?type=realTime&stn=09AH003

Appendix A - 2017 Photo Log



June 2017 Big Creek



June 2017 Big Creek



June 2017 Slimy Sculpin Big Creek



June 2017 MCF21



July 2017 Deceased JCS at Big creek



July 2017 Juvenile Burbot (Big Creek)



July 2017 BC2



July 2017 MCF-14 dry



July 2017 MCF-12 dry



August 2017 fish barrier @ MCF-21



August 2017 JCS from Big creek



August 2017 MCF-15 Fish Trap



August 2017 Slimy Sculpin at Big creek



September 2017 JCS at Big Creek



September 2017 BC2 fish trap



September 2017 Burbot at Big Creek

Appendix B - Fish Data, Minto Creek and Big Creek, 2017

Fisheries Monitoring Program
2017 Summary Report

Fish Data

| Date | Location | Location Code | Samplers | Species | Length (mm) | Weight (g) | Fate | Sex | Maturity | Age |
|-------------|-----------|---------------|----------|---------|-------------|------------|-----------------|---------|----------|----------|
| 2017/Jun/10 | Big Creek | BC1 | SR/SB | CCG | 53 | 2.09 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Jun/10 | Big Creek | BC2 | SR/SB | CCG | 52 | 2.01 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Jun/10 | Big Creek | BC2 | SR/SB | CCG | 59 | 3.31 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Jun/10 | Big Creek | BC2 | SR/SB | CCG | 56 | 1.63 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Jul/20 | Big Creek | BC1 | CH/CP | CH | 48 | 2.07 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Jul/20 | Big Creek | BC1 | CH/CP | CH | 51 | 2.22 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Jul/20 | Big Creek | BC2 | CH/CP | CH | 63 | 3.32 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Jul/20 | Big Creek | BC2 | CH/CP | BB | 148 | 21.64 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Jul/20 | Big Creek | BC3 | CH/CP | CH | 55 | 2.73 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Jul/20 | Big Creek | BC3 | CH/CP | CH | 55 | 2.72 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Jul/20 | Big Creek | BC3 | CH/CP | CH | 60 | 3.73 | Deceased | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC1 | CH/CP | CH | 59 | 3.42 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC1 | CH/CP | CH | 52 | 2.48 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC1 | CH/CP | CH | 61 | 3.87 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC1 | CH/CP | CH | 58 | 3.2 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC1 | CH/CP | CH | 51 | 2.35 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC1 | CH/CP | CH | 51 | 2.51 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC1 | CH/CP | CH | 68 | 4.59 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC1 | CH/CP | CH | 65 | 4.5 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC1 | CH/CP | CH | 55 | 3.68 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC1 | CH/CP | CH | 57 | 3.48 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC4 | CH/CP | CCG | 48 | 1.05 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Aug/17 | Big Creek | BC4 | CH/CP | CH | 58 | 2.93 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC1 | CH/EB | CCG | 35 | 0.72 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC1 | CH/EB | CH | 78 | 6.45 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC1 | CH/EB | CH | 59 | 2.62 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC3 | CH/EB | CH | 80 | 5.34 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC3 | CH/EB | CH | 71 | 4.79 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC3 | CH/EB | CH | 73 | 5.74 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC3 | CH/EB | CH | 85 | 9.72 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC3 | CH/EB | CH | 73 | 5.96 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC4 | CH/EB | BB | 101 | 7.39 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC4 | CH/EB | CH | 65 | 5.1 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC4 | CH/EB | CH | 64 | 4.17 | Released (good) | Unknown | Immature | Juvenile |
| 2017/Sep/25 | Big Creek | BC4 | CH/EB | CH | 62 | 3.96 | Released (good) | Unknown | Immature | Juvenile |

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Data Summary

| ID | Licence Or Ref. No. | Corporation | Sampler Or Data Collectors | Collection Date (YYYY-MM-DD) | Waterbody Name | Watershed Code | Waterbody ID (Lakes) | Upper Latitude (Decimal Degree eg. 62.82527) | Upper Longitude (Decimal Degree eg. -137.62750) | Lower Latitude | Lower Longitude | Species (see look-up tab) | Lifestage | Number Captured | Number Retained | Number Of Incidental Mortalities | Capture Method | Effort | Unit of Measure | Comments |
|--------------|---------------------|-----------------------|--------------------------------|------------------------------|----------------|----------------|----------------------|--|---|----------------|-----------------|---------------------------|-----------|-----------------|-----------------|----------------------------------|----------------|----------|-----------------|-----------------|
| XR154-2017-1 | XR154-2017-1 | Capstone Mining Corp. | Shelby Black Shaun Roberts | 2017/Jun/10 | Big Creek | 80080623801957 | | 62.598706 | -137.013264 | | | CCG | juvenile | 4 | 0 | 0 | MT | 92 hr | | 4 traps |
| XR154-2017-2 | XR154-2017-2 | Capstone Mining Corp. | Shelby Black Shaun Roberts | 2017/Jun/10 | Minto Creek | 800803912 | | 62.65442 | -137.0929558 | | | n/a | n/a | 0 | 0 | 0 | MT | 320 hr | | 14 traps |
| XR154-2017-1 | XR154-2017-1 | Capstone Mining Corp. | Chris Harry Colin Prentice | 2017/Jul/20 | Big Creek | 80080623801957 | | 62.598706 | -137.013264 | | | BB | juvenile | 1 | 0 | 0 | MT | 68.55 hr | | 3 traps |
| XR154-2017-1 | XR154-2017-1 | Capstone Mining Corp. | Chris Harry Colin Prentice | 2017/Jul/20 | Big Creek | 80080623801957 | | 62.65442 | -137.0929558 | | | CH | juvenile | 6 | 0 | 1 | MT | 68.55 hr | | 3 traps |
| XR154-2017-2 | XR154-2017-2 | Capstone Mining Corp. | Chris Harry Colin Prentice | 2017/Jul/20 | Minto Creek | 800803912 | | 62.65442 | -137.0929558 | | | n/a | n/a | 0 | 0 | 0 | MT | 139.9 hr | | 6 traps placed |
| XR154-2017-1 | XR154-2017-1 | Capstone Mining Corp. | Chris Harry Colin Prentice | 2017/Aug/17 | Big Creek | 80080623801957 | | 62.598706 | -137.013264 | | | CH | juvenile | 11 | 0 | 0 | MT | 66.6 hr | | 3 traps |
| XR154-2017-1 | XR154-2017-1 | Capstone Mining Corp. | Chris Harry Colin Prentice | 2017/Aug/17 | Big Creek | 80080623801957 | | 62.598706 | -137.013264 | | | CCG | juvenile | 1 | 0 | 0 | MT | 66.6 hr | | 3 traps |
| XR154-2017-2 | XR154-2017-2 | Capstone Mining Corp. | Chris Harry Colin Prentice | 2017/Aug/17 | Minto Creek | 800803912 | | 62.65442 | -137.0929558 | | | n/a | n/a | 0 | 0 | 0 | MT | 272.4 hr | | 12 traps placed |
| XR154-2017-1 | XR154-2017-1 | Capstone Mining Corp. | Chris Harry Emilie Bouchard | 2017/Sep/25 | Big Creek | 80080623801957 | | 62.598706 | -137.013264 | | | CCG | juvenile | 1 | 0 | 0 | MT | | | 4 traps placed |
| XR154-2017-1 | XR154-2017-1 | Capstone Mining Corp. | Chris Harry Emilie Bouchard | 2017/Sep/25 | Big Creek | 80080623801957 | | 62.598706 | -137.013264 | | | BB | juvenile | 1 | 0 | 0 | MT | | | 4 traps placed |
| XR154-2017-1 | XR154-2017-1 | Capstone Mining Corp. | Chris Harry Emilie Bouchard | 2017/Sep/25 | Big Creek | 80080623801957 | | 62.598706 | -137.013264 | | | CH | juvenile | 10 | 0 | 0 | MT | | | 4 traps placed |
| XR154-2017-1 | XR154-2017-2 | Capstone Mining Corp. | Chris Harry Emilie Bouchard | 2017/Sep/25 | Minto Creek | 800803912 | | 62.65442 | -137.0929558 | | | n/a | n/a | | | | | | | |

Net Times

| Site | Date Set | Set | Date Pulled | Pulled | Net Time |
|--------|-----------|-------|-------------|--------|----------|
| BC1 | 6/9/2017 | 14:55 | 6/10/2017 | 14:06 | 23 |
| BC2 | 6/9/2017 | 15:00 | 6/10/2017 | 14:12 | 23 |
| BC3 | 6/9/2017 | 15:10 | 6/10/2017 | 14:22 | 23 |
| BC4 | 6/9/2017 | 15:15 | 6/10/2017 | 14:25 | 23 |
| MCF12 | 6/9/2017 | 15:50 | 6/10/2017 | 14:48 | 23 |
| MCF13 | 6/9/2017 | 15:55 | 6/10/2017 | 14:50 | 23 |
| MCF14 | 6/9/2017 | 16:00 | 6/10/2017 | 14:54 | 23 |
| MCF15 | 6/9/2017 | 16:18 | 6/10/2017 | 15:06 | 23 |
| MCF16 | 6/9/2017 | 16:30 | 6/10/2017 | 15:09 | 23 |
| MCF26 | 6/9/2017 | 16:35 | 6/10/2017 | 15:20 | 23 |
| MCF17 | 6/9/2017 | 16:40 | 6/10/2017 | 16:31 | 24 |
| MCF18 | 6/9/2017 | 16:50 | 6/10/2017 | 16:25 | 24 |
| MCF W1 | 6/9/2017 | 16:55 | 6/10/2017 | 16:26 | 24 |
| MCF19 | 6/9/2017 | 17:20 | 6/10/2017 | 16:17 | 23 |
| MCF20 | 6/9/2017 | 17:25 | 6/10/2017 | 16:13 | 23 |
| MCF21 | 6/9/2017 | 17:30 | 6/10/2017 | 16:10 | 23 |
| MCF22 | 6/9/2017 | 17:34 | 6/10/2017 | 15:34 | 22 |
| MCF23 | 6/9/2017 | 17:35 | 6/10/2017 | 15:36 | 22 |
| BC1 | 7/19/2017 | 16:29 | 7/20/2017 | 15:33 | 23.1 |
| BC2 | 7/19/2017 | 16:22 | 7/20/2017 | 15:03 | 22.7 |
| BC3 | 7/19/2017 | 16:25 | 7/20/2017 | 15:13 | 22.8 |
| MCF15 | 7/19/2017 | 14:24 | 7/20/2017 | 13:46 | 23.4 |
| MCF17 | 7/19/2017 | 14:35 | 7/20/2017 | 14:00 | 23.4 |
| MCF20 | 7/19/2017 | 14:49 | 7/20/2017 | 14:44 | 23.9 |
| MCF22 | 7/19/2017 | 15:00 | 7/20/2017 | 14:23 | 23.4 |
| MCF B1 | 7/19/2017 | 15:18 | 7/20/2017 | 14:17 | 23.0 |
| MCF24 | 7/19/2017 | 15:24 | 7/20/2017 | 14:14 | 22.8 |
| MCF14 | 8/16/2017 | 14:41 | 8/17/2017 | 13:14 | 22.5 |
| MCF15 | 8/16/2017 | 14:33 | 8/17/2017 | 13:39 | 23.1 |
| MCF16 | 8/16/2017 | 14:30 | 8/17/2017 | 13:41 | 23.2 |
| MCF17 | 8/16/2017 | 15:15 | 8/17/2017 | 14:36 | 23.3 |
| MCF18 | 8/16/2017 | 15:19 | 8/17/2017 | 14:31 | 23.2 |
| MCF19 | 8/16/2017 | 15:30 | 8/17/2017 | 14:36 | 23.1 |
| MCF20 | 8/16/2017 | 15:40 | 8/17/2017 | 14:25 | 22.7 |
| MCF21 | 8/16/2017 | 16:08 | 8/17/2017 | 14:15 | 22.1 |
| MCF22 | 8/16/2017 | 15:45 | 8/17/2017 | 14:21 | 22.6 |
| MCF-B1 | 8/16/2017 | 16:15 | 8/17/2017 | 15:03 | 22.8 |

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| Site | Date Set | Set | Date Pulled | Pulled | Net Time |
|--------|-----------|-------|-------------|--------|----------|
| MCF24 | 8/16/2017 | 16:23 | 8/17/2017 | 14:13 | 21.8 |
| MCF27 | 8/16/2017 | 16:27 | 8/17/2017 | 14:15 | 21.8 |
| BC1 | 8/16/2017 | 16:55 | 8/17/2017 | 15:03 | 22.1 |
| BC2 | 8/16/2017 | 16:57 | 8/17/2017 | 15:09 | 22.2 |
| BC3 | 8/16/2017 | 17:00 | 8/17/2017 | 15:15 | 22.2 |
| MCF12 | 9/25/2017 | 14:06 | 9/26/2017 | 9:26 | 19.3 |
| MCF13 | 9/25/2017 | 14:11 | 9/26/2017 | 9:28 | 19.3 |
| MCF14 | 9/25/2017 | 14:15 | 9/26/2017 | 9:32 | 19.3 |
| MCF15 | 9/25/2017 | 14:23 | 9/26/2017 | 9:39 | 19.3 |
| MCF25 | 9/25/2017 | 14:27 | 9/26/2017 | 13:39 | 23.2 |
| MCF27 | 9/25/2017 | 14:51 | 9/26/2017 | 13:50 | 23.0 |
| MCF24 | 9/25/2017 | 14:56 | 9/26/2017 | 13:54 | 23.0 |
| MCF-B1 | 9/25/2017 | 15:00 | 9/26/2017 | 13:57 | 23.0 |
| MCF-22 | 9/25/2017 | 15:09 | 9/26/2017 | 14:02 | 22.9 |
| MCF-21 | 9/25/2017 | 15:14 | 9/26/2017 | 14:07 | 22.9 |
| MCF-20 | 9/25/2017 | 15:18 | 9/26/2017 | 14:10 | 22.9 |
| MCF-18 | 9/25/2017 | 15:31 | 9/26/2017 | 14:27 | 22.9 |
| MCF-17 | 9/25/2017 | 15:37 | 9/26/2017 | 14:32 | 22.9 |
| MCF-26 | 9/25/2017 | 15:41 | 9/26/2017 | 14:34 | 22.9 |
| BC1 | 9/25/2017 | 15:58 | 9/26/2017 | 14:56 | 23.0 |
| BC2 | 9/25/2017 | 16:02 | 9/26/2017 | 15:09 | 23.1 |
| BC3 | 9/25/2017 | 16:05 | 9/26/2017 | 15:13 | 23.1 |
| BC4 | 9/25/2017 | 16:08 | 9/26/2017 | 15:17 | 23.2 |

Monthly Report Tables

August

| Site | # Traps | Date and Time In | Date and Time Out | Soak Time (hrs) | Results | Species | Length (mm) | Weight (g) |
|------|---------|------------------|-------------------|-----------------|---------|---------|-------------|------------|
| BC1 | 1 | 8/16/2017 16:55 | 8/17/2017 15:03 | 22.1 | 10 | CH | 59 | 3.42 |
| | | | | | | CH | 52 | 2.48 |
| | | | | | | CH | 61 | 3.87 |
| | | | | | | CH | 58 | 3.2 |
| | | | | | | CH | 51 | 2.35 |
| | | | | | | CH | 51 | 2.51 |
| | | | | | | CH | 68 | 4.59 |
| | | | | | | CH | 65 | 4.5 |
| | | | | | | CH | 55 | 3.68 |
| | | | | | | CH | 57 | 3.48 |
| BC3 | 1 | 8/16/2017 17:00 | 8/17/2017 15:15 | 22.2 | 2 | CCG | 48 | 1.05 |
| | | | | | | CH | 58 | 2.93 |

| Site | # Traps | Date and Time In | Date and Time Out | Soak Time | Results |
|--------|---------|------------------|-------------------|-----------|---------|
| MCF14 | 1 | 8/16/2017 14:41 | 8/17/2017 13:14 | 22.5 | 0 |
| MCF15 | 1 | 8/16/2017 14:33 | 8/17/2017 13:39 | 23.1 | 0 |
| MCF16 | 1 | 8/16/2017 14:30 | 8/17/2017 13:41 | 23.2 | 0 |
| MCF17 | 1 | 8/16/2017 15:15 | 8/17/2017 14:36 | 23.3 | 0 |
| MCF18 | 1 | 8/16/2017 15:19 | 8/17/2017 14:31 | 23.2 | 0 |
| MCF19 | 1 | 8/16/2017 15:30 | 8/17/2017 14:36 | 23.1 | 0 |
| MCF20 | 1 | 8/16/2017 15:40 | 8/17/2017 14:25 | 22.7 | 0 |
| MCF21 | 1 | 8/16/2017 16:08 | 8/17/2017 14:15 | 22.1 | 0 |
| MCF22 | 1 | 8/16/2017 15:45 | 8/17/2017 14:21 | 22.6 | 0 |
| MCF-B1 | 1 | 8/16/2017 16:15 | 8/17/2017 15:03 | 22.8 | 0 |
| MCF24 | 1 | 8/16/2017 16:23 | 8/17/2017 14:13 | 21.8 | 0 |
| MCF27 | 1 | 8/16/2017 16:27 | 8/17/2017 14:15 | 21.8 | 0 |

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| Site | Date | Time | Water Temp (°C) | DO (%) | DO (mg/L) | pH | ORP (mV) |
|------------------|-----------|-------|-----------------|--------|-----------|------|----------|
| Big Creek (BC1) | 8/16/2017 | 16:55 | 11.8 | 106.3 | 11.61 | 7.69 | 160.9 |
| Minto Creek (W2) | 8/16/2017 | 14:50 | 6.7 | 100.6 | 12.27 | 7.5 | 182.2 |

| Date | Time | Water Level (m) | Discharge (m3/s) |
|-----------|-------|-----------------|------------------|
| 8/16/2017 | 15:15 | 0.122 | 0.006 |

September

| Site | # Traps | Date and Time In | Date and Time Out | Soak Time (hrs) | Results | Species | Length (mm) | Weight (g) |
|------|---------|------------------|-------------------|-----------------|---------|---------|-------------|------------|
| BC1 | 1 | 9/25/2017 15:58 | 9/25/2017 14:56 | 23 | 3 | CCG | 35 | 0.72 |
| | | | | | | CH | 78 | 6.45 |
| | | | | | | CH | 59 | 2.62 |
| BC3 | 1 | 9/25/2017 16:05 | 9/26/2017 15:13 | 23.1 | 5 | CH | 80 | 5.34 |
| | | | | | | CH | 71 | 4.79 |
| | | | | | | CH | 73 | 5.74 |
| | | | | | | CH | 85 | 9.72 |
| | | | | | | CH | 73 | 5.96 |
| BC4 | 1 | 9/25/2017 16:08 | 9/26/2017 15:17 | 23.2 | 4 | BB | 101 | 7.39 |
| | | | | | | CH | 65 | 5.1 |
| | | | | | | CH | 64 | 4.17 |
| | | | | | | CH | 62 | 3.96 |

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| Site | # Traps | Date and Time In | Date and Time Out | Soak Time | Results |
|--------|---------|------------------|-------------------|-----------|---------|
| MCF12 | 1 | 9/25/2017 14:06 | 9/26/2017 9:26 | 19.3 | 0 |
| MCF13 | 1 | 9/25/2017 14:06 | 9/26/2017 9:28 | 19.3 | 0 |
| MCF14 | 1 | 9/25/2017 14:06 | 9/26/2017 9:32 | 19.3 | 0 |
| MCF15 | 1 | 9/25/2017 14:06 | 9/26/2017 9:39 | 19.3 | 0 |
| MCF25 | 1 | 9/25/2017 14:27 | 9/26/2017 13:39 | 23.2 | 0 |
| MCF27 | 1 | 9/25/2017 14:51 | 9/26/2017 13:50 | 23.0 | 0 |
| MCF24 | 1 | 9/25/2017 14:56 | 9/26/2017 13:54 | 23.0 | 0 |
| MCF-B1 | 1 | 9/25/2017 15:00 | 9/26/2017 13:57 | 23.0 | 0 |
| MCF-22 | 1 | 9/25/2017 15:09 | 9/26/2017 14:02 | 22.9 | 0 |
| MCF-21 | 1 | 9/25/2017 15:14 | 9/26/2017 14:07 | 22.9 | 0 |
| MCF-20 | 1 | 9/25/2017 15:18 | 9/26/2017 14:10 | 22.9 | 0 |
| MCF-18 | 1 | 9/25/2017 15:31 | 9/26/2017 14:27 | 22.9 | 0 |
| MCF-17 | 2 | 9/25/2017 15:37 | 9/26/2017 14:32 | 22.9 | 0 |
| MCF-26 | 3 | 9/25/2017 16:02 | 9/26/2017 15:09 | 22.9 | 0 |

| Site | Date | Time | Water Temp (°C) | DO (%) | DO (mg/L) | pH | ORP (mV) |
|------------------|-----------|-------|-----------------|--------|-----------|------|----------|
| Big Creek (BC1) | 9/26/2017 | 15:05 | 3.5 | 100.8 | 13.38 | 7.76 | 207.7 |
| Minto Creek (W2) | 9/26/2017 | 14:50 | 1.3 | 87.4 | 12.31 | 7.6 | 192.6 |
| Yukon River (W4) | 9/26/2017 | 9:45 | 8.3 | 94.8 | 11.14 | 8.03 | 203.9 |

| Date | Time | Water Level (m) | Discharge (m3/s) |
|-----------|-------|-----------------|------------------|
| 9/26/2017 | 14:18 | 0.146 | 0.009 |

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CPUE

| Month | Total net times MC | Total net times BC | CH Caught BC | CH Caught MC | CCG caught BC | CCG caught MC | BB Caught BC | BB Caught MC | CH CPUE BC | CH CPUE MC | CCG CPUE BC | CCG CPUE MC | BB CPUE BC | BB CPUE MC |
|-----------|--------------------|--------------------|--------------|--------------|---------------|---------------|--------------|--------------|-------------|------------|-------------|-------------|-------------|------------|
| June | 320 | 93 | 0 | 0 | 4 | 0 | 0 | | 0 | | | 0 | | |
| July | 140 | 69 | 6 | 0 | 0 | 0 | 1 | | 0.087527352 | 0 | 0 | | 0.014587892 | |
| August | 272.4 | 66.6 | 11 | 0 | 1 | 0 | 0 | 0 | 0.165165165 | 0 | 0.015015015 | 0 | 0 | 0 |
| September | 306.6 | 92.4 | 10 | 0 | 1 | 0 | 1 | 0 | 0.108225108 | 0 | 0.010822511 | 0 | 0.010822511 | 0 |
| | | | | | | | | | 0.090229406 | 0 | 0.008612509 | 0 | 0.008470134 | 0 |

Appendix M – Copper Toxicity in Turbid Flow Report (Minnow)

January 31, 2018

Mr. Ryan Herbert
Environmental Manager
Capstone Mining Corporation - Minto Mine
PO Box 11
Whitehorse Central PO
Whitehorse, Yukon, Y1A 2V3

Dear Mr. Herbert,

Re: Turbid Flow Water Toxicity Testing to Verify the Minto Mine Water Quality Objective for Copper in Minto Creek

This brief letter report provides a summary and interpretation of the results of toxicity testing undertaken to verify the Minto Mine's water quality objective (WQO) for copper in lower Minto Creek. As required under the Minto Mine Water Use Licence (WUL; QZ14-031), turbid flow conditions were tested (on a sample collected in early May 2017).

Background

In August 2015, the Yukon Water Board (YWB) issued an amended WUL to the Minto Mine that included a WQO of 20 µg/L dissolved copper when dissolved organic carbon (DOC) concentrations exceed 10 mg/L and 13 µg/L dissolved copper when DOC concentrations are 10 mg/L or lower¹ (YWB 2015). The amended WUL also included Clause 105 stipulating that "the licensee shall complete the study generally described in the document entitled Study Plan for Evaluating the Toxicity of Copper to Selected Aquatic Organisms in Minto Creek Water Version 3 and shall submit the results to the Board by March 31, 2017 for Review and Approval." The Study Plan (Appendix A) was designed by MacDonald Environmental Sciences Limited (MESL) and reviewed by Minnow Environmental Inc. (Minnow) prior to a YWB public hearing in March 2015.

The Study Plan was designed to determine if the WQO is protective of sensitive organisms and endpoints (survival, growth, and reproduction) under a range of water quality conditions. The Study Plan includes laboratory testing with site water collected during clear and turbid flow

¹ WQOs apply at Station W2 in lower Minto Creek when water is flowing at the mine site (Stations W15 and W35) and apply to water leaving the site at Station W16 when there is no flow at Stations W15 and W35 (see Figure 1 for station locations). The former condition is the focus of this document, as WQOs are intended to be protective of lower Minto Creek.

conditions. Clear flow is defined as flowing water with less than 25 mg/L total suspended solids (TSS) and turbid flow as flowing water with greater than 25 mg/L TSS.

Minto's WQO for copper was based on evaluations which identified high background copper concentrations and high concentrations of DOC (approximately 12 mg/L, on average) which is known to limit the bioavailability and toxicity of copper. Minto's WQO for copper was based on a combination of background concentration characterization (e.g., Minnow 2009), toxicity testing in site water (e.g., Minnow 2009), application of scientific literature-based quantitative relationships between copper toxicity and DOC, biotic ligand modelling (e.g., Minnow 2009, 2013, 2014) and testing of potential effects to fish olfaction (Kennedy et al. 2012). The WQO was supported through the Yukon Environmental and Socio-economic Assessment Board (YESAB) environmental assessment, when independent evaluation suggested that 40 µg/L could potentially be used as the WQO for copper in lower Minto Creek (Ecometrix 2014).

In late September 2015, copper toxicity testing was conducted under clear flow conditions. A downward revision of WQO was unnecessary since there were no endpoints for which the 20th percentile effect concentration was below 20 µg/L and the 20 µg/L (or lower) copper concentration treatments also differed significantly from the laboratory control (Minnow 2016).

Methods

Site water for turbid flow testing was collected on May 5th 2017 from lower Minto Creek (W2) and the water storage pond (WSP; W16; Figure 1). The original decision path developed for the Study Plan implementation guided the timing of collection (Figure 2; Minnow 2015). Appropriate turbid flow conditions did not occur in 2016 (due, at least in part, to a mild snow melt/spring freshet). The water collected on May 5th 2017 arrived at the Nautilus Environmental (Nautilus) toxicity testing laboratory (Calgary, AB) on May 12th, 2017. A 3:1 ratio of Minto Creek water to effluent (W2:W16) was mixed at the laboratory. This ratio mimics the expected ratio at maximum effluent discharge. In accordance with the Study Plan (Appendix A) and standard protocols (Appendix B - Nautilus 2017), four long-term (i.e., chronic) static-renewal toxicity tests were completed:

- a 48-h rotifer (*Brachionus calyciflorus*) toxicity test (intrinsic rate of population increase);
- a 21-d cladoceran (*Daphnia magna*) toxicity test (survival, reproduction);
- a 32-d fathead minnow (*Pimephales promelas*) toxicity test (hatching success, total post-hatch survival, overall survival, length, and biomass); and

- a 42-d amphipod (*Hyalella azteca*) toxicity test (survival, growth², and reproduction).

Mixed site water was spiked with copper at the following nominal copper concentrations: 5, 10, 20, 40, 80, and 160 µg/L (Appendix B - Nautilus 2017). Each test evaluated the six exposure concentrations, an un-spiked mixed site water control, and a laboratory control. Dissolved and total copper concentrations were measured in all test vessels on a weekly basis. Major ions (calcium, magnesium, potassium, sodium, sulphate, and chloride) and alkalinity were measured in the site and laboratory control waters, and DOC was measured in the mixed site water control (Appendix B – Nautilus 2017).

Lethal concentrations (LC) or inhibitory concentrations (IC) were determined for all 13 endpoints associated with the four toxicity tests. All LC and IC values were calculated at the 10th, 20th, and 50th percentiles (Appendix B – Nautilus 2017). Mean survival, growth, and/or reproduction associated with each treatment was statistically contrasted with the laboratory control. Criteria for interpreting suitability of the WQO were defined a-priori (MESL 2015). The WQO for copper is considered protective if 20th percentile effect concentrations (LC20 and IC20) are greater than 20 µg/L and endpoints (i.e., survival, growth, and/or reproduction) associated with copper concentrations of 20 µg/L (and lower) do not differ significantly from those of the control ($p = 0.05$; Appendix A). Conversely, if one or more of the 20th percentile effect concentrations is less than or equal to 20 µg/L and that endpoint (or those endpoints) associated with copper concentrations of 20 µg/L (or lower) also differ significantly from the control ($p = 0.05$), the WQO would be revised downward to establish a level protective of aquatic organisms in site water (Appendix A).

Results

The mean concentration of DOC in mixed test waters collected on May 5, 2017 (29.1 ± 3.0 mg/L) was higher than 10 mg/L, and therefore the objective of 20 µg/L of dissolved copper would apply as outlined in Minto's WUL.

Evaluation of toxicity test results as reported in Appendix B (Nautilus 2017) indicated that the 20th percentile effect concentrations were well above the SSWQO of 20 µg/L dissolved copper for 12 of 13 endpoints (Table 1 and Figure 3). The IC20 for "intrinsic rate of population increase" of *B. calyciflorus* was 150 µg/L dissolved copper (161 µg/L total; Table 1). Only the highest exposure concentration (168 µg/L dissolved copper; 180 µg/L total) resulted in a growth rate significantly lower than the laboratory control (Appendix B – Nautilus 2017). *D. magna* survival and reproduction LC20s and IC20s were greater than the highest concentration tested

² Survival and growth of *Hyalella azteca* were evaluated after 28-days and after 42-days

(nominally 160 µg/L and measured as 149 µg/L dissolved copper and 167 µg/L total copper) and neither survival nor reproduction in any treatment differed from the laboratory control (Table 1). Similarly, all five endpoints for *P. promelas* yielded LC20 or IC20 values greater than the highest concentration tested (nominally 160 µg/L and measured as either 144 µg/L or 158 µg/L dissolved copper and 168 µg/L or 170 µg/L total copper) and neither survival nor growth in any treatment differed from the laboratory control (Table 1). *H. azteca* survival LC20 was also greater than the highest concentration tested in 28-day and in 42-day exposures, and there were no significant differences between any of the treatments and the laboratory control (Table 1; Appendix B – Nautilus 2017). The IC20 for *H. azteca* biomass was 97.0 µg/L dissolved copper (106 µg/L total) in the 28-day exposure and 96.6 µg/L dissolved copper (102 µg/L total) in the 42-day exposure (Table 1). The only treatment that differed significantly from the laboratory control (over both exposure durations) was the nominal 160 µg/L treatment (measured as 154 µg/L dissolved and 167 µg/L total in the 28-day exposure and 160 µg/L dissolved and 169 µg/L total in the 42-day exposure; Table 1; Appendix B – Nautilus 2017).

The reproductive endpoint in the 42-day test of *H. azteca* was the most sensitive endpoint and was the only endpoint (as reported in Appendix B – Nautilus 2017) with a reported IC20 lower than the SSWQO of 20 µg/L (Table 1 and Figure 3). Despite good *H. azteca* survival and growth at nominal copper concentrations up to approximately 80 µg/L (measured as 86.4 µg/L dissolved copper and 92.7 µg/L total copper), the IC20 for the *H. azteca* reproductive endpoint was <14.9 µg/L dissolved copper (<17.5 µg/L total copper) and mean reproduction was significantly lower than that associated with the laboratory control (Table 2; Figure 4). Reproductive output associated with all exposure concentrations were significantly lower than the laboratory control with the exception of the nominal 5 µg/L treatment (19.8 µg/L dissolved copper and 22.3 µg/L total copper; Figure 4).

Expression of the IC20 as a “<” (Table 1; Appendix B – Nautilus 2017) prompted a review of the test data and the associated statistical analysis. Review of the test data (Appendix B – Nautilus 2017) and statistical examination of the data (Appendix C) revealed three primary issues contributing to the “<” result: 1) extreme reproductive output associated with two of eight laboratory control organisms (43, 30, 16, 12, 12, 11, 11, and 7 neonates); 2) an unusual dose-response curve (e.g., reproductive output in the nominal 5 µg/L treatment was higher than that of the site control, reproductive output in the nominal 20 µg/L treatment was greater than that of the 10 µg/L treatment; Figure 4); and 3) strong heterogeneity of variance that violated the assumptions of the log-linear regression model applied in the data analysis. Re-analysis was conducted to address some of these issues (Table 2; Appendix C). The approach addressed the leveraging effect of the two unusually high reproductive outputs by basing analysis upon the

median lab control (12 neonates per organism versus a leveraged mean of 17.8 neonates per organism), identified and eliminated on outlier (associated with the nominal 10 µg/L treatment), and eliminated the violation of the assumption of homogeneity of variance by data transformation (Appendix C). The regression models with the best overall fit indicated IC20 values for *H. azteca* reproduction of 27.6 µg/L dissolved copper and 30.1 µg/L total copper (Figure 5; Appendix C).

Comparisons to Clear Flow Toxicity Testing


The concentration of DOC was substantially higher during turbid flow conditions (29.1 ± 3.0 mg/L) than during clear flow conditions (9.2 ± 0.5 mg/L). During clear flow conditions, the only endpoints with effect concentrations lower than 20 µg/L were survival of *D. magna* and reproduction of *H. azteca*. Neither of these endpoints differed significantly from the laboratory control at the 20 µg/L exposure concentration (or lower). During turbid flow conditions, survival of *D. magna* was not impacted by even the highest test concentration (149 µg/L dissolved copper), a substantial difference from the LC20 observed during clear flow testing (18.3 µg/L dissolved copper). The difference is consistent with amelioration of copper toxicity by DOC (e.g., Grosell 2012). The difference between clear- and turbid-flow IC20 values for *H. azteca* reproduction was much smaller than for *D. magna* survival (27.6 µg/L dissolved copper in turbid-flow testing versus 17.6 µg/L copper in clear-flow testing). Reproduction is typically highly correlated with biomass (e.g., Ivey et al. 2016), and was 2.5-times more sensitive than biomass in the clear water testing and 3.5-times more sensitive than biomass in the turbid water testing. Similarly, sensitivity of the *H. azteca* reproduction endpoint was almost identical to that of *D. magna* survival in clear water testing, but was 5.4-times more sensitive in turbid water testing. Although the reproductive endpoint in *H. azteca* tests is known to be among the more variable test endpoints, this suggests that *H. azteca* reproduction may not respond to concentrations of copper and DOC in the same manner as *D. magna* survival.

Conclusion and Closure

As defined in the Study Plan (Appendix A), the SSWQO for copper (20 µg/L dissolved copper when DOC is greater than 10 mg/L) would be considered protective of aquatic organisms in site water if the reported 20th percentile effect concentrations are greater than 20 µg/L and copper concentrations of 20 µg/L (and lower) also do not differ significantly from the control. This was the case for all endpoints in the clear flow testing (sample collected on September 28th 2015; Minnow 2017) and in turbid flow testing (sample collected May 5th 2017). Specifically, in the clear flow testing, two 20th percentile endpoints were less than 20 µg/L dissolved copper (the LC20 for *D. magna* [18.3 µg/L dissolved copper] and the IC20 for *H. azteca* reproduction

[17.6 µg/L dissolved copper]), but neither differed significantly from the laboratory control (Minnow 2016). In the turbid flow testing, all lowest 20th percentile effect endpoints were greater than 20 µg/L dissolved copper (the lowest IC20 value [by far] was for reproduction in the 42-day test of *H. azteca* [27.6 µg/L dissolved copper]). Therefore, the SSWQO for copper, as defined in Minto's Water Use Licence (WUL), appears to be protective of the aquatic life of Minto Creek.

Sincerely,
Minnow Environmental Inc.

A handwritten signature in blue ink, appearing to read 'Pierre Stecko', is positioned above the typed name.

Pierre Stecko, M.Sc., EP, RPBio
Senior Aquatic Scientist

References

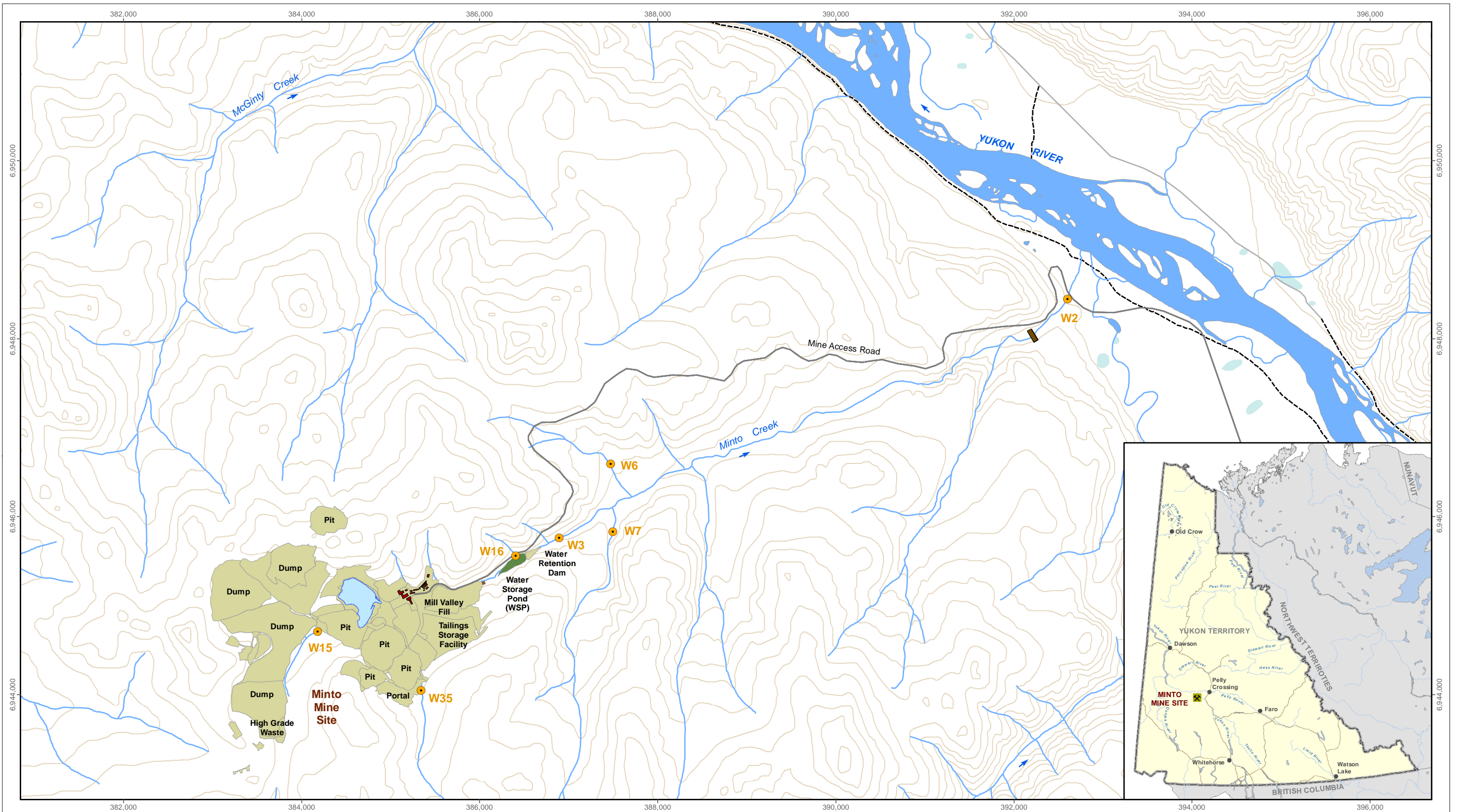
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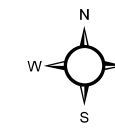
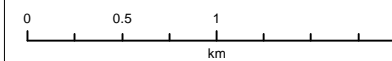
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FIGURES



- LEGEND**
- Water Quality Station
 - Main Pit Lake
 - Fish Barrier
 - Building
 - Water Storage Pond
 - Mine Footprint



Projection: North American Datum 1983 UTM Zone 8U
 Reproduced under licence from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

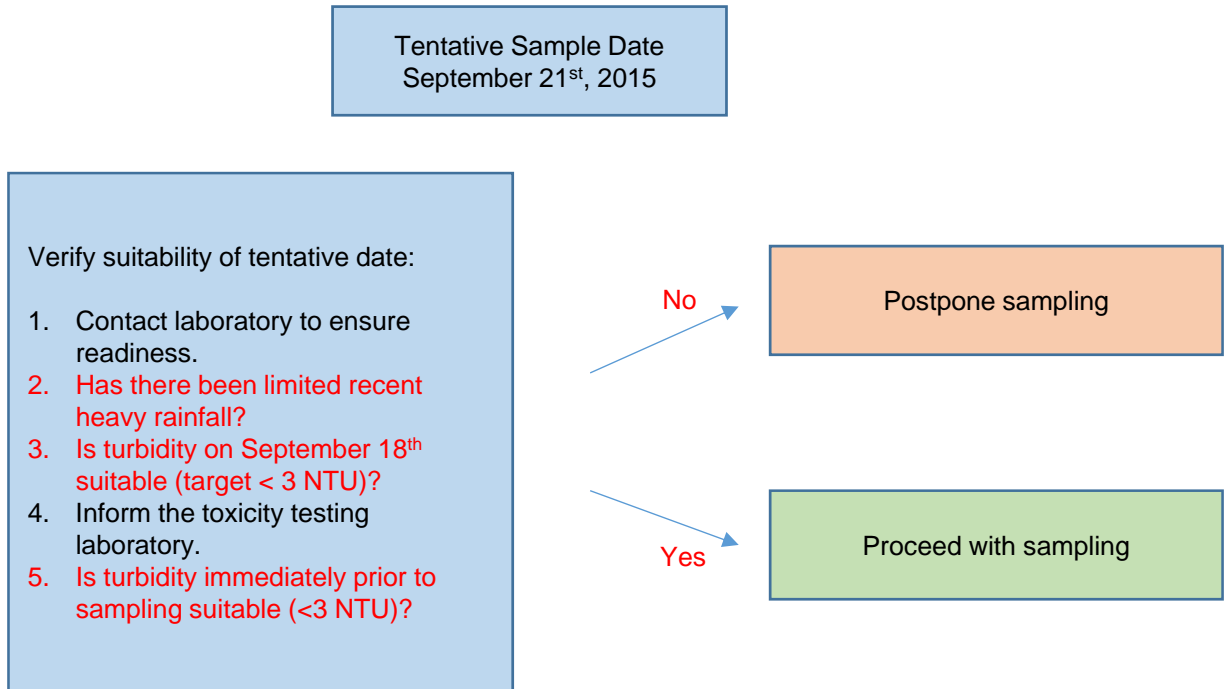
Location and Layout of the Minto Mine

Date January 2018
 Project 157202.0072



Figure 1

a: Clear flow conditions (< 25 mg/L TSS)



b: Turbid flow conditions (> 25 mg/L TSS)

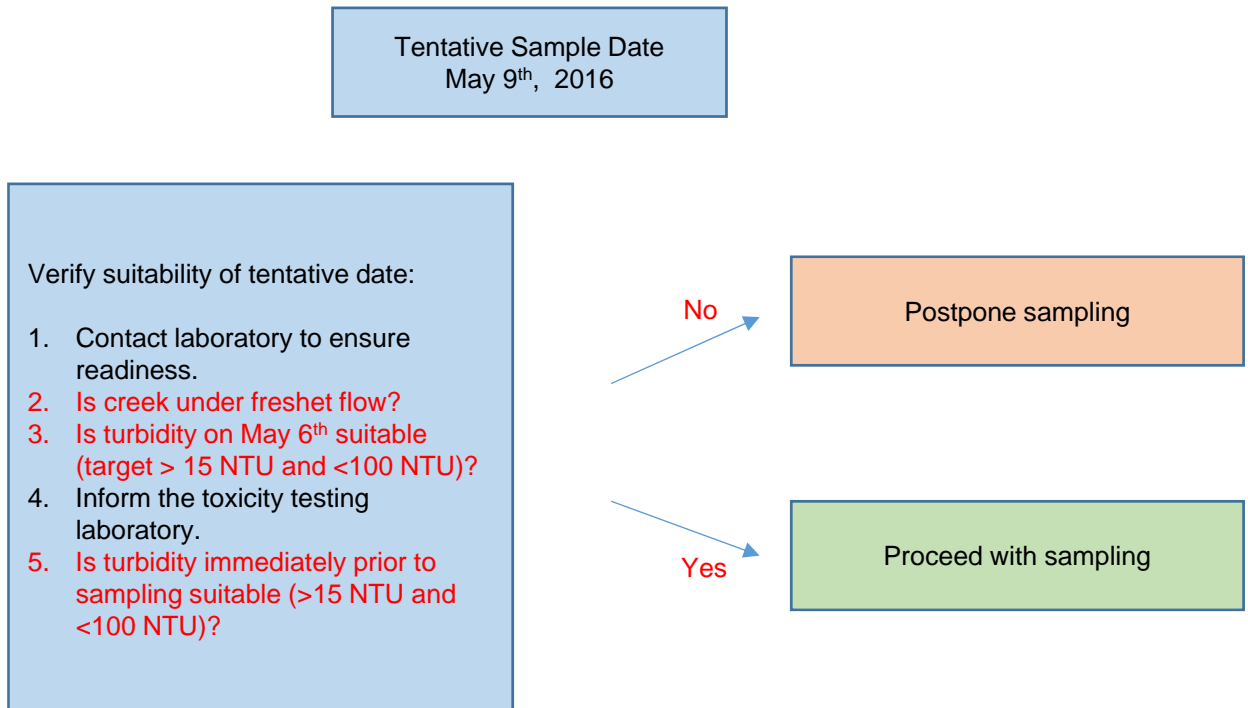


Figure 2: Original Decision Path for when to Sample under a) Clear Flow (< 25 mg/L Total Suspended Solids [TSS]); and b) Turbid Flow (> 25 mg/L TSS)

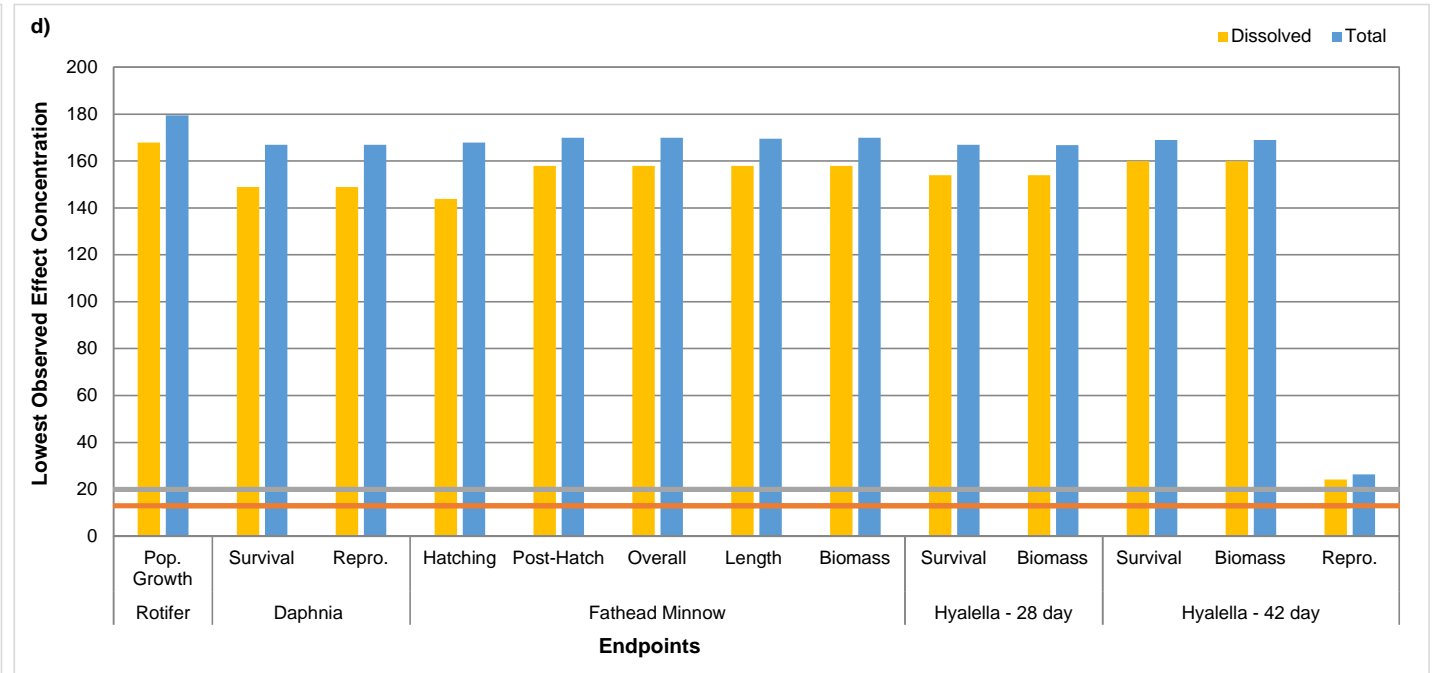
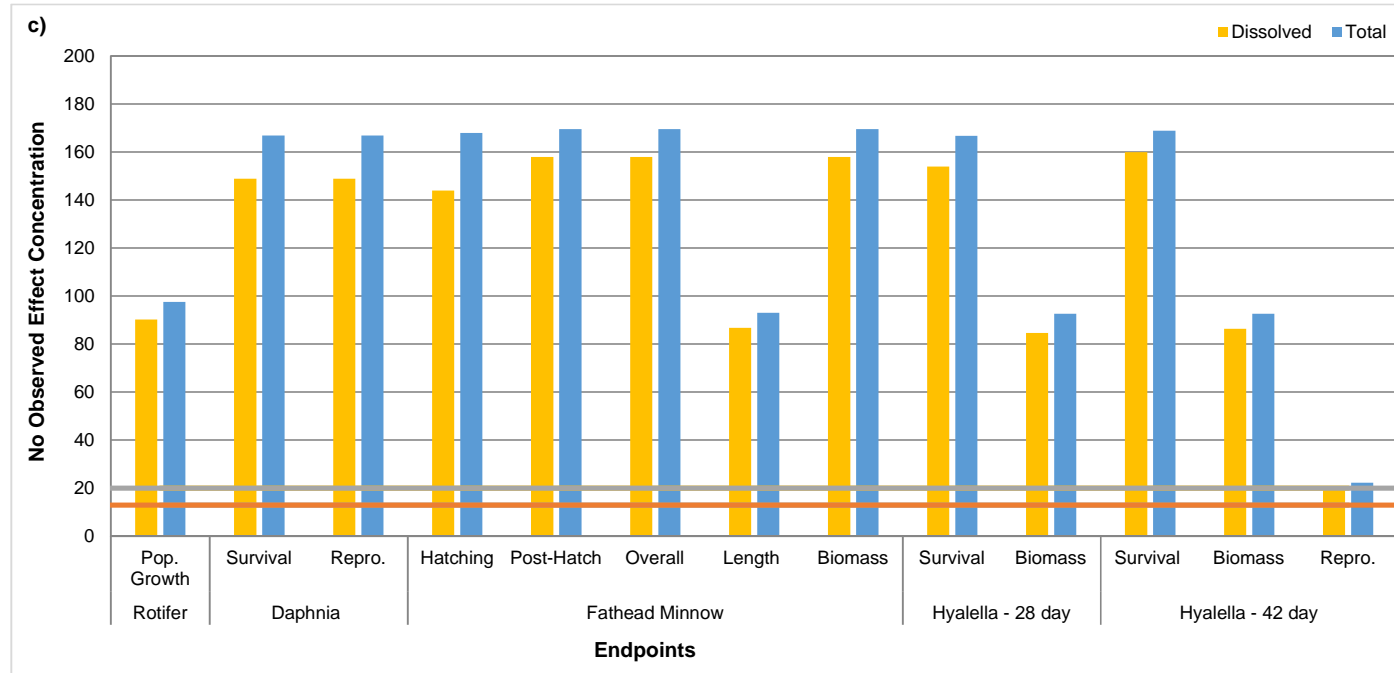
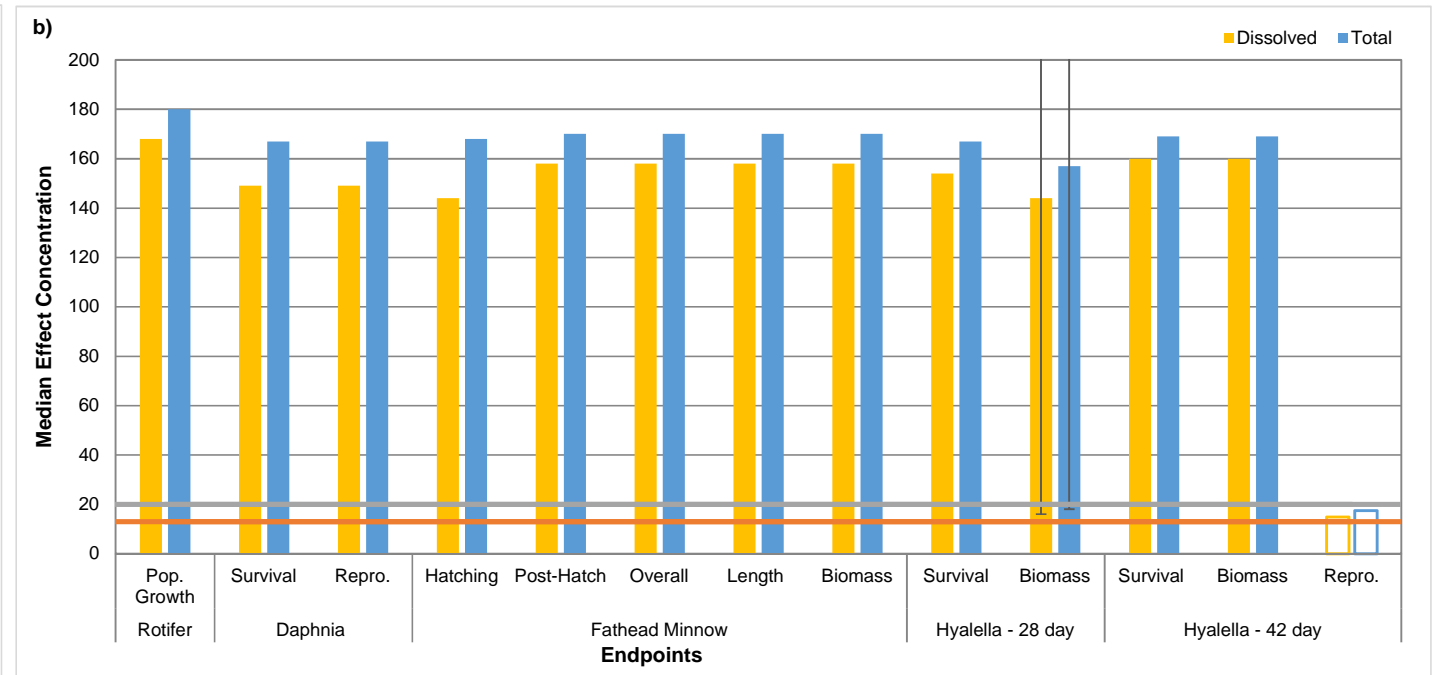
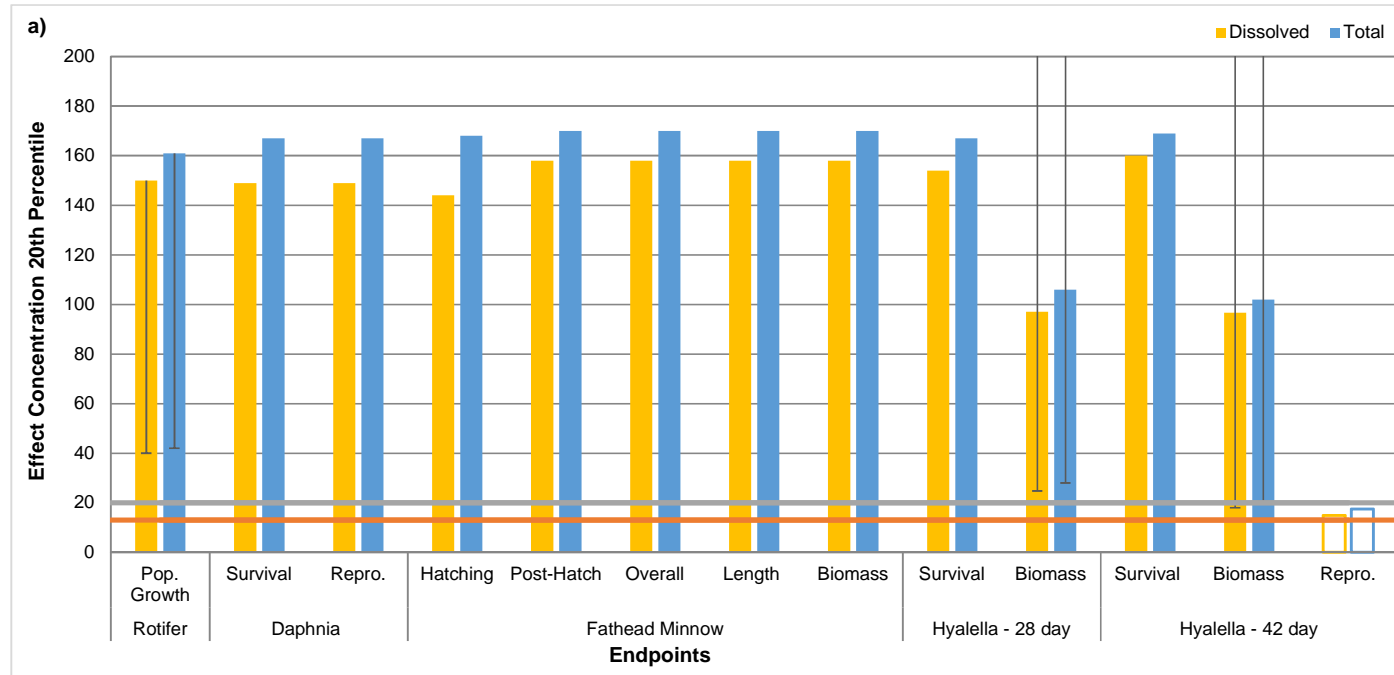


Figure 3: Copper Concentrations (Dissolved and Total) from Sub-lethal Toxicity Tests of Minto Creek Water under Turbid Flow (May 5, 2017): a) 20th Percentile Effect Concentrations; b) Median Effect Concentrations; c) No Observed Effect Concentrations; and d) Lowest Observed Effect Concentrations

Notes: Pop. Growth = Population Growth; Repro. = Reproduction; Hatching = Hatching Success; Post-Hatch = Post-Hatch Survival; Overall = Overall Survival; Rotifer = *Brachionus calyciflorus*; Daphnia = *Daphnia magna*; FHM = *Pimephales promelas*; Hyalella = *Hyalella azteca*.
 Orange lines represent Water Quality Objective of 13 µg/L when dissolved organic carbon (DOC) ≤ 10 mg/L.
 Grey lines represent Water Quality Objective of 20 µg/L when dissolved organic carbon (DOC) > 10 mg/L.
 Hollow bars represent endpoints reported as "less than" (<) values.

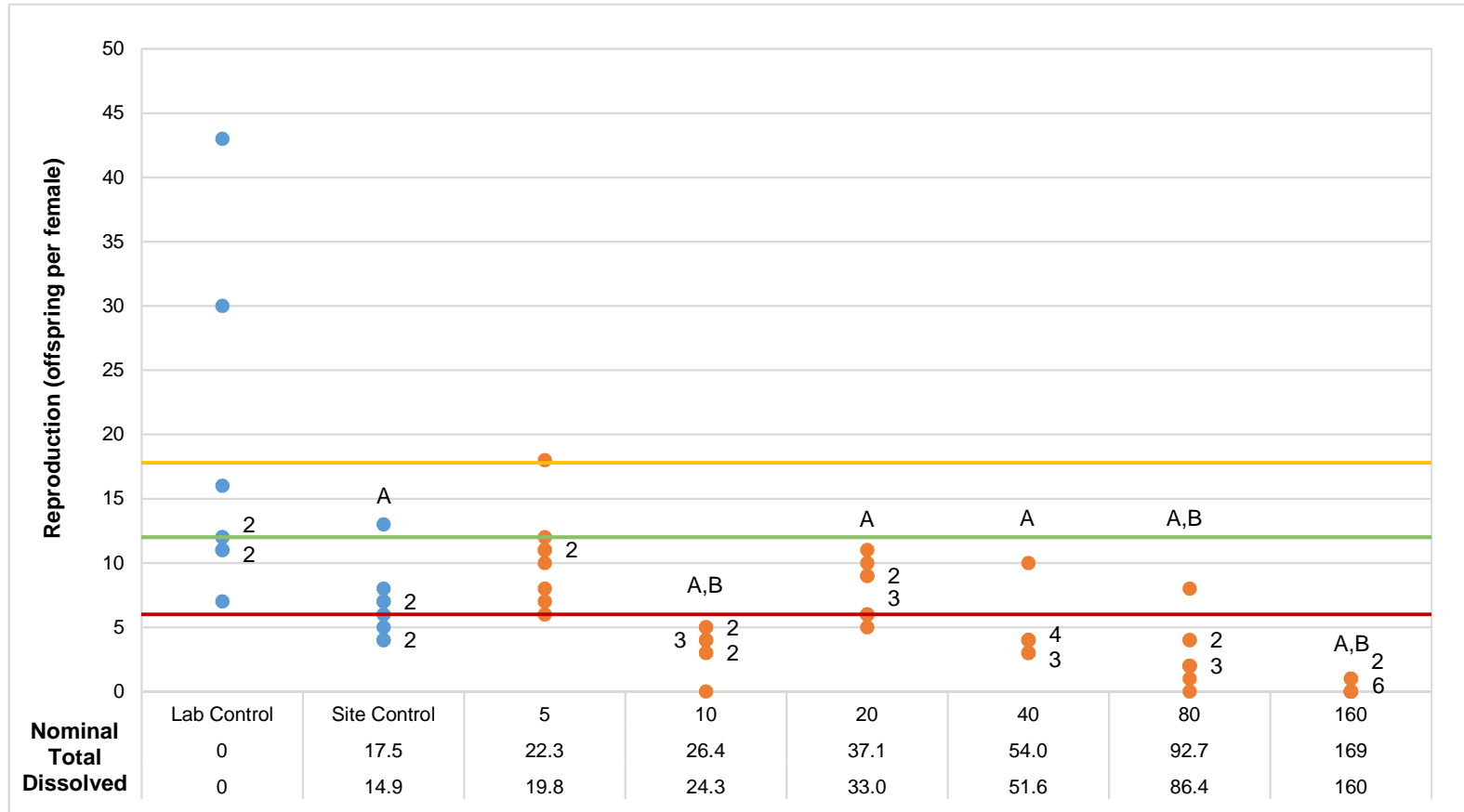


Figure 4: Reproduction Results of *Hyalella azteca* 42 day Test During Turbid Flow Conditions

Notes: Letters represent significant differences between spiked copper samples (orange) and controls (blue). A represents a significant difference from the laboratory control and B represents a significant difference from the site control.

Red solid line represents the laboratory control performance criteria of 6 offspring per female (Nautilus 2017).

Green solid line represents the laboratory control median (12.0 offspring per female).

Yellow solid line represents the laboratory control mean (17.8 offspring per female).

Numbers beside dots indicate number of replicates (n=8) with same result.

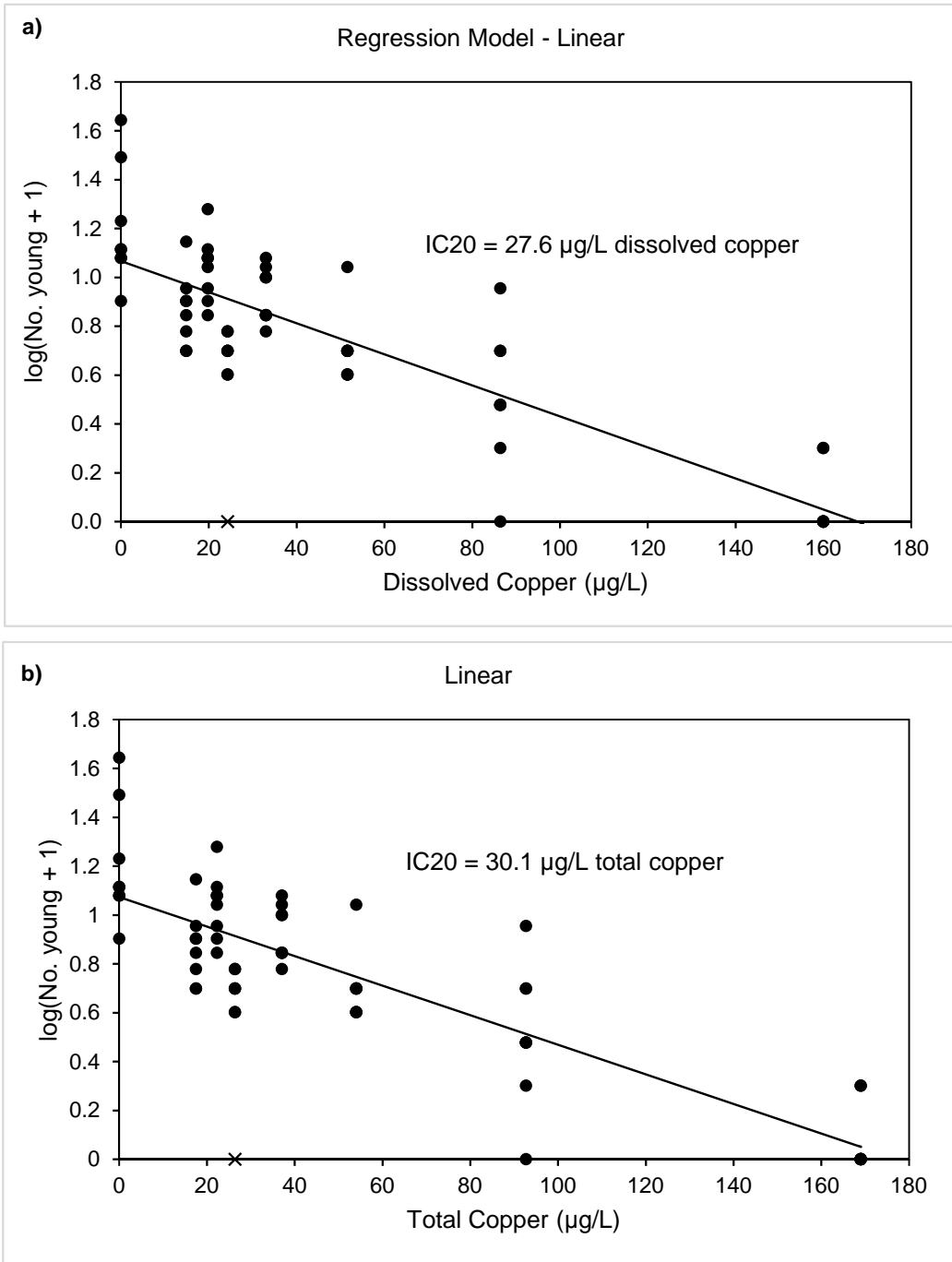


Figure 5: Scatterplots and Best-Fit Regression Models for *Hyallela azteca* 42-d Reproduction versus Concentration: a) Dissolved Copper; b) Total Copper, Minto Creek Turbid Flow, May 5th 2017

Notes: outliers removed from analysis denoted by an ×

TABLES

Table 1: Results of Turbid Flow Toxicity Testing of Dissolved and Total Copper (µg/L) as Reported in Appendix B (Nautilus 2017) ^a

| Organism | Endpoint | Dissolved Copper (µg/L) | | | | | | Total Copper (µg/L) | | | | | |
|--|------------------------|-------------------------|-------|--------------------|------------------|------|-------|---------------------|-------|-------------------|------------------|------|-------|
| | | LC20 | LC50 | IC20 | IC50 | NOEC | LOEC | LC20 | LC50 | IC20 | IC50 | NOEC | LOEC |
| <i>Brachionus calyciflorus</i> - 48 hour | Population Growth Rate | - | - | 150 (110-NC) | > 168 | 90 | 168 | - | - | 161 (119-NC) | > 180 | 98 | 180 |
| <i>Daphnia magna</i> - 21 day | Survival | > 149 | > 149 | - | - | 149 | > 149 | > 167 | > 167 | - | - | 167 | > 167 |
| | Reproduction | - | - | > 149 | > 149 | 149 | > 149 | - | - | > 167 | > 167 | 167 | > 167 |
| <i>Pimephales promelas</i> - 32 day | Hatching Success | > 144 | > 144 | - | - | 144 | > 144 | > 168 | > 168 | - | - | 168 | > 168 |
| | Post-hatch Survival | > 158 | > 158 | - | - | 158 | > 158 | > 170 | > 170 | - | - | 170 | > 170 |
| | Overall Survival | > 158 | > 158 | - | - | 158 | > 158 | > 170 | > 170 | - | - | 170 | > 170 |
| | Length | - | - | > 158 | > 158 | 87 | 158 | - | - | > 170 | > 170 | 93 | 170 |
| | Biomass | - | - | > 158 | > 158 | 158 | > 158 | - | - | > 170 | > 170 | 170 | > 170 |
| <i>Hyalella azteca</i> - 28 day | Survival | > 154 | > 154 | - | - | 154 | > 154 | > 167 | > 167 | - | - | 167 | > 167 |
| | Biomass | - | - | 97 (72.2-116) | 144 (128-163) | 85 | 154 | - | - | 106 (78-126) | 157 (139-177) | 93 | 167 |
| <i>Hyalella azteca</i> - 42 day | Survival | > 160 | > 160 | - | - | 160 | > 160 | > 169 | > 169 | - | - | 169 | > 169 |
| | Biomass | - | - | 96.6 (78.6-115) | > 160 | 86 | 160 | - | - | 102 (81.6-122) | > 169 | 93 | 169 |
| | Reproduction | - | - | < 14.9 | < 14.9 | 20 | 24 | - | - | < 17.5 | < 17.5 | 22 | 26 |

^a Water sample collected on May 5th, 2017.



 Endpoint value is lower than 13 µg/L (the water quality objective [WQO] applicable at dissolved organic carbon [DOC] ≤ 10 mg/L).
 Endpoint value is lower than 20 µg/L (the water quality objective [WQO] applicable at dissolved organic carbon [DOC] > 10 mg/L).

Table 2: Evaluation of Turbid Flow Toxicity Testing of Dissolved and Total Copper (µg/L) Relative to Pre-Defined Criteria ^a

| Organism | Endpoint | Criterion 1 ^b | | | | Criterion 2 ^c | | | | | | | | |
|--|---------------------------|--|-----------------|---------------------|-----------------|--|---------|-------------------------|--|---------|-------------------------|---|---------|-------------------------|
| | | LC20 or IC20 (Measured Concentrations) | | | | Copper Treatment | | | | | | | | |
| | | Dissolved Copper (µg/L) | | Total Copper (µg/L) | | Site Control (Nominal) 14 - 20 µg/L (Dissolved) 17 - 24 µg/L (Total) | | | 5 µg/L (Nominal) 18 - 25 µg/L (Dissolved) 21 - 28 µg/L (Total) | | | 10 µg/L (Nominal) 23 - 30 µg/L (Dissolved) 26 - 34 µg/L (Total) | | |
| | | Mean | EC20 < 20 µg/L? | Mean | EC20 < 20 µg/L? | Mean ± SD | p value | Significant Difference? | Mean ± SD | p value | Significant Difference? | Mean ± SD | p value | Significant Difference? |
| <i>Brachionus calyciflorus</i> - 48 hour | Population Growth Rate | 150 | NO | 161 | NO | 0.67 ± 0.09 | 0.890 | NO | 0.78 ± 0.09 | 1.000 | NO | 0.82 ± 0.11 | 1.000 | NO |
| <i>Daphnia magna</i> - 21 day | Survival | > 149 | NO | > 167 | NO | 100 | 1.000 | NO | 90 | 1.000 | NO | 100 | 1.000 | NO |
| | Reproduction | > 149 | NO | > 167 | NO | 117 ± 19 | 1.000 | NO | 113 ± 14 | 1.000 | NO | 114 ± 39 | 1.000 | NO |
| <i>Pimephales promelas</i> - 32 day | Hatching Success | > 144 | NO | > 168 | NO | 95 ± 6.4 | 0.753 | NO | 97 ± 3.9 | 0.875 | NO | 100 ± 0 | 0.987 | NO |
| | Post-hatch Survival | > 158 | NO | > 170 | NO | 74 ± 26 | > 0.050 | NO | 90 ± 8.5 | > 0.050 | NO | 88 ± 6.4 | > 0.050 | NO |
| | Overall Survival | > 158 | NO | > 170 | NO | 70 ± 25 | 0.118 | NO | 87 ± 5.4 | 0.726 | NO | 88 ± 6.3 | 0.818 | NO |
| | Length | > 158 | NO | > 170 | NO | 9.9 ± 0.8 | 0.985 | NO | 9.1 ± 0.1 | 0.172 | NO | 9.1 ± 0.1 | 0.150 | NO |
| | Biomass | > 168 | NO | > 170 | NO | 1.01 ± 0.04 | 0.550 | NO | 0.95 ± 0.18 | 0.303 | NO | 0.93 ± 0.07 | 0.230 | NO |
| <i>Hyalella azteca</i> - 28 day | Survival | > 154 | NO | > 167 | NO | 94 ± 7.9 | 0.908 | NO | 93 ± 7.8 | 0.826 | NO | 92 ± 7.1 | 0.567 | NO |
| | Biomass | 97 | NO | 106 | NO | 0.69 ± 0.10 | 0.778 | NO | 0.68 ± 0.07 | 0.718 | NO | 0.78 ± 0.08 | 0.998 | NO |
| <i>Hyalella azteca</i> - 42 day | Survival | > 160 | NO | > 169 | NO | 86 ± 11 | 0.884 | NO | 85 ± 11 | 0.820 | NO | 85 ± 14 | 0.849 | NO |
| | Biomass | 97 | NO | 102 | NO | 0.92 ± 0.16 | 0.973 | NO | 0.94 ± 0.13 | 0.992 | NO | 0.92 ± 0.11 | 0.972 | NO |
| | Reproduction | < 14.9 | YES | < 17.5 | YES | 6.8 ± 2.9 | 0.025 | YES | 10.4 ± 3.7 | 0.374 | NO | 3.5 ± 1.6 | < 0.001 | NO |
| | Reproduction ^d | 27.6 | NO | 30.1 | NO | 6.8 ± 2.9 | 0.025 | YES | 10.4 ± 3.7 | 0.374 | NO | 3.5 ± 1.6 | < 0.001 | NO |


^a Water sample collected on May 5th, 2017.

^b 20th percentile effect concentration relative to 20 µg/L.

^c Concentrations not significantly different from control.

^d Re-analysis to address the leveraging effect of extreme reproduction in two laboratory control replication and a violation of the assumption of equality of variance.

 Endpoint value is lower than 13 µg/L (the water quality objective [WQO] applicable at dissolved organic carbon [DOC] ≤ 10 mg/L).

 Endpoint value is lower than 20 µg/L (the water quality objective [WQO] applicable at dissolved organic carbon [DOC] > 10 mg/L).


 p value < 0.050.

Table 2: Evaluation of Turbid Flow Toxicity Testing of Dissolved and Total Copper (µg/L) Relative to Pre-Defined Criteria ^a

| Organism | Endpoint | Criterion 2 ^c | | | | | | | | | | | |
|--|---------------------------|---|---------|-------------------------|---|---------|-------------------------|---|---------|-------------------------|--|---------|-------------------------|
| | | Copper Treatment | | | | | | | | | | | |
| | | 20 µg/L (Nominal) 31 - 39 µg/L (Dissolved) 36 - 44 µg/L (Total) | | | 40 µg/L (Nominal) 49 - 56 µg/L (Dissolved) 53 - 63 µg/L (Total) | | | 80 µg/L (Nominal) 84 - 90 µg/L (Dissolved) 93 - 98 µg/L (Total) | | | 160 µg/L (Nominal) 149 - 168 µg/L (Dissolved) 167 - 180 µg/L (Total) | | |
| | | Mean ± SD | p value | Significant Difference? | Mean ± SD | p value | Significant Difference? | Mean ± SD | p value | Significant Difference? | Mean ± SD | p value | Significant Difference? |
| <i>Brachionus calyciflorus</i> - 48 hour | Population Growth Rate | 0.90 ± 0.07 | 1.000 | NO | 0.85 ± 0.06 | 1.000 | NO | 0.78 ± 0.09 | 1.000 | NO | 0.50 ± 0.11 | 0.040 | YES |
| <i>Daphnia magna</i> - 21 day | Survival | 100 | 1.000 | NO | 90 | 1.000 | NO | 100 | 1.000 | NO | 100 | 1.000 | NO |
| | Reproduction | 115 ± 11 | 1.000 | NO | 119 ± 17 | 1.000 | NO | 141 ± 16 | 1.000 | NO | 128 ± 16 | 1.000 | NO |
| <i>Pimephales promelas</i> - 32 day | Hatching Success | 100 ± 0 | 0.987 | NO | 98 ± 3.3 | 0.955 | NO | 90 ± 13 | 0.327 | NO | 97 ± 6.7 | 0.891 | NO |
| | Post-hatch Survival | 85 ± 14 | > 0.050 | NO | 90 ± 3.7 | > 0.050 | NO | 83 ± 8.5 | > 0.050 | NO | 93 ± 0.5 | > 0.050 | NO |
| | Overall Survival | 85 ± 14 | 0.708 | NO | 88 ± 3.3 | 0.801 | NO | 75 ± 15 | 0.184 | NO | 90 ± 6.7 | 0.887 | NO |
| | Length | 9.4 ± 0.2 | 0.627 | NO | 9.1 ± 0.1 | 0.130 | NO | 9.0 ± 0.7 | 0.096 | NO | 8.7 ± 0.3 | 0.009 | YES |
| | Biomass | 1.06 ± 0.13 | 0.741 | NO | 0.97 ± 0.10 | 0.382 | NO | 1.00 ± 0.30 | 0.514 | NO | 0.92 ± 0.17 | 0.216 | NO |
| <i>Hyalella azteca</i> - 28 day | Survival | 88 ± 11 | 0.376 | NO | 97 ± 4.9 | 0.984 | NO | 98 ± 4.5 | 0.994 | NO | 85 ± 9.1 | 0.050 | NO |
| | Biomass | 0.77 ± 0.07 | 0.996 | NO | 0.67 ± 0.09 | 0.662 | NO | 0.63 ± 0.06 | 0.296 | NO | 0.32 ± 0.04 | < 0.001 | NO |
| <i>Hyalella azteca</i> - 42 day | Survival | 80 ± 11 | 0.433 | NO | 93 ± 7 | 0.996 | NO | 91 ± 8 | 0.990 | NO | 76 ± 14 | 0.211 | NO |
| | Biomass | 0.89 ± 0.10 | 0.918 | NO | 0.95 ± 0.10 | 0.996 | NO | 0.74 ± 0.16 | 0.085 | NO | 0.49 ± 0.15 | < 0.001 | NO |
| | Reproduction | 7.8 ± 2.3 | 0.008 | YES | 4.4 ± 2.3 | 0.001 | YES | 2.9 ± 2.5 | 0.001 | YES | 0.3 ± 0.5 | 0.001 | YES |
| | Reproduction ^d | 7.8 ± 2.3 | 0.008 | YES | 4.4 ± 2.3 | 0.001 | YES | 2.9 ± 2.5 | 0.001 | YES | 0.3 ± 0.5 | 0.001 | YES |


^a Water sample collected on May 5th, 2017.

^b 20th percentile effect concentration relative to 20 µg/L.

^c Concentrations not significantly different from control.

^d Re-analysis to address the leveraging effect of extreme reproduction in two laboratory control replication and a violation of the assumption of equality of variance.

 Endpoint value is lower than 13 µg/L (the water quality objective [WQO] applicable at dissolved organic carbon [DOC] ≤ 10 mg/L).

 Endpoint value is lower than 20 µg/L (the water quality objective [WQO] applicable at dissolved organic carbon [DOC] > 10 mg/L).

 p value < 0.050.

APPENDIX

APPENDIX A
STUDY PLAN FOR EVALUATING THE
TOXICITY OF COPPER TO SELECTED
AQUATIC ORGANISMS IN MINTO CREEK
WATER – VERSION 3
(MESL 2015)

Attachment 1:

Study Plan for Evaluating the Toxicity of Copper to Selected Aquatic Organisms in Minto Creek Water Version 3

Prepared by: MESL/PERC, with comments by Minnow Environmental
Version 3 Prepared: January 14, 2015

Purpose: The purpose of this study is to determine if the proposed water quality objective (WQO) for copper in Minto Creek (20 µg/L) would be protective of aquatic organisms.

Approach: The protectiveness of the proposed WQO for copper would be evaluated by conducting a series of laboratory toxicity tests with selected species of fish and invertebrates. A resident species approach could be applied to evaluate the protectiveness of the proposed WQO (which could involve toxicity testing with chinook salmon, slimy sculpin, Yukon floaters, and various crustaceans and/or insect larvae). However, it is more practical to utilize an indicator species approach that involves conducting toxicity tests with a number of commonly-tested fish and invertebrate species that are likely to be representative of sensitive species that utilize aquatic habitats within Minto Creek. Application of this approach would involve:

- Collecting site water (i.e., Minto Creek at W2) during two periods of the hydrological regime (i.e., clear flow; TSS < 25 mg/L; and, turbid flow: TSS ≥ 25 mg/L);
- Transporting sufficient quantities of site water to the toxicity testing laboratory to support toxicity testing;
- Spiking site water with copper chloride to achieve five exposure concentrations, as well as a negative control (Lab water), site control (i.e., unspiked site water);
- Conducting a total of four long-term (i.e., chronic) static-renewal toxicity tests to evaluate the effects of copper on aquatic organisms in site water, including:
 1. 42-d toxicity test with the amphipod, *Hyaella azteca* (Endpoints: Survival, growth, and reproduction);

2. 21-d toxicity test with the cladoceran, *Daphnia magna* (Endpoints: Survival and reproduction);
 3. 48-h toxicity test with the rotifer, *Brachionus calyciflorus* (Endpoint: Intrinsic rate of population increase); and,
 4. 32-d toxicity test with fathead minnows, *Pimephales promelas* (Endpoints: Hatching success, total post-hatch survival, overall survival, and dry weight);
- Conducting a reference toxicity test with each species to confirm that sensitivity is within the expected range;
 - Measuring the concentrations of total and dissolved copper in each treatment for each toxicity test at the beginning of the test, the end of the test, and periodically during the test (i.e., depending on when new batches of site water are used and/or when dilution water is prepared. Note our preference would be to have all of the tests conducted with a single batch of homogenized site water);
 - Characterizing water quality in each treatment at the beginning of the test, the end of the test, and periodically during the test (i.e., depending on when new batches of site water are used);
 - Calculating EC₁₀ and EC₂₀ values; and,
 - Compiling and reporting the results of the toxicity testing program.

Interpretation: The WQO for copper will be considered to be protective if the reported EC₂₀ values are greater than 20 µg/L for all tested species and the 20 µg/L treatment does not differ significantly from the control (p = 0.05). If one or more of the EC₂₀ values is less than or equal to the proposed WQO and the 20 µg/L treatment is significantly impaired relative to control (p = 0.05), the WQO would be revised downward to establish a level that is protective of aquatic organisms in site water.

Note: This general approach can be modified to evaluate the protectiveness of the WQOs that have been proposed for all of the COPCs. In this case, site water would be spiked with all of the identified COPCs at levels equivalent to the WQOs (i.e., in site water collected during clear-flow and turbid flow periods).

Note: Add Table of Test Conditions for Each Toxicity Test to complete Study Plan.

APPENDIX B
COPPER TOXICITY TESTING FOR MINTO
CREEK
(NAUTILUS 2017)



Copper Toxicity Testing for Minto Creek

W2, W16

Final Report

November 6, 2017

Submitted to: **Minnow Environmental Inc.**
Victoria, BC

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SIGNATURE PAGE

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This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

SUMMARY

A summary of sample information and test results from the *Brachionus calyciflorus*, *Daphnia magna*, *Pimephales promelas* and *Hyaella azteca* toxicity tests are provided in the tables below for the samples W2 and W16 amended with copper. Testing was initiated for *B. calyciflorus* on May 23, 2017 at the Nautilus Burnaby laboratory. Testing was initiated for *D. magna* on May 24, 2017 and for *P. promelas* and *H. azteca* on May 25, 2017 at the Nautilus Calgary laboratory.

Sample and Test Type Information

| | |
|----------------------------|--------------------------------|
| Sample ID | W2, W16 |
| Sample collection date | May 5, 2017 |
| Sample receipt date | May 12, 2017 |
| Sample receipt temperature | 6°C |
| Test species | <i>Brachionus calyciflorus</i> |
| | <i>Daphnia magna</i> |
| | <i>Pimephales promelas</i> |
| | <i>Hyaella azteca</i> |

Summary of Results

| Endpoint | Sample ID | |
|--------------------------|--|----------------------------------|
| | W2:W16 (3:1 ratio) amended with copper | |
| | Total copper endpoint (µg/L) | Dissolved copper endpoint (µg/L) |
| <i>B. calciflorus</i> | | |
| Growth IC20 | 161 (119-NC) | 150 (110-NC) |
| <i>D. magna</i> | | |
| Survival LC20 | >167 | >149 |
| Reproduction IC20 | >167 | >149 |
| <i>P. promelas</i> | | |
| Hatch % EC20 | >168 | >144 |
| Post Hatch Survival EC20 | >170 | >158 |
| Overall Survival EC20 | >170 | >158 |
| Biomass IC20 | >170 | >158 |
| Length IC20 | >170 | >158 |
| <i>H. azteca</i> | | |
| 28-d Survival LC20 | >167 | >154 |
| 42-d Survival LC20 | >169 | >160 |
| 28-d Biomass IC20 | 106 (78.0-126) | 97.0 (72.2-116) |
| 42-d Biomass IC20 | 102 (81.6-122) | 96.6 (76.8-115) |
| Reproduction IC20 | <17.5 | <14.9 |

1.0 INTRODUCTION

Nautilus Environmental Company Inc. (Nautilus Environmental) conducted sub-lethal toxicity tests for Minnow Environmental Inc. (Minnow Environmental) to investigate the effects of copper in site water collected from Minto Creek by Minto Mine. This investigation was conducted on site water with elevated total suspended solids and the purpose was to determine if the proposed water quality objective for copper in Minto Creek would be protective of aquatic life.

The following sub-lethal toxicity tests were performed:

- 48-hour *Brachionus calyciflorus* population growth test
- 21-day *Daphnia magna* survival and reproduction test
- 32-day *Pimephales promelas* survival and growth test
- 42-day *Hyaella azteca* survival, reproduction and growth test

The *B. calyciflorus* test was performed at the Nautilus Environmental Burnaby, BC location, while all other testing took place at the Nautilus Environmental Calgary, AB location.

2.0 METHODS

Water samples were collected on May 5, 2017 from stations W2 and W16 and were submitted by Minto Mine to Nautilus Environmental in Calgary, AB on May 12, 2017. The samples were delivered in 200-L plastic drums and were received in good condition.

Test water was prepared in the laboratory by mixing the two site waters in a 3:1 ratio of W2:W16. The site water was then amended with copper using a stock solution of copper chloride dihydrate. The nominal concentrations of copper tested were 5, 10, 20, 40, 80 and 160 µg/L. In addition to un-amended site water, laboratory control water was also evaluated in each test. Total and dissolved copper was measured weekly in each test concentration and calcium, magnesium, potassium, sodium, sulfate, chloride and alkalinity were measured in the site and laboratory controls. The site control water was also analyzed weekly for dissolved organic carbon. Chemical analysis was performed by ALS Laboratories.

Testing was conducted following standard protocols that are currently employed in Canada and the United States and are described in further detail below. Statistical analyses for all tests were performed using CETIS (Tidepool Scientific Software, 2015) and are based on average measured total or dissolved copper. Where possible, linear or non-linear regression models were used to

calculate point estimates. In cases where the data did not fit these models, linear interpolation of log-transformed data was used.

The *B. calyciflorus* tests followed procedures outlined in Snell and Moffat (1992) and APHA (2012) and are summarized in Table 1. The test was a 48-hour growth test that measured the intrinsic rate of population increase. The test was conducted at $25 \pm 1^\circ\text{C}$ and *B. calyciflorus* were fed green algae (*Pseudokirchneriella subcapitata*) at test initiation.

The *D. magna* test followed methods described in ASTM (2012), which are summarized in Table 2. The test involved a 21-day exposure under static-renewal conditions, with solutions being renewed three times per week and survival and reproduction being monitored. The test was conducted at $20 \pm 1^\circ\text{C}$ and daphnids were fed a mixture of green algae (*P. subcapitata*) and digested yeast, cerophyll and trout chow (YCT).

The *P. promelas* test followed methods described in USEPA (1996) and ASTM (2013), which are summarized in Table 3. The test evaluated hatch, survival and growth during a 32-day static-renewal exposure, with solutions being renewed daily. The test was conducted at $25 \pm 1^\circ\text{C}$ and minnows were fed daily with *Artemia nauplii*. The test used four replicates for each test concentration with 15 eggs in each test container. After 48 hours of exposure, undeveloped eggs in each replicate (i.e., unfertilized eggs) were replaced with eggs contained in two additional sacrificial test containers that were initiated for each test concentration for this purpose.

The *H. azteca* tests followed methods described by USEPA (2000), with modifications described recently by the *Hyaella* Advisory Group, headed by Dr. Chris Ingersoll of USGS. A description of test conditions is provided in Table 4. The test involved a 42 day exposure of 7- to 8-day old organisms using twelve replicates of ten amphipods. Four replicates were terminated at Day 28 to assess biomass and survival, and the remaining eight were continued to Day 42 and were used to evaluate survival, biomass and reproduction. The test organisms were fed a ramped diet of Tetramin and YCT, with increased feeding rates as the test progressed. The test was conducted under static renewal conditions, with one water renewal three times per week. The control and test waters for the *H. azteca* tests contained at least 0.02 mg/L Br and 15 mg/L Cl. Reproduction was assessed on days 35 and 42. On day 42, the number of adult females was evaluated in each replicate so that reproduction could be reported on the basis of the number of female amphipods.

Table 1. Summary of test conditions: *Brachionus calyciflorus* growth test.

| | |
|---|---|
| Test organism | <i>Brachionus calyciflorus</i> |
| Test organism age | < 2 h-post hatch |
| Test type | Static |
| Test duration | 48 h |
| Test chamber | Test tube |
| Test solution volume | 12 mL |
| Test concentrations | Six concentrations, plus site water and laboratory controls |
| Number of replicates | 7 |
| Control water | Moderately-hard reconstituted water (hardness 80-100 mg/L) |
| Test solution renewal | None |
| Test temperature | 25 ± 1°C |
| Number of organisms/chamber | 6 |
| Feeding | <i>Pseudokirchneriella subcapitata</i> at test initiation |
| Photoperiod | Continuous darkness |
| Aeration | None |
| Test protocol | Snell and Moffat (1992); APHA (2012) |
| Test endpoints | Growth rate (intrinsic rate of population increase; r) |
| Test acceptability criterion for controls | r ≥ 0.7 |

Table 2. Summary of test conditions: *Daphnia magna* survival and reproduction test.

| | |
|---|---|
| Test organism | <i>Daphnia magna</i> |
| Test organism source | In-house culture |
| Test organism age | <24-h old neonates |
| Test type | Static-renewal |
| Test duration | 21 days |
| Test chamber | 120-mL plastic cup |
| Test solution volume | 100 mL |
| Test concentrations | Six concentrations, plus site water and laboratory controls |
| Number of replicates | 10 |
| Control/dilution water | Moderately hard water (hardness 80-100 mg/L CaCO ₃) |
| Test solution renewal | Three times weekly |
| Test temperature | 20 ± 2°C |
| Number of organisms/chamber | 1 |
| Feeding | Daily, with <i>Pseudokirchneriella subcapitata</i> and digested yeast, cerophyll and trout chow |
| Light intensity | 400 to 800 lux |
| Photoperiod | 16 hours light/8 hours dark |
| Aeration | None |
| Test protocol | ASTM E1193 – 97 |
| Test endpoints | Survival and reproduction |
| Test acceptability criterion for controls | ≥70% survival; average of ≥60 young per surviving control female |
| Reference Toxicant | Sodium chloride |

Table 3. Summary of test conditions: *Pimephales promelas* early life stage test.

| | |
|---|---|
| Test organism | <i>Pimephales promelas</i> |
| Test organism age | < 24-h old fertilized eggs |
| Test type | Static-renewal |
| Test duration | ~32 days |
| Test chamber | 1-L glass jars |
| Test solution volume | 1 L |
| Test concentrations | Six concentrations, plus site water and laboratory controls |
| Number of replicates | 4 |
| Control water | Dechlorinated tap water amended with 4 mg/L KCl |
| Test solution renewal | Daily |
| Test temperature | 25 ± 1°C |
| Number of organisms/chamber | 15 |
| Feeding | Twice daily, with <i>Artemia</i> nauplii |
| Light intensity | 100 to 600 lux |
| Photoperiod | 16 hours light/8 hours dark |
| Aeration | None unless required to maintain DO >50% saturation |
| Test protocol | USEPA (1996); ASTM (2013) |
| Test endpoints | Survival, hatch, growth |
| Test acceptability criterion for controls | >66% hatch; ≥70% post-hatch survival |

Table 4. Summary of test conditions: *Hyalella azteca* survival, growth and reproduction test.

| | |
|--|--|
| Test organism | <i>Hyalella azteca</i> |
| Test organism age | 7-8 days old |
| Test type | Static-renewal |
| Test duration | 42 days |
| Test vessel | 375 mL glass container with a 5 cm disc of Nitex for substrate |
| Test volume | 200 mL of water |
| Test concentrations | Six concentrations, plus site water and laboratory controls |
| Test replicates | 12 test replicates per treatment; 4 terminated at day 28 |
| Number of organisms | 10 per replicate |
| Control water | Borgman's water (Environment Canada 2011) containing >25 mg/L Cl and supplemented with 0.02 mg/L Br. |
| Test solution renewal | 3 x per week |
| Test temperature | 23 ± 1°C |
| Feeding | 1 mL of YCT daily to each container. Tetramin daily, with amounts in each test container increasing weekly: Week 1, 0.25 mg; Week 2, 0.5 mg; Week 3, 1 mg; Week 4, 1 mg; Week 5, 1.5 mg; Week 6, 2.0 mg. |
| Light intensity | 500 to 1000 lux at water surface |
| Photoperiod | 16 hours light/8 hours dark |
| Aeration | None |
| Test protocol | Modified from US EPA (2000) |
| Test endpoint | Survival, dry weight, reproduction |
| Test acceptability criteria for controls | Mean control survival of ≥80% survival, >6 young/female |
| Reference toxicant | Copper |

3.0 RESULTS

The nominal and mean measured concentration are presented in Table 5. The site control was included in the statistical analysis as an additional treatment level due to the concentration of copper that was present.

Table 5. Measured copper concentration for each test species.

| Nominal Concentration (µg/L Cu) | Mean measured concentration (total, dissolved µg/L Cu) | | | | |
|------------------------------------|--|-----------------|--------------------|---------------------------|---------------------------|
| | <i>B. calyciflorus</i> | <i>D. magna</i> | <i>P. promelas</i> | <i>H. azteca</i> – day 28 | <i>H. azteca</i> – day 42 |
| Site Control | 23.6, 20.0 | 16.6, 13.8 | 18.1, 15.3 | 17.6, 14.7 | 17.5, 14.9 |
| 5 | 28.4, 24.6 | 20.9, 18.0 | 23.0, 20.1 | 22.1, 19.1 | 22.3, 19.8 |
| 10 | 34.0, 30.0 | 25.6, 22.8 | 27.0, 24.5 | 25.9, 23.7 | 26.4, 24.3 |
| 20 | 43.6, 39.0 | 35.6, 31.3 | 37.5, 33.4 | 35.6, 32.4 | 37.1, 33.0 |
| 40 | 63.4, 56.4 | 53.8, 49.0 | 54.7, 50.9 | 53.3, 49.7 | 54.0, 51.6 |
| 80 | 97.6, 90.3 | 94.2, 83.6 | 93.1, 86.9 | 92.7, 84.7 | 92.7, 86.4 |
| 160 | 180, 168 | 167, 149 | 170, 158 | 167, 154 | 169, 160 |

The results of the *B. calyciflorus* test are presented in Table 6. There was an adverse effect observed on the population growth of *B. calyciflorus*, resulting in an IC20 of 161 µg/L total copper.

The results of the *D. magna* test are presented in Table 7. No adverse effects were observed for either survival or reproduction, resulting in endpoints of >167 µg/L total copper for both the LC20 and IC20.

The results of the *P. promelas* test are presented in Tables 8 and 9. No adverse effects were observed on the three survival endpoints in the test (hatch, post hatch survival and overall survival), resulting in an EC20 of >168 µg/L total copper for hatch and >170 µg/L total copper for both post hatch survival and overall survival. The IC20 endpoints for length and biomass were also >170 µg/L total copper. The IC10 reported for biomass is likely an unreliable estimate, as the test was likely not able to statistically detect this level of effect with a reasonable degree of confidence. This is supported by the fact that the NOEC was 169 µg/L and LOEC was >169 µg/L total copper, indicating that there were no statistically significant adverse effects when compared to the laboratory control in any of the concentrations tested.

The results of the *H. azteca* test are presented in Tables 10 and 11. There were no adverse effects observed on survival after 28 and 42 days resulting in LC20 endpoints of >167 and >169 µg/L total copper, respectively. There were adverse effects observed for both biomass and reproduction endpoints. Biomass IC20 endpoints after 28 and 42 days were 106 and 102 µg/L total copper, respectively. The highest test concentration at both time points for biomass was significantly adversely affected when compared to the laboratory control. Reproduction was also adversely affected resulting in an IC20 of <17.5 µg/L total copper; all concentrations, with the exception of 22.3 µg/L total copper, were statistically significantly adversely affected relative to the control.

The low reproduction endpoint observed with *H. azteca* may partially be attributed to the exceptional performance of the laboratory control (average of 17.8 young per female); the site control had an average of 6.8 young per female. Both of these controls met the requirement for control performance of at least 6 offspring per female. It is possible that the difference observed between the two controls reflects random chance, or some influence of differences in water chemistry on the reproductive rate of this species. When the statistical analysis for reproduction was performed in comparison to the site control instead of the laboratory control, the IC20 (and 95% confidence intervals) increased to 33.1 (15.0 – 48.9) µg/L total copper.

Table 6. Results: *B. calyciflorus* toxicity test using copper.

| Copper Concentration (µg/L) | | | Growth rate (r) (Mean ± SD) |
|--|-----------------------|---------------------------|--|
| Nominal | Measured Total | Measured Dissolved | |
| Lab Control | Lab control | Lab control | 0.66 ± 0.10 |
| Site Control | 23.6 | 20.0 | 0.67 ± 0.09 |
| 5 | 28.4 | 24.6 | 0.78 ± 0.09 |
| 10 | 34.0 | 30.0 | 0.82 ± 0.11 |
| 20 | 43.6 | 39.0 | 0.90 ± 0.07 |
| 40 | 63.4 | 56.4 | 0.85 ± 0.06 |
| 80 | 97.6 | 90.3 | 0.78 ± 0.09 |
| 160 | 180 | 168 | 0.50 ± 0.11 * |
| Test endpoint (µg/L total copper) | | | |
| | IC10 (95% CL) | | 125 (43-140) |
| | IC20 (95% CL) | | 161 (119-NC) |
| | IC50 | | >180 |
| Test endpoint (µg/L dissolved copper) | | | |
| | IC10 (95% CL) | | 117 (34-135) |
| | IC20 (95% CL) | | 150 (110-NC) |
| | IC50 | | >168 |

SD = Standard deviation, CL = Confidence limits, IC = Inhibition concentration, NC = Not calculable

* statistically significantly adversely affected relative to the control

Table 7. Results: *D. magna* toxicity test using copper.

| Copper Concentration (µg/L) | | | Survival (%) | Reproduction (Mean ± SD) |
|--|-----------------------|---------------------------|---------------------|---------------------------------|
| Nominal | Measured Total | Measured Dissolved | | |
| Lab Control | Lab control | Lab control | 100 | 75 ± 11 |
| Site Control | 16.6 | 13.8 | 100 | 117 ± 19 |
| 5 | 20.9 | 18.0 | 90 | 113 ± 14 |
| 10 | 25.6 | 22.8 | 100 | 114 ± 39 |
| 20 | 35.6 | 31.3 | 100 | 115 ± 11 |
| 40 | 53.8 | 49.0 | 90 | 119 ± 17 |
| 80 | 94.2 | 83.6 | 100 | 141 ± 16 |
| 160 | 167 | 149 | 100 | 128 ± 16 |
| Test endpoint (µg/L total copper) | | | | |
| | LC10 | | >167 | -- |
| | LC20 | | >167 | -- |
| | LC50 | | >167 | -- |
| | IC10 | | -- | >167 |
| | IC20 | | -- | >167 |
| | IC50 | | -- | >167 |
| Test endpoint (µg/L dissolved copper) | | | | |
| | LC10 | | >149 | -- |
| | LC20 | | >149 | -- |
| | LC50 | | >149 | -- |
| | IC10 | | -- | >149 |
| | IC20 | | -- | >149 |
| | IC50 | | -- | >149 |

SD = Standard deviation, CL = Confidence limits, IC = Inhibition concentration, NC = Not calculable

* statistically significantly adversely affected relative to the control

Table 8. Results: hatch and survival in the *P. promelas* toxicity test using copper.

| Nominal | Copper Concentration (µg/L) | | Hatch (%)** (Mean ± SD) | Post Hatch Survival (%) (Mean ± SD) | Overall Survival (%) (Mean ± SD) |
|--|-----------------------------|-----------------------|----------------------------|---|--|
| | Measured Total | Measured Dissolved | | | |
| Lab Control | Lab control | Lab control | 97 ± 3.9 | 93 ± 5.4 | 90 ± 3.8 |
| Site Control | 18.1 | 15.3 | 95 ± 6.4 | 74 ± 26 | 70 ± 25 |
| 5 | 23.0 | 20.1 | 97 ± 3.9 | 90 ± 8.5 | 87 ± 5.4 |
| 10 | 27.0 | 24.5 | 100 ± 0 | 88 ± 6.4 | 88 ± 6.3 |
| 20 | 37.5 | 33.4 | 100 ± 0 | 85 ± 14 | 85 ± 14 |
| 40 | 54.7 | 50.9 | 98 ± 3.3 | 90 ± 3.7 | 88 ± 3.3 |
| 80 | 93.1 | 86.9 | 90 ± 13 | 83 ± 8.5 | 75 ± 15 |
| 160 | 170 | 158 | 97 ± 6.7 | 93 ± 0.5 | 90 ± 6.7 |
| Test endpoint (µg/L total copper) | | | | | |
| | EC10 | | >168 | >170 | >170 |
| | EC20 | | >168 | >170 | >170 |
| | EC50 | | >168 | >170 | >170 |
| Test endpoint (µg/L dissolved copper) | | | | | |
| | EC10 (95% CL) | | >144 | >158 | >158 |
| | EC20 (95% CL) | | >144 | >158 | >158 |
| | EC50 (95% CL) | | >144 | >158 | >158 |

SD = Standard deviation, CL = Confidence limits, IC = Inhibition concentration, NC = Not calculable

* statistically significantly adversely affected relative to the control

** the measured concentrations of total copper for Hatch were as follows: lab control, 14.0, 19.9, 24.2, 32.9, 51.5, 95.1 and 168 µg/L

** the measured concentrations for dissolved copper for Hatch were as follows: lab control, 12.1, 16.5, 22.3, 29.7, 46.6, 85.0 and 144 µg/L

Table 9. Results: growth in the *P. promelas* toxicity test using copper.

| Copper Concentration (µg/L) | | | | |
|--|-----------------------|---------------------------|------------------------------------|-------------------------------------|
| Nominal | Measured Total | Measured Dissolved | Length (mm) (Mean ± SD) | Biomass (mg) (Mean ± SD) |
| Lab Control | Lab control | Lab control | 9.6 ± 0.2 | 1.10 ± 0.09 |
| Site Control | 18.1 | 15.3 | 9.9 ± 0.8 | 1.01 ± 0.04 |
| 5 | 23.0 | 20.1 | 9.1 ± 0.1 | 0.95 ± 0.18 |
| 10 | 27.0 | 24.5 | 9.1 ± 0.1 | 0.93 ± 0.07 |
| 20 | 37.5 | 33.4 | 9.4 ± 0.2 | 1.06 ± 0.13 |
| 40 | 54.7 | 50.9 | 9.1 ± 0.1 | 0.97 ± 0.10 |
| 80 | 93.1 | 86.9 | 9.0 ± 0.7 | 1.00 ± 0.30 |
| 160 | 170 | 158 | 8.7 ± 0.3 * | 0.92 ± 0.17 |
| Test endpoint (µg/L total copper) | | | | |
| | IC10 (95% CL) | | 162 (69 - >170) | 15 (<18.1 - >170) |
| | IC20 | | >170 | >170 |
| | IC50 | | >170 | >170 |
| Test endpoint (µg/L dissolved copper) | | | | |
| | IC10 (95% CL) | | 150 (63-287) | 13 (<15.3 - >158) |
| | IC20 | | >158 | >158 |
| | IC50 | | >158 | >158 |

SD = Standard deviation, CL = Confidence limits, IC = Inhibition concentration, NC = Not calculable

* statistically significantly adversely affected relative to the control

Table 10. 28-d Results: *H. azteca* toxicity test using copper.

| Nominal | Copper Concentration (µg/L) | | Survival (%) (Mean ± SD) | Biomass (mg) (Mean ± SD) |
|--|-----------------------------|--------------------|-----------------------------|-----------------------------|
| | Measured Total | Measured Dissolved | | |
| Lab Control | Lab control | Lab control | 94 ± 6.7 | 0.70 ± 0.08 |
| Site Control | 17.6 | 14.7 | 94 ± 7.9 | 0.69 ± 0.10 |
| 5 | 22.1 | 19.1 | 93 ± 7.8 | 0.68 ± 0.07 |
| 10 | 25.9 | 23.7 | 92 ± 7.1 | 0.78 ± 0.08 |
| 20 | 35.6 | 32.4 | 88 ± 11 | 0.77 ± 0.07 |
| 40 | 53.8 | 49.7 | 97 ± 4.9 | 0.67 ± 0.09 |
| 80 | 92.7 | 84.7 | 98 ± 4.5 | 0.63 ± 0.06 |
| 160 | 167 | 154 | 85 ± 9.1 | 0.32 ± 0.04 * |
| Test endpoint (µg/L total copper) | | | | |
| | LC10 | | >167 | -- |
| | LC20 | | >167 | -- |
| | LC50 | | >167 | -- |
| | IC10 (95% CL) | | -- | 84.2 (31.8 - 105) |
| | IC20 (95% CL) | | -- | 106 (78.0 - 126) |
| | IC50 (95% CL) | | -- | 157 (139 - 177) |
| Test endpoint (µg/L dissolved copper) | | | | |
| | LC10 (95% CL) | | >154 | -- |
| | LC20 (95% CL) | | >154 | -- |
| | LC50 (95% CL) | | >154 | -- |
| | IC10 (95% CL) | | -- | 76.8 (30.6 - 96.1) |
| | IC20 (95% CL) | | -- | 97.0 (72.2 - 116) |
| | IC50 (95% CL) | | -- | 144 (128 - 163) |

SD = Standard deviation, CL = Confidence limits, IC = Inhibition concentration, NC = Not calculable

* statistically significantly adversely affected relative to the control

Table 11. 42-d Results: *H. azteca* toxicity test using copper.

| Copper Concentration (µg/L) | | | Survival (%) (Mean ± SD) | Biomass (mg) (Mean ± SD) | Reproduction (Mean ± SD) |
|--|-------------------|-----------------------|-----------------------------|-----------------------------|-----------------------------|
| Nominal | Measured Total | Measured Dissolved | | | |
| Lab Control | Lab control | Lab control | 86 ± 9.1 | 0.88 ± 0.08 | 17.8 ± 12.3 |
| Site Control | 17.5 | 14.9 | 86 ± 11 | 0.92 ± 0.16 | 6.8 ± 2.9 * |
| 5 | 22.3 | 19.8 | 85 ± 11 | 0.94 ± 0.13 | 10.4 ± 3.7 |
| 10 | 26.4 | 24.3 | 85 ± 14 | 0.92 ± 0.11 | 3.5 ± 1.6 * |
| 20 | 37.1 | 33.0 | 80 ± 11 | 0.89 ± 0.10 | 7.8 ± 2.3 * |
| 40 | 54.0 | 51.6 | 93 ± 7 | 0.95 ± 0.10 | 4.4 ± 2.3 * |
| 80 | 92.7 | 86.4 | 91 ± 8 | 0.74 ± 0.16 | 2.9 ± 2.5 * |
| 160 | 169 | 160 | 76 ± 14 | 0.49 ± 0.15 * | 0.3 ± 0.5 * |
| Test endpoint (µg/L total copper) | | | | | |
| | LC10 (95% CL) | | 153 (108 – NC) | -- | -- |
| | LC20 | | >169 | -- | -- |
| | LC50 | | >169 | -- | -- |
| | IC10 (95% CL) | | -- | 77.5 (48.0 – 97.6) | <17.5 |
| | IC20 (95% CL) | | -- | 102 (81.6 – 122) | <17.5 |
| | IC50 | | -- | >169 | <17.5 |
| Test endpoint (µg/L dissolved copper) | | | | | |
| | LC10 (95% CL) | | 145 (102 – NC) | -- | -- |
| | LC20 | | >160 | -- | -- |
| | LC50 | | >160 | -- | -- |
| | IC10 (95% CL) | | -- | 72.9 (45.1 – 91.9) | <14.9 |
| | IC20 (95% CL) | | -- | 96.6 (76.8 – 115) | <14.9 |
| | IC50 (95% CL) | | -- | >160 | <14.9 |

SD = Standard deviation, CL = Confidence limits, IC = Inhibition concentration, NC = Not calculable
 * statistically significantly adversely affected relative to the control

4.0 QA/QC

The health histories of the test organisms used in the exposures were acceptable and met the requirements of the test protocols. The tests met all control acceptability criteria and water quality parameters remained within ranges specified in the protocols throughout the tests. Uncertainty associated with these tests is best described by the standard deviations around the means.

Results of the reference toxicant tests conducted during the testing program are summarized in Table 12. Results for these tests fell within the acceptable range for organism performance of mean and two standard deviations, based on historical results obtained by the laboratory for the *D. magna* and *H. azteca* tests. In the test using *P. promelas*, the reference toxicant results fell outside of the historical range for the test, indicating that the test organisms used for this species may have been more sensitive than usual. The test was reviewed and testing and culturing procedures were considered to have been followed appropriately. The results of the control performance from the test was acceptable. Thus, despite not falling within the two standard deviation historical range, the test with the sample was considered to be a useful measure of sensitivity to copper, particularly since there was no evidence of adverse effects from copper in the test. There were not sufficient historical data with which to prepare a historical reference toxicant range for the *B. calyciflorus* test.

Table 12. Reference toxicant test results.

| Test Species | Endpoint | Historical Mean (2 SD Range) | CV (%) | Test Date |
|------------------------|--|---------------------------------|-----------|--------------|
| <i>P. promelas</i> | Survival (LC50): 3.3 g/L NaCl | 7.3 (5.4-9.8) | 9.6 | May 29, 2017 |
| | Biomass (IC25): 2.3 g/L NaCl | 4.4 (3.1-6.3) | 12 | |
| <i>D. magna</i> | Survival (LC50): 5.4 g/L NaCl | 4.9 (4.2-5.8) | 5.3 | May 31, 2017 |
| <i>B. calyciflorus</i> | Survival (IC50) 1.6 (0.6-2.0) g/L NaCl | NA | NA | May 23, 2107 |
| <i>H. azteca</i> | Survival (LC50): 416 µg/L Cu | 631 (251-1259) | 33 | May 25, 2017 |

SD = Standard Deviation, CV = Coefficient of Variation, LC = Lethal Concentration, IC = Inhibition Concentration, EC = Effect Concentration, NA = Not Available

5.0 REFERENCES

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- ASTM. 2004. Standard Guide for Conducting *Daphnia magna* Life-Cycle Toxicity Tests. Method: E1193 - 97 (Reapproved 2004). In: Annual Book of ASTM Standards. Volume 11.06. Biological Effects and Environmental Fate; Biotechnology, Water and Environmental Technology, American Society for Testing and Materials. Philadelphia, PA.
- ASTM. 2013. Standard guide for conducting early life-stage toxicity tests with fishes. E1241-05. 29 pp.
- Environment Canada, 2005. Guidance Document on Statistical Methods for Environmental Toxicity Tests. EPS 1/RM/46.
- Snell TW. 1992. A 2-d Life Cycle Test with the Rotifer *Brachionus calyciflorus*. Environ Toxicol Chem 11:1249-1257.
- Tidepool Scientific Software. 2015. CETIS comprehensive environmental toxicity information system, version 1.9.0.8 Tidepool Scientific Software, McKinleyville, CA.
- USEPA. 1996. Ecological Effects Test Guidelines. OPPTS 850.1400 Fish Early-Life Stage Toxicity Test. EPA-712-C-96-121, Public Draft.
- USEPA. 2000. Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates. EPA 600/R-99/064. March 2000.
- ASTM. 2013. Standard guide for conducting early life-stage toxicity tests with fishes. E1241-05, 29 p.

APPENDIX A – *Brachionus calyciflorus* Toxicity Test Data

Brachionus calyciflorus Summary Sheet

Client: Calgary Nautilus (Minnow Environmental)
Work Order No.: 170494

Start Date/Time: May 23, 2017 @ 14:00
Test Species: Brachionus calyciflorus
Set up by: EMM

Sample Information:

Sample ID: W2:W16 mixture
Sample Date: n/a
Date Received: May 23/17
Sample Volume: W2 - 2 x 2L and W16 - 1 x 2L

Test Organism Information:

Age of young (Day 0): <2 hours

NaCl Reference Toxicant Results:

Reference Toxicant ID: BC04
Stock Solution ID: 17Na02
Date Initiated: May 23/17
48-h IC50 (95% CL): 1.6 (0.6 - 2.0) g/L NaCl

Reference Toxicant Mean \pm 2 SD: n/a
Reference Toxicant CV (%): n/a

1 -
Test Results: The resulting IC25 and IC50 values were >179.5 μ g/L Cu.
The NOEC and LOEC was 97.6 and 179.5 μ g/L Cu, respectively.
1 - endpoints were calculated using laboratory control as the negative control against total copper values.

Reviewed by: 

Date reviewed: Sept 27/17

1/2

Freshwater Acute 48 Hour Toxicity Test Data Sheet

Client: Minnow Environmental
Sample ID: W2:W16 (3:1 mixture)
Work Order No.: 170494

Start Date/Time: ^{23^{er}} May 25/17 02:1400h
Test Organism: Brachionus calyciflorus
Set up by: EMM

DO meter: DO-1 pH meter: pH-1 Conductivity meter: C-1

| Concentration (µg/L CW) | Temperature (°C) | | Dissolved oxygen (mg/L) | | pH | | Conductivity (µS/cm) | |
|----------------------------|------------------|------|-------------------------|-----|-----|-----|----------------------|-----|
| | 0 | 48 | 0 | 48 | 0 | 48 | 0 | 48 |
| lab MHW control | 24.0 | 24.0 | 8.2 | 8.0 | 7.9 | 7.8 | 354 | 353 |
| site control (W2:W16) | 24.0 | 24.0 | 8.1 | 7.9 | 7.2 | 7.1 | 221 | 222 |
| 5 | 24.0 | 24.0 | 8.1 | 7.9 | 7.2 | 7.2 | 221 | 220 |
| 10 | 24.0 | 24.0 | 8.0 | 7.8 | 7.2 | 7.2 | 222 | 220 |
| 20 | 24.0 | 24.0 | 8.0 | 7.8 | 7.3 | 7.2 | 222 | 221 |
| 40 | 24.0 | 24.0 | 8.1 | 7.9 | 7.3 | 7.2 | 221 | 222 |
| Technician Initials | EMM | EMM | EMM | EMM | EMM | EMM | EMM | EMM |

| | Hardness | Alkalinity |
|-----------------------|----------|------------|
| Control | 100 | 72 |
| Highest concentration | N/A | N/A |

| | Adjustment | Adjusted WQ |
|--------------|------------|-------------|
| Temp (°C) | N/A | N/A |
| DO (mg/L) | N/A | N/A |
| pH | N/A | N/A |
| Cond (µS/cm) | N/A | N/A |

Comments: initiated test w/ six organisms per replicate
Reviewed by: JCB June 29/17

**Freshwater Acute
48 Hour Toxicity Test Data Sheet**

212

Client: Minnew Environmental
 Sample ID: W2:W16 (3:1 mixture)
 Work Order No.: 170494

Start Date/Time: May 27 7:00 AM
 Test Organism: Brachionus calyciflorus
 Set up by: EMM

DO meter: DO-1 pH meter: pH-1 Conductivity meter: C-1

| Concentration (µg/L Cu) | Temperature (°C) | | Dissolved oxygen (mg/L) | | pH | | Conductivity (µS/cm) | |
|----------------------------|------------------|------|-------------------------|-----|-----|-----|----------------------|-----|
| | 0 | 48 | 0 | 48 | 0 | 48 | 0 | 48 |
| 80 | 24.0 | 24.0 | 8.1 | 7.8 | 7.3 | 7.2 | 221 | 220 |
| 160 | 24.0 | 24.6 | 8.1 | 7.8 | 7.3 | 7.2 | 221 | 220 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Technician Initials | EMM | EMM | EMM | EMM | EMM | EMM | EMM | EMM |

| | Hardness | Alkalinity |
|-----------------------|----------|------------|
| Control | 100 | 72 |
| Highest concentration | N/A | N/A |

| | Adjustment | Adjusted WQ |
|--------------|------------|-------------|
| Temp (°C) | N/A | N/A |
| DO (mg/L) | N/A | N/A |
| pH | N/A | N/A |
| Cond (µS/cm) | N/A | N/A |

Comments: _____

Reviewed by: JOU June 29/17

Freshwater Acute Toxicity Test
B. calyciflorus Survival

May 23/17 to May 25/17
 e-

Client: Minnow Environmental
 Sample ID: W2:W16 (3:1 Mixture)
 Work Order: 170494

Start Date & Time: MAY 25/17 @ 1400h
 Stop Date & Time: MAY 27/17 @ 1400h
 Set up by: EMM

(µg/L Cu)

| Hrs | Concentration: MHW lab control | | | | | | | | Concentration: W2:W16 site control | | | | | | | |
|-----|--------------------------------|--------|----|----|----|----|----|------|------------------------------------|--------|----|----|----|----|----|------|
| | A | B | C | D | E | F | G | Init | A | B | C | D | E | F | G | Init |
| 24 | 6 | —————→ | | | | | | EMM | 6 | —————→ | | | | | | EMM |
| 48 | 27 | 28 | 23 | 24 | 28 | 20 | 16 | EMM | 28 | 22 | 29 | 20 | 18 | 22 | 24 | EMM |

| Hrs | Concentration: 5 | | | | | | | | Concentration: 10 | | | | | | | |
|-----|------------------|--------|----|----|----|----|----|------|-------------------|--------|----|----|----|----|----|------|
| | A | B | C | D | E | F | G | Init | A | B | C | D | E | F | G | Init |
| 24 | 6 | —————→ | | | | | | EMM | 6 | —————→ | | | | | | EMM |
| 48 | 30 | 32 | 28 | 28 | 34 | 20 | 29 | EMM | 20 | 28 | 30 | 32 | 38 | 36 | 38 | EMM |

| Hrs | Concentration: 20 | | | | | | | | Concentration: 40 | | | | | | | |
|-----|-------------------|--------|----|----|----|----|----|------|-------------------|--------|----|----|----|----|----|------|
| | A | B | C | D | E | F | G | Init | A | B | C | D | E | F | G | Init |
| 24 | 6 | —————→ | | | | | | EMM | 6 | —————→ | | | | | | EMM |
| 48 | 38 | 39 | 28 | 39 | 40 | 38 | 32 | EMM | 38 | 38 | 30 | 32 | 34 | 28 | 33 | EMM |

Sample Description: clear, slightly yellow, odorous
 Comments: _____

Reviewed by: Jba

Date reviewed: June 29/17

Freshwater Acute Toxicity Test
B. calyciflorus Survival

23/17 to 25/17

Client: Minnan
 Sample ID: W2:W16(3:1 mixture)
 Work Order: 17CM99

Start Date & Time: May 25/17 @ 1400h
 Stop Date & Time: May 27/17 @ 1400h
 Set up by: EMM

| Hrs | Concentration: 80 | | | | | | | | Concentration: 160 | | | | | | | |
|-----|-------------------|--------|----|----|----|----|----|------|--------------------|--------|----|----|----|----|----|------|
| | A | B | C | D | E | F | G | Init | A | B | C | D | E | F | G | Init |
| 24 | 6 | —————→ | | | | | | EMM | 6 | —————→ | | | | | | EMM |
| 48 | 36 | 30 | 28 | 28 | 31 | 30 | 20 | EMM | 21 | 19 | 16 | 11 | 20 | 16 | 14 | EMM |

| Hrs | Concentration: | | | | | | | | Concentration: | | | | | | | |
|-----|----------------|---|---|---|---|---|---|------|----------------|---|---|---|---|---|---|------|
| | A | B | C | D | E | F | G | Init | A | B | C | D | E | F | G | Init |
| 24 | | | | | | | | | | | | | | | | |
| 48 | | | | | | | | | | | | | | | | |

| Hrs | Concentration: | | | | | | | | Concentration: | | | | | | | |
|-----|----------------|---|---|---|---|---|---|------|----------------|---|---|---|---|---|---|------|
| | A | B | C | D | E | F | G | Init | A | B | C | D | E | F | G | Init |
| 24 | | | | | | | | | | | | | | | | |
| 48 | | | | | | | | | | | | | | | | |

Sample Description: same as previous page
 Comments: _____

Reviewed by: JCH

Date reviewed: June 29/17

Client: Hinnow Environmental
 W.O.#: 170494

Hardness and Alkalinity Datasheet

| Sample ID | Subsample Date | Date Measured | Alkalinity | | | | Hardness | | | Technician |
|-----------|------------------------------|---------------|--------------------|--|---|--|--------------------|--------------------------------|--|------------|
| | | | Sample Volume (mL) | (mL) 0.02N HCL/H ₂ SO ₄ used to pH 4.5 | (mL) of 0.02N HCL/H ₂ SO ₄ used to pH 4.2 | Total Alkalinity (mg/L CaCO ₃) | Sample Volume (mL) | Volume of 0.01M EDTA Used (mL) | Total Hardness (mg/L CaCO ₃) | |
| 141W | 10/27/17 10/27/17 | 10/27/17 | 50 | 4.0 | 4.4 | 72 | 50 | 50 | 100 | YML |
| | | | | | | | | | | |
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Notes:

Reviewed by: JBa Date Reviewed: June 29/17

CETIS Summary Report

Report Date: 27 Sep-17 10:18 (p 1 of 1)
 Test Code: 170494 | 15-3040-3260

Rotifer 48-h Life Cycle Test

Nautilus Environmental

| | | |
|-------------------------------------|---|-------------------------------------|
| Batch ID: 06-8148-8809 | Test Type: Rotifer Growth | Analyst: Emma Marus |
| Start Date: 23 May-17 14:00 | Protocol: SNELL/ET&C 11 (1992) | Diluent: |
| Ending Date: 25 May-17 14:00 | Species: Brachionus calyciflorus | Brine: |
| Duration: 48h | Source: Brine Shrimp Direct | Age: |
| Sample ID: 11-5967-1644 | Code: 451F2F5C | Client: Minnow Environmental |
| Sample Date: 23 May-17 | Material: Copper | Project: |
| Receive Date: 23 May-17 | Source: Minnow Environmental | |
| Sample Age: 14h (20 °C) | Station: W2/W16 | |

Comparison Summary

| Analysis ID | Endpoint | NOEL | LOEL | TOEL | PMSD | TU | Method |
|--------------|---------------|------|-------|-------|-------|----|------------------------------|
| 14-3261-1670 | Growth Rate-r | 97.6 | 179.5 | 132.4 | 17.6% | | Steel Many-One Rank Sum Test |

Point Estimate Summary

| Analysis ID | Endpoint | Level | ug/L | 95% LCL | 95% UCL | TU | Method |
|--------------|---------------|-------|--------|---------|---------|----|------------------------------|
| 07-5016-8812 | Growth Rate-r | IC5 | 110.6 | 8.325 | 115.9 | | Linear Interpolation (ICPIN) |
| | | IC10 | 125.3 | 42.67 | 139.6 | | |
| | | IC15 | 141.9 | 102 | N/A | | |
| | | IC20 | 160.8 | 118.9 | N/A | | |
| | | IC25 | >179.5 | N/A | N/A | | |
| | | IC40 | >179.5 | N/A | N/A | | |
| 09-4910-7142 | Growth Rate-r | IC5 | 106.3 | 81.8 | 108.9 | | Linear Interpolation (ICPIN) |
| | | IC10 | 115.8 | 101.6 | 122 | | |
| | | IC15 | 126.1 | 113.6 | 136.5 | | |
| | | IC20 | 137.3 | 124 | 152.7 | | |
| | | IC25 | 149.5 | 133.3 | 171.2 | | |
| | | IC40 | >179.5 | N/A | N/A | | |
| IC50 | >179.5 | N/A | N/A | | | | |

adjusted for homosis

Growth Rate-r Summary

| C-ug/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|--------|------------------|-------|--------|---------|---------|--------|--------|---------|---------|--------|---------|
| 1 | Negative Control | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 23.6 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 28.4 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 34 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 43.6 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 63.4 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 97.6 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 179.5 | | 7 | 0.5018 | 0.397 | 0.6065 | 0.3031 | 0.6264 | 0.04281 | 0.1133 | 22.57% | 24.43% |

Growth Rate-r Detail

| C-ug/L | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 |
|--------|------------------|--------|--------|--------|--------|--------|--------|--------|
| 1 | Negative Control | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 23.6 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 28.4 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 34 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 43.6 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 63.4 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 97.6 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 179.5 | | 0.6264 | 0.5763 | 0.4904 | 0.3031 | 0.602 | 0.4904 | 0.4236 |

CETIS Analytical Report

Report Date: 25 Sep-17 13:11 (p 1 of 2)
 Test Code: 170494 | 15-3040-3260

Rotifer 48-h Life Cycle Test

Nautilus Environmental

| | | |
|------------------------------|--|------------------------------|
| Analysis ID: 09-4910-7142 | Endpoint: Growth Rate-r | CETIS Version: CETISv1.8.7 |
| Analyzed: 25 Sep-17 13:10 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 06-8148-8809 | Test Type: Rotifer Growth | Analyst: Emma Marus |
| Start Date: 23 May-17 14:00 | Protocol: SNELL/ET&C 11 (1992) | Diluent: |
| Ending Date: 25 May-17 14:00 | Species: Brachionus calyciflorus | Brine: |
| Duration: 48h | Source: Brine Shrimp Direct | Age: |
| Sample ID: 11-5967-1644 | Code: 451F2F5C | Client: Minnow Environmental |
| Sample Date: 23 May-17 | Material: Copper (total) | Project: |
| Receive Date: 23 May-17 | Source: Minnow Environmental | |
| Sample Age: 14h (20 °C) | Station: W2/W16 | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 603402 | 200 | Yes | Two-Point Interpolation |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|--------|---------|---------|
| IC5 | 106.3 | 81.8 | 108.9 |
| IC10 | 115.8 | 101.6 | 122 |
| IC15 | 126.1 | 113.6 | 136.5 |
| IC20 | 137.3 | 124 | 152.7 |
| IC25 | 149.5 | 133.3 | 171.2 |
| IC40 | >179.5 | N/A | N/A |
| IC50 | >179.5 | N/A | N/A |

Growth Rate-r Summary

Calculated Variate

| C-ug/L | Control Type | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
|--------|------------------|-------|--------|--------|--------|---------|---------|--------|---------|
| 1 | Negative Control | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 23.6 | Site control | 7 | 0.6717 | 0.5493 | 0.7878 | 0.03253 | 0.08607 | 12.81% | -1.17% |
| 28.4 | | 7 | 0.777 | 0.602 | 0.8673 | 0.03213 | 0.08501 | 10.94% | -17.04% |
| 34 | | 7 | 0.8222 | 0.602 | 0.9229 | 0.04294 | 0.1136 | 13.82% | -23.84% |
| 43.6 | | 7 | 0.8962 | 0.7702 | 0.9486 | 0.02521 | 0.06671 | 7.44% | -34.98% |
| 63.4 | | 7 | 0.8539 | 0.7702 | 0.9229 | 0.0215 | 0.05688 | 6.66% | -28.62% |
| 97.6 | | 7 | 0.7813 | 0.602 | 0.8959 | 0.03388 | 0.08964 | 11.47% | -17.67% |
| 179.5 | | 7 | 0.5018 | 0.3031 | 0.6264 | 0.04281 | 0.1133 | 22.57% | 24.43% |

Growth Rate-r Detail

| C-ug/L | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 |
|--------|------------------|--------|--------|--------|--------|--------|--------|--------|
| 1 | Negative Control | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 23.6 | Site control | 0.7702 | 0.6496 | 0.7878 | 0.602 | 0.5493 | 0.6496 | 0.6931 |
| 28.4 | | 0.8047 | 0.837 | 0.7702 | 0.7702 | 0.8673 | 0.602 | 0.7878 |
| 34 | | 0.602 | 0.7702 | 0.8047 | 0.837 | 0.9229 | 0.8959 | 0.9229 |
| 43.6 | | 0.9229 | 0.9359 | 0.7702 | 0.9359 | 0.9486 | 0.9229 | 0.837 |
| 63.4 | | 0.9229 | 0.9229 | 0.8047 | 0.837 | 0.8673 | 0.7702 | 0.8524 |
| 97.6 | | 0.8959 | 0.8047 | 0.7702 | 0.7702 | 0.8211 | 0.8047 | 0.602 |
| 179.5 | | 0.6264 | 0.5763 | 0.4904 | 0.3031 | 0.602 | 0.4904 | 0.4236 |

CETIS Analytical Report

Report Date: 25 Sep-17 13:11 (p 2 of 2)
Test Code: 170494 | 15-3040-3260

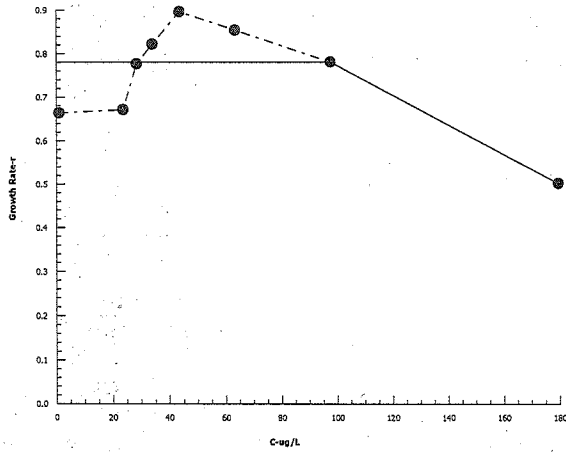
Rotifer 48-h Life Cycle Test

Nautilus Environmental

Analysis ID: 09-4910-7142 Endpoint: Growth Rate-r
Analyzed: 25 Sep-17 13:10 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 27 Sep-17 10:15 (p 1 of 2)
 Test Code: 170494 | 15-3040-3260

Rotifer 48-h Life Cycle Test

Nautilus Environmental

| | | |
|-------------------------------------|---|-------------------------------------|
| Analysis ID: 07-5016-8812 | Endpoint: Growth Rate-r | CETIS Version: CETISv1.8.7 |
| Analyzed: 27 Sep-17 10:15 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 06-8148-8809 | Test Type: Rotifer Growth | Analyst: Emma Marus |
| Start Date: 23 May-17 14:00 | Protocol: SNELL/ET&C 11 (1992) | Diluent: |
| Ending Date: 25 May-17 14:00 | Species: Brachionus calyciflorus | Brine: |
| Duration: 48h | Source: Brine Shrimp Direct | Age: |
| Sample ID: 11-5967-1644 | Code: 451F2F5C | Client: Minnow Environmental |
| Sample Date: 23 May-17 | Material: Copper | Project: |
| Receive Date: 23 May-17 | Source: Minnow Environmental | |
| Sample Age: 14h (20 °C) | Station: W2/W16 | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|---------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 1672544 | 200 | Yes | Two-Point Interpolation |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|--------|---------|---------|
| IC5 | 110.6 | 8.325 | 115.9 |
| IC10 | 125.3 | 42.67 | 139.6 |
| IC15 | 141.9 | 102 | N/A |
| IC20 | 160.8 | 118.9 | N/A |
| IC25 | >179.5 | N/A | N/A |
| IC40 | >179.5 | N/A | N/A |
| IC50 | >179.5 | N/A | N/A |

Growth Rate-r Summary

Calculated Variate

| C-ug/L | Control Type | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
|--------|------------------|-------|--------|--------|--------|---------|---------|--------|---------|
| 1 | Negative Control | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 23.6 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 28.4 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 34 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 43.6 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 63.4 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 97.6 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 179.5 | | 7 | 0.5018 | 0.3031 | 0.6264 | 0.04281 | 0.1133 | 22.57% | 24.43% |

Growth Rate-r Detail

| C-ug/L | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 |
|--------|------------------|--------|--------|--------|--------|--------|--------|--------|
| 1 | Negative Control | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 23.6 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 28.4 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 34 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 43.6 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 63.4 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 97.6 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 179.5 | | 0.6264 | 0.5763 | 0.4904 | 0.3031 | 0.602 | 0.4904 | 0.4236 |

Rotifer 48-h Life Cycle Test

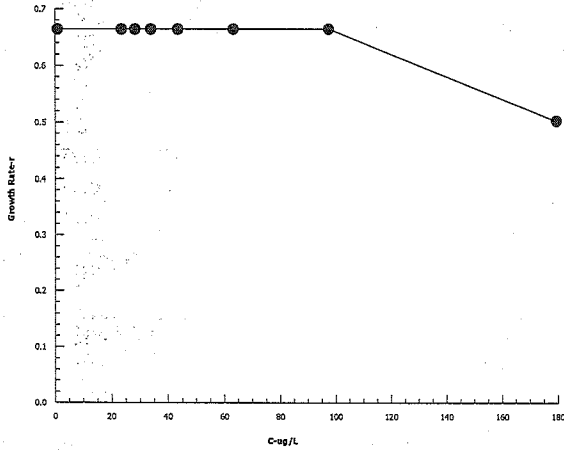
Nautilus Environmental

Analysis ID: 07-5016-8812
Analyzed: 27 Sep-17 10:15

Endpoint: Growth Rate-r
Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 25 Sep-17 13:11 (p 1 of 2)
 Test Code: 170494 | 15-3040-3260

| | | | | | |
|-------------------------------------|---|------------------------------|-------------------------------|--|--|
| Rotifer 48-h Life Cycle Test | | | Nautilus Environmental | | |
| Analysis ID: 14-3261-1670 | Endpoint: Growth Rate-r | CETIS Version: CETISv1.8.7 | | | |
| Analyzed: 25 Sep-17 13:11 | Analysis: Nonparametric-Control vs Treatments | Official Results: Yes | | | |
| Batch ID: 06-8148-8809 | Test Type: Rotifer Growth | Analyst: Emma Marus | | | |
| Start Date: 23 May-17 14:00 | Protocol: SNELL/ET&C 11 (1992) | Diluent: | | | |
| Ending Date: 25 May-17 14:00 | Species: Brachionus calyciflorus | Brine: | | | |
| Duration: 48h | Source: Brine Shrimp Direct | Age: | | | |
| Sample ID: 11-5967-1644 | Code: 451F2F5C | Client: Minnow Environmental | | | |
| Sample Date: 23 May-17 | Material: Copper (total) | Project: | | | |
| Receive Date: 23 May-17 | Source: Minnow Environmental | | | | |
| Sample Age: 14h (20 °C) | Station: W2/W16 | | | | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | PMSD | NOEL | LOEL | TOEL | TU |
|----------------|------|---------|--------|------|-------|------|-------|-------|----|
| Untransformed | NA | C > T | NA | NA | 17.6% | 97.6 | 179.5 | 132.4 | |

Steel Many-One Rank Sum Test

| Control | vs | C-ug/L | Test Stat | Critical | Ties | DF | P-Value | P-Type | Decision(α:5%) |
|---------|----|--------|-----------|----------|------|----|---------|--------|------------------------|
| 1 | | 23.6 | 53 | 34 | 5 | 12 | 0.8904 | Asymp | Non-Significant Effect |
| 1 | | 28.4 | 69.5 | 34 | 3 | 12 | 0.9999 | Asymp | Non-Significant Effect |
| 1 | | 34 | 70.5 | 34 | 3 | 12 | 1.0000 | Asymp | Non-Significant Effect |
| 1 | | 43.6 | 76 | 34 | 2 | 12 | 1.0000 | Asymp | Non-Significant Effect |
| 1 | | 63.4 | 76 | 34 | 2 | 12 | 1.0000 | Asymp | Non-Significant Effect |
| 1 | | 97.6 | 69.5 | 34 | 3 | 12 | 0.9999 | Asymp | Non-Significant Effect |
| 1 | | 179.5* | 33.5 | 34 | 2 | 12 | 0.0404 | Asymp | Significant Effect |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 0.7989955 | 0.1141422 | 7 | 13.9 | <0.0001 | Significant Effect |
| Error | 0.3942036 | 0.008212575 | 48 | | | |
| Total | 1.193199 | | 55 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|-------------------------------|-----------|----------|---------|-------------------------|
| Variances | Bartlett Equality of Variance | 4.189 | 18.48 | 0.7577 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality | 0.9322 | 0.9426 | 0.0037 | Non-normal Distribution |

Growth Rate-r Summary

| C-ug/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|--------|------------------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 1 | Negative Control | 7 | 0.6639 | 0.5733 | 0.7546 | 0.6719 | 0.4904 | 0.7702 | 0.03705 | 14.77% | 0.0% |
| 23.6 | Site Control | 7 | 0.6717 | 0.5921 | 0.7513 | 0.6496 | 0.5493 | 0.7878 | 0.03253 | 12.81% | -1.17% |
| 28.4 | | 7 | 0.777 | 0.6984 | 0.8556 | 0.7878 | 0.602 | 0.8673 | 0.03213 | 10.94% | -17.04% |
| 34 | | 7 | 0.8222 | 0.7172 | 0.9273 | 0.837 | 0.602 | 0.9229 | 0.04294 | 13.82% | -23.84% |
| 43.6 | | 7 | 0.8962 | 0.8345 | 0.9579 | 0.9229 | 0.7702 | 0.9486 | 0.02521 | 7.44% | -34.98% |
| 63.4 | | 7 | 0.8539 | 0.8013 | 0.9065 | 0.8524 | 0.7702 | 0.9229 | 0.0215 | 6.66% | -28.62% |
| 97.6 | | 7 | 0.7813 | 0.6984 | 0.8642 | 0.8047 | 0.602 | 0.8959 | 0.03388 | 11.47% | -17.67% |
| 179.5 | | 7 | 0.5018 | 0.397 | 0.6065 | 0.4904 | 0.3031 | 0.6264 | 0.04281 | 22.57% | 24.43% |

Growth Rate-r Detail

| C-ug/L | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 |
|--------|------------------|--------|--------|--------|--------|--------|--------|--------|
| 1 | Negative Control | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 23.6 | Site Control | 0.7702 | 0.6496 | 0.7878 | 0.602 | 0.5493 | 0.6496 | 0.6931 |
| 28.4 | | 0.8047 | 0.837 | 0.7702 | 0.7702 | 0.8673 | 0.602 | 0.7878 |
| 34 | | 0.602 | 0.7702 | 0.8047 | 0.837 | 0.9229 | 0.8959 | 0.9229 |
| 43.6 | | 0.9229 | 0.9359 | 0.7702 | 0.9359 | 0.9486 | 0.9229 | 0.837 |
| 63.4 | | 0.9229 | 0.9229 | 0.8047 | 0.837 | 0.8673 | 0.7702 | 0.8524 |
| 97.6 | | 0.8959 | 0.8047 | 0.7702 | 0.7702 | 0.8211 | 0.8047 | 0.602 |
| 179.5 | | 0.6264 | 0.5763 | 0.4904 | 0.3031 | 0.602 | 0.4904 | 0.4236 |

Rotifer 48-h Life Cycle Test

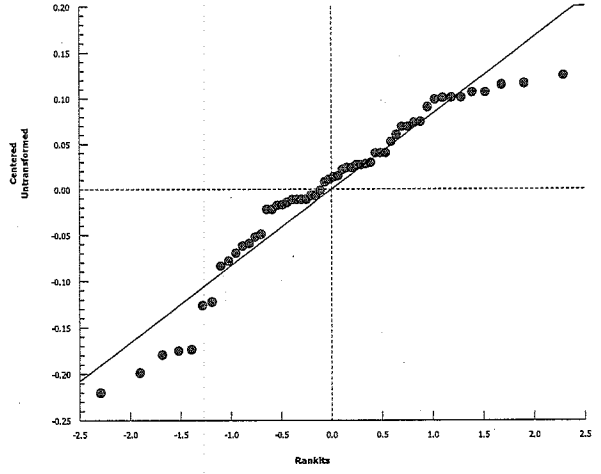
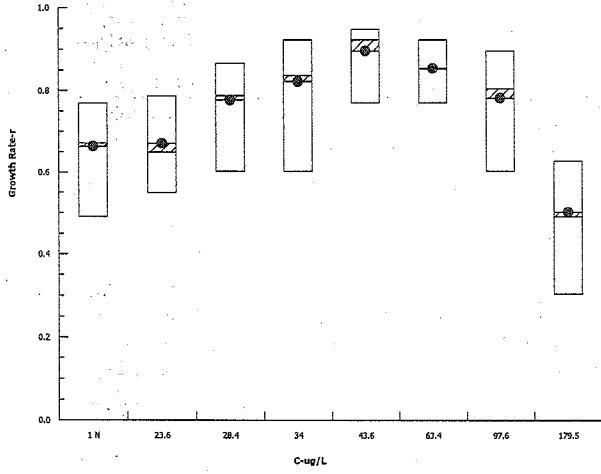
Nautilus Environmental

Analysis ID: 14-3261-1670
Analyzed: 25 Sep-17 13:11

Endpoint: Growth Rate-r
Analysis: Nonparametric-Control vs Treatments

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



Brachionus calyciflorus Summary Sheet

Client: Calgary Nautilus (Minnow Environmental)
Work Order No.: 170494

Start Date/Time: May 23, 2017 @ 14:00
Test Species: Brachionus calyciflorus
Set up by: EMM

Sample Information:

Sample ID: W2:W16 mixture
Sample Date: n/a
Date Received: May 23/17
Sample Volume: W2 - 2 x 2L and W16 - 1 x 2L

Test Organism Information:

Age of young (Day 0): <2 hours

NaCl Reference Toxicant Results:

Reference Toxicant ID: BC04
Stock Solution ID: 17Na02
Date Initiated: May 23/17
48-h IC50 (95% CL): 1.6 (0.6 - 2.0) g/L NaCl

Reference Toxicant Mean \pm 2 SD: n/a
Reference Toxicant CV (%): n/a

1 -

Test Results: The resulting IC25 and IC50 values were >168 μ g/L Cu.
The NOEC and LOEC was 90.3 and 168.0 μ g/L Cu, respectively.
1 - endpoints were calculated using laboratory control as the negative control against dissolved copper values.

Reviewed by: JCA

Date reviewed: Sep. 27/17

CETIS Summary Report

Report Date: 27 Sep-17 10:18 (p 1 of 1)
 Test Code: 170494(dissolve | 18-9936-5638)

Rotifer 48-h Life Cycle Test

Nautilus Environmental

| | | |
|-------------------------------------|---|-------------------------------------|
| Batch ID: 06-8148-8809 | Test Type: Rotifer Growth | Analyst: Emma Marus |
| Start Date: 23 May-17 14:00 | Protocol: SNELL/ET&C 11 (1992) | Diluent: |
| Ending Date: 25 May-17 14:00 | Species: Brachionus calyciflorus | Brine: |
| Duration: 48h | Source: Brine Shrimp Direct | Age: |
| Sample ID: 05-9182-0491 | Code: 234676CB | Client: Minnow Environmental |
| Sample Date: 23 May-17 | Material: Copper | Project: |
| Receive Date: 23 May-17 | Source: Minnow Environmental | |
| Sample Age: 14h (20 °C) | Station: W2/W16 | |

Comparison Summary

| Analysis ID | Endpoint | NOEL | LOEL | TOEL | PMSD | TU | Method |
|--------------|---------------|------|------|-------|-------|----|------------------------------|
| 16-0667-5684 | Growth Rate-r | 90.3 | 168 | 123.2 | 17.6% | | Steel Many-One Rank Sum Test |

Point Estimate Summary

| Analysis ID | Endpoint | Level | ug/L | 95% LCL | 95% UCL | TU | Method |
|--------------|---------------|-------|-------|---------|---------|----|------------------------------|
| 12-8150-0850 | Growth Rate-r | IC5 | 98.51 | 72.56 | 101 | | Linear Interpolation (ICPIN) |
| | | IC10 | 107.5 | 91.82 | 113 | | |
| | | IC15 | 117.2 | 102.8 | 126.9 | | |
| | | IC20 | 127.9 | 113.8 | 142.2 | | |
| | | IC25 | 139.4 | 123.7 | 161.6 | | |
| | | IC40 | >168 | N/A | N/A | | |
| 18-5740-8791 | Growth Rate-r | IC5 | 102.6 | 5.827 | 107.3 | | Linear Interpolation (ICPIN) |
| | | IC10 | 116.5 | 33.9 | 135.3 | | |
| | | IC15 | 132.3 | 91.61 | 167 | | |
| | | IC20 | 150.2 | 110.3 | N/A | | |
| | | IC25 | >168 | N/A | N/A | | |
| | | IC40 | >168 | N/A | N/A | | |
| IC50 | >168 | N/A | N/A | | | | |

adjusted for hormesis

Growth Rate-r Summary

| C-ug/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Min | Max | Std Err | Std Dev | CV% | %Effect |
|--------|------------------|-------|--------|---------|---------|--------|--------|---------|---------|--------|---------|
| 0.3 | Negative Control | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 20 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 24.6 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 30 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 39 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 56.4 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 90.3 | | 7 | 0.6639 | 0.5733 | 0.7546 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 168 | | 7 | 0.5018 | 0.397 | 0.6065 | 0.3031 | 0.6264 | 0.04281 | 0.1133 | 22.57% | 24.43% |

Growth Rate-r Detail

| C-ug/L | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 |
|--------|------------------|--------|--------|--------|--------|--------|--------|--------|
| 0.3 | Negative Control | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 20 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 24.6 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 30 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 39 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 56.4 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 90.3 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 168 | | 0.6264 | 0.5763 | 0.4904 | 0.3031 | 0.602 | 0.4904 | 0.4236 |

CETIS Analytical Report

Report Date: 25 Sep-17 12:48 (p 1 of 2)
 Test Code: 170494(dissolve | 18-9936-5638)

Rotifer 48-h Life Cycle Test

Nautilus Environmental

| | | |
|------------------------------|--|------------------------------|
| Analysis ID: 12-8150-0850 | Endpoint: Growth Rate-r | CETIS Version: CETISv1.8.7 |
| Analyzed: 25 Sep-17 12:47 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 06-8148-8809 | Test Type: Rotifer Growth | Analyst: Emma Marus |
| Start Date: 23 May-17 14:00 | Protocol: SNELL/ET&C 11 (1992) | Diluent: |
| Ending Date: 25 May-17 14:00 | Species: Brachionus calyciflorus | Brine: |
| Duration: 48h | Source: Brine Shrimp Direct | Age: |
| Sample ID: 05-9182-0491 | Code: 234676CB | Client: Minnow Environmental |
| Sample Date: 23 May-17 | Material: Copper (dissolved) | Project: |
| Receive Date: 23 May-17 | Source: Minnow Environmental | |
| Sample Age: 14h (20 °C) | Station: W2/W16 | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 550775 | 200 | Yes | Two-Point Interpolation |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| IC5 | 98.51 | 72.56 | 101 |
| IC10 | 107.5 | 91.82 | 113 |
| IC15 | 117.2 | 102.8 | 126.9 |
| IC20 | 127.9 | 113.8 | 142.2 |
| IC25 | 139.4 | 123.7 | 161.6 |
| IC40 | >168 | N/A | N/A |
| IC50 | >168 | N/A | N/A |

Growth Rate-r Summary

Calculated Variate

| C-ug/L | Control Type | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
|--------|------------------|-------|--------|--------|--------|---------|---------|--------|---------|
| 0.3 | Negative Control | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 20 | (Site control) | 7 | 0.6717 | 0.5493 | 0.7878 | 0.03253 | 0.08607 | 12.81% | -1.17% |
| 24.6 | | 7 | 0.777 | 0.602 | 0.8673 | 0.03213 | 0.08501 | 10.94% | -17.04% |
| 30 | | 7 | 0.8222 | 0.602 | 0.9229 | 0.04294 | 0.1136 | 13.82% | -23.84% |
| 39 | | 7 | 0.8962 | 0.7702 | 0.9486 | 0.02521 | 0.06671 | 7.44% | -34.98% |
| 56.4 | | 7 | 0.8539 | 0.7702 | 0.9229 | 0.0215 | 0.05688 | 6.66% | -28.62% |
| 90.3 | | 7 | 0.7813 | 0.602 | 0.8959 | 0.03388 | 0.08964 | 11.47% | -17.67% |
| 168 | | 7 | 0.5018 | 0.3031 | 0.6264 | 0.04281 | 0.1133 | 22.57% | 24.43% |

Growth Rate-r Detail

| C-ug/L | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 |
|--------|------------------|--------|--------|--------|--------|--------|--------|--------|
| 0.3 | Negative Control | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 20 | (Site control) | 0.7702 | 0.6496 | 0.7878 | 0.602 | 0.5493 | 0.6496 | 0.6931 |
| 24.6 | | 0.8047 | 0.837 | 0.7702 | 0.7702 | 0.8673 | 0.602 | 0.7878 |
| 30 | | 0.602 | 0.7702 | 0.8047 | 0.837 | 0.9229 | 0.8959 | 0.9229 |
| 39 | | 0.9229 | 0.9359 | 0.7702 | 0.9359 | 0.9486 | 0.9229 | 0.837 |
| 56.4 | | 0.9229 | 0.9229 | 0.8047 | 0.837 | 0.8673 | 0.7702 | 0.8524 |
| 90.3 | | 0.8959 | 0.8047 | 0.7702 | 0.7702 | 0.8211 | 0.8047 | 0.602 |
| 168 | | 0.6264 | 0.5763 | 0.4904 | 0.3031 | 0.602 | 0.4904 | 0.4236 |

CETIS Analytical Report

Report Date: 25 Sep-17 12:48 (p 2 of 2)
Test Code: 170494(dissolve | 18-9936-5638)

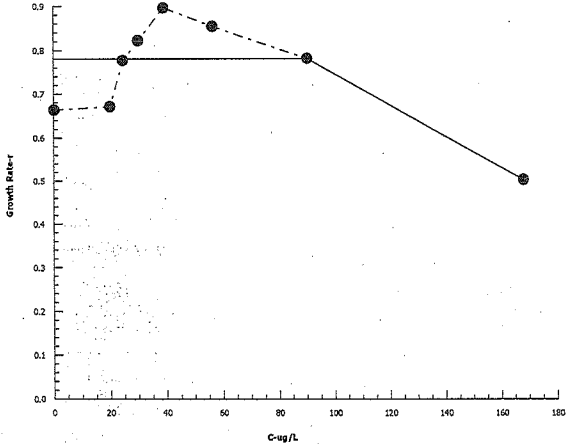
Rotifer 48-h Life Cycle Test

Nautilus Environmental

Analysis ID: 12-8150-0850 Endpoint: Growth Rate-r
Analyzed: 25 Sep-17 12:47 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 27 Sep-17 10:17 (p 1 of 2)
 Test Code: 170494(dissolve | 18-9936-5638)

Rotifer 48-h Life Cycle Test

Nautilus Environmental

| | | |
|------------------------------|--|------------------------------|
| Analysis ID: 18-5740-8791 | Endpoint: Growth Rate-r | CETIS Version: CETISv1.8.7 |
| Analyzed: 27 Sep-17 10:16 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 06-8148-8809 | Test Type: Rotifer Growth | Analyst: Emma Marus |
| Start Date: 23 May-17 14:00 | Protocol: SNELL/ET&C 11 (1992) | Diluent: |
| Ending Date: 25 May-17 14:00 | Species: Brachionus calyciflorus | Brine: |
| Duration: 48h | Source: Brine Shrimp Direct | Age: |
| Sample ID: 05-9182-0491 | Code: 234676CB | Client: Minnow Environmental |
| Sample Date: 23 May-17 | Material: Copper | Project: |
| Receive Date: 23 May-17 | Source: Minnow Environmental | |
| Sample Age: 14h (20 °C) | Station: W2/W16 | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|---------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 1740520 | 200 | Yes | Two-Point Interpolation |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| IC5 | 102.6 | 5.827 | 107.3 |
| IC10 | 116.5 | 33.9 | 135.3 |
| IC15 | 132.3 | 91.61 | 167 |
| IC20 | 150.2 | 110.3 | N/A |
| IC25 | >168 | N/A | N/A |
| IC40 | >168 | N/A | N/A |
| IC50 | >168 | N/A | N/A |

Growth Rate-r Summary

Calculated Variate

| C-ug/L | Control Type | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
|--------|------------------|-------|--------|--------|--------|---------|---------|--------|---------|
| 0.3 | Negative Control | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 20 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 24.6 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 30 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 39 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 56.4 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 90.3 | | 7 | 0.6639 | 0.4904 | 0.7702 | 0.03705 | 0.09803 | 14.77% | 0.0% |
| 168 | | 7 | 0.5018 | 0.3031 | 0.6264 | 0.04281 | 0.1133 | 22.57% | 24.43% |

Growth Rate-r Detail

| C-ug/L | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 |
|--------|------------------|--------|--------|--------|--------|--------|--------|--------|
| 0.3 | Negative Control | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 20 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 24.6 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 30 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 39 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 56.4 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 90.3 | | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 168 | | 0.6264 | 0.5763 | 0.4904 | 0.3031 | 0.602 | 0.4904 | 0.4236 |

CETIS Analytical Report

Report Date: 27 Sep-17 10:17 (p 2 of 2)
Test Code: 170494(dissolve | 18-9936-5638)

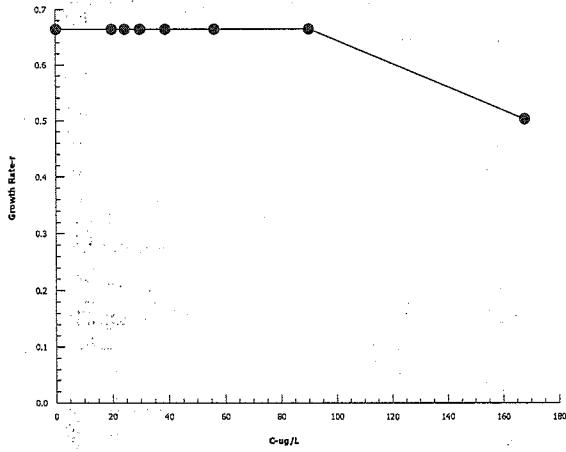
Rotifer 48-h Life Cycle Test

Nautilus Environmental

Analysis ID: 18-5740-8791 Endpoint: Growth Rate-r
Analyzed: 27 Sep-17 10:16 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 25 Sep-17 12:48 (p 1 of 2)
 Test Code: 170494(dissolve | 18-9936-5638)

| Rotifer 48-h Life Cycle Test | | | | Nautilus Environmental | | | |
|------------------------------|-----------------|------------|-------------------------------------|------------------------|----------------------|--|--|
| Analysis ID: | 16-0667-5684 | Endpoint: | Growth Rate-r | CETIS Version: | CETISv1.8.7 | | |
| Analyzed: | 25 Sep-17 12:48 | Analysis: | Nonparametric-Control vs Treatments | Official Results: | Yes | | |
| Batch ID: | 06-8148-8809 | Test Type: | Rotifer Growth | Analyst: | Emma Marus | | |
| Start Date: | 23 May-17 14:00 | Protocol: | SNELL/ET&C 11 (1992) | Diluent: | | | |
| Ending Date: | 25 May-17 14:00 | Species: | Brachionus calyciflorus | Brine: | | | |
| Duration: | 48h | Source: | Brine Shrimp Direct | Age: | | | |
| Sample ID: | 05-9182-0491 | Code: | 234676CB | Client: | Minnow Environmental | | |
| Sample Date: | 23 May-17 | Material: | Copper (dissolved) | Project: | | | |
| Receive Date: | 23 May-17 | Source: | Minnow Environmental | | | | |
| Sample Age: | 14h (20 °C) | Station: | W2/W16 | | | | |

| Data Transform | Zeta | Alt Hyp | Trials | Seed | PMSD | NOEL | LOEL | TOEL | TU |
|----------------|------|---------|--------|------|-------|------|------|-------|----|
| Untransformed | NA | C > T | NA | NA | 17.6% | 90.3 | 168 | 123.2 | |

Steel Many-One Rank Sum Test

| Control | vs | C-ug/L | Test Stat | Critical | Ties | DF | P-Value | P-Type | Decision(α:5%) |
|---------|----|--------|-----------|----------|------|----|---------|--------|------------------------|
| 0.3 | | 20 | 53 | 34 | 5 | 12 | 0.8904 | Asymp | Non-Significant Effect |
| 0.3 | | 24.6 | 69.5 | 34 | 3 | 12 | 0.9999 | Asymp | Non-Significant Effect |
| 0.3 | | 30 | 70.5 | 34 | 3 | 12 | 1.0000 | Asymp | Non-Significant Effect |
| 0.3 | | 39 | 76 | 34 | 2 | 12 | 1.0000 | Asymp | Non-Significant Effect |
| 0.3 | | 56.4 | 76 | 34 | 2 | 12 | 1.0000 | Asymp | Non-Significant Effect |
| 0.3 | | 90.3 | 69.5 | 34 | 3 | 12 | 0.9999 | Asymp | Non-Significant Effect |
| 0.3 | | 168* | 33.5 | 34 | 2 | 12 | 0.0404 | Asymp | Significant Effect |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 0.7989955 | 0.1141422 | 7 | 13.9 | <0.0001 | Significant Effect |
| Error | 0.3942036 | 0.008212575 | 48 | | | |
| Total | 1.193199 | | 55 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|-------------------------------|-----------|----------|---------|-------------------------|
| Variances | Bartlett Equality of Variance | 4.189 | 18.48 | 0.7577 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality | 0.9322 | 0.9426 | 0.0037 | Non-normal Distribution |

Growth Rate-r Summary

| C-ug/L | Control Type | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|--------|------------------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 0.3 | Negative Control | 7 | 0.6639 | 0.5733 | 0.7546 | 0.6719 | 0.4904 | 0.7702 | 0.03705 | 14.77% | 0.0% |
| 20 | (site control) | 7 | 0.6717 | 0.5921 | 0.7513 | 0.6496 | 0.5493 | 0.7878 | 0.03253 | 12.81% | -1.17% |
| 24.6 | | 7 | 0.777 | 0.6984 | 0.8556 | 0.7878 | 0.602 | 0.8673 | 0.03213 | 10.94% | -17.04% |
| 30 | | 7 | 0.8222 | 0.7172 | 0.9273 | 0.837 | 0.602 | 0.9229 | 0.04294 | 13.82% | -23.84% |
| 39 | | 7 | 0.8962 | 0.8345 | 0.9579 | 0.9229 | 0.7702 | 0.9486 | 0.02521 | 7.44% | -34.98% |
| 56.4 | | 7 | 0.8539 | 0.8013 | 0.9065 | 0.8524 | 0.7702 | 0.9229 | 0.0215 | 6.66% | -28.62% |
| 90.3 | | 7 | 0.7813 | 0.6984 | 0.8642 | 0.8047 | 0.602 | 0.8959 | 0.03388 | 11.47% | -17.67% |
| 168 | | 7 | 0.5018 | 0.397 | 0.6065 | 0.4904 | 0.3031 | 0.6264 | 0.04281 | 22.57% | 24.43% |

Growth Rate-r Detail

| C-ug/L | Control Type | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 |
|--------|------------------|--------|--------|--------|--------|--------|--------|--------|
| 0.3 | Negative Control | 0.6496 | 0.7702 | 0.6719 | 0.6931 | 0.7702 | 0.602 | 0.4904 |
| 20 | (site control) | 0.7702 | 0.6496 | 0.7878 | 0.602 | 0.5493 | 0.6496 | 0.6931 |
| 24.6 | | 0.8047 | 0.837 | 0.7702 | 0.7702 | 0.8673 | 0.602 | 0.7878 |
| 30 | | 0.602 | 0.7702 | 0.8047 | 0.837 | 0.9229 | 0.8959 | 0.9229 |
| 39 | | 0.9229 | 0.9359 | 0.7702 | 0.9359 | 0.9486 | 0.9229 | 0.837 |
| 56.4 | | 0.9229 | 0.9229 | 0.8047 | 0.837 | 0.8673 | 0.7702 | 0.8524 |
| 90.3 | | 0.8959 | 0.8047 | 0.7702 | 0.7702 | 0.8211 | 0.8047 | 0.602 |
| 168 | | 0.6264 | 0.5763 | 0.4904 | 0.3031 | 0.602 | 0.4904 | 0.4236 |

Rotifer 48-h Life Cycle Test

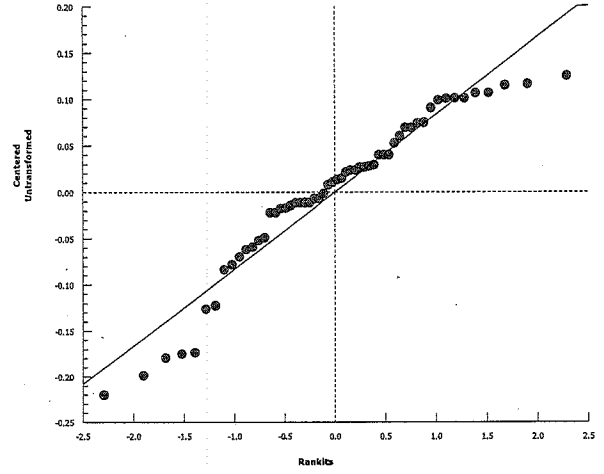
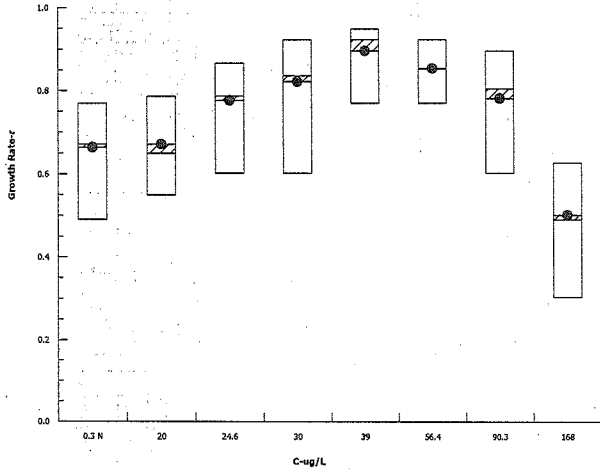
Nautilus Environmental

Analysis ID: 16-0667-5684
Analyzed: 25 Sep-17 12:48

Endpoint: Growth Rate-r
Analysis: Nonparametric-Control vs Treatments

CETIS Version: CETISv1.8.7
Official Results: Yes

Graphics



APPENDIX B – *Daphnia magna* Toxicity Test Data

Daphnia Bench Sheet

Method 21-d DA

Client MIN100

Sample SP1617-029

Test Log

| Date | Day | Time | Technicians | Fed (✓) ^{Feed (Daily)} | Comments | Bench Sheet Review |
|------------|-----|------|-------------|---------------------------------|-------------------------|--------------------|
| 2017/05/24 | 0 | 1235 | JW/JN | ✓ | - | SS |
| 17/05/25 | 1 | 0830 | NML | ✓ | - | JW |
| 2017/05/26 | 2 | 1030 | JW | ✓ | - | JN |
| 2017/05/27 | 3 | 1240 | PW | ✓ | - | LC |
| 2017/05/28 | 4 | 1200 | NML | ✓ | - | SS |
| 2017/05/29 | 5 | 1030 | PW | ✓ | - | NML |
| 2017/05/30 | 6 | 1000 | PW | ✓ | - | SS |
| 2017/05/31 | 7 | 1146 | PW/LC | ✓ | Saw first broods today. | LC |
| 2017/06/01 | 8 | 1040 | PW | ✓ | - | LC |
| 2017/06/02 | 9 | 1310 | PW | ✓ | - | LC |
| 2017/06/03 | 10 | 1330 | LC | ✓ | - | EP |
| 2017/06/04 | 11 | 1250 | PW | ✓ | - | NML |
| 2017/06/05 | 12 | 1030 | PW | ✓ | - | FD |
| 2017/06/06 | 13 | 1030 | PW | ✓ | - | FD |
| 2017/06/07 | 14 | 1030 | PW | ✓ | - | LC |
| 2017/06/08 | 15 | 1400 | LC | ✓ | - | HS |
| 2017/06/09 | 16 | 1500 | LC | ✓ | - | SS |
| 2017/06/10 | 17 | 0930 | LC | ✓ | - | HS |
| 2017/06/11 | 18 | 1145 | NML | ✓ | - | SS |
| 2017/06/12 | 19 | 1045 | NML | ✓ | - | HS |
| 2017/06/13 | 20 | 1200 | PW | ✓ | - | NML |
| 2017/06/14 | 21 | 0945 | PW | - | Take down | HS |

Culture

 Young jars D1 Jar(s) mortality 7 days prior to test (must be ≤25%) 01.
QA (previous month)

 Days to first brood (≤12 days) 7
 Average number of young produced (≥15 young) 29.8
Sample

 Duration of pre-aeration (rate of 37.5 ± 12.5 mL/min.L-1) -
 Hardness adjustment of sample (must be between 25 - 30 mg CaCO₃/L) 120-250
Lab Control Water

| Day | Pail | Prep Date | Hardness (mg/L) |
|-----|------|-----------------------|-----------------|
| 0 | D | 05/23 | 91 |
| 2 | H | 05/24 | 84 |
| 5 | G | 05/25/23 ⁺ | 93 |
| 7 | D | 05/29 | 86 |
| 9 | G | 06/01 | 89 |
| 12 | H | 06/02 | 84 |

| Day | Pail | Prep Date | Hardness (mg/L) |
|-----|------|-----------|-----------------|
| 14 | D | 06/04 | 86 |
| 16 | E | 06/05 | 83 |
| 19 | D | 06/10 | 84 |
| | | | |
| | | | |

 Meter/Probe Used: water / soil / sample sign-in / products

Daphnia Bench Sheet

| | |
|---------------|-------------------|
| Client MIN100 | Sample SP1617-029 |
|---------------|-------------------|

Chemistry (Monday, Wednesday, Friday)

New Solutions

Old Solutions

| dose (ug/L) | Lab | Site | 5 | 10 | 20 | 40 | 80 | 160 |
|-------------|-----|------|---|----|----|----|----|-----|
| day | CTL | CTL | | | | | | |

| Lab | Site | 5 | 10 | 20 | 40 | 80 | 160 |
|-----|------|---|----|----|----|----|-----|
| CTL | CTL | | | | | | |

pH (units)

pH (units)

| | | | | | | | | |
|----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 7.3 | 6.9 | 6.9 | 6.9 | 7.0 | 6.9 | 6.9 | 7.0 |
| 2 | 7.5 | 7.2 | 7.3 | 7.2 | 7.2 | 7.3 | 7.5 | 7.5 |
| 5 | 7.0 | 7.0 | 7.0 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 |
| 7 | 7.3 | 7.0 | 7.0 | 7.0 | 7.1 | 7.7 | 7.1 | 7.1 |
| 9 | 7.3 | 7.3 | 7.2 | 7.2 | 7.2 | 7.2 | 7.3 | 7.3 |
| 12 | 7.9 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 |
| 14 | 7.8 | 7.7 | 7.7 | 7.8 | 7.8 | 7.5 | 7.5 | 7.5 |
| 16 | 7.7 | 7.6 | 7.5 | 7.4 | 7.4 | 7.4 | 7.5 | 7.4 |
| 19 | 7.9 | 7.8 | 7.9 | 7.9 | 7.9 | 7.8 | 7.9 | 7.9 |
| 21 | | | | | | | | |

| | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | | | | | | | | |
| 7.9 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |
| 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.3 | 7.3 | 7.3 | 7.3 |
| 7.1 | 7.4 | 7.4 | 7.4 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| 7.8 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 |
| 7.8 | 7.7 | 7.7 | 7.7 | 7.7 | 7.8 | 7.8 | 7.8 | 7.8 |
| 7.7 | 7.8 | 7.8 | 7.8 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 |
| 8.0 | 7.9 | 7.9 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 7.9 |
| 7.7 | 7.8 | 7.8 | 7.7 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |

conductance (uS/cm)

conductance (uS/cm)

| | | | | | | | | |
|----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 324 | 236 | 230 | 231 | 230 | 231 | 230 | 231 |
| 2 | 376 | 242 | 231 | 230 | 229 | 225 | 227 | 229 |
| 5 | 319 | 236 | 229 | 229 | 225 | 229 | 229 | 229 |
| 7 | 323 | 235 | 233 | 234 | 233 | 234 | 235 | 235 |
| 9 | 316 | 243 | 240 | 239 | 238 | 239 | 238 | 239 |
| 12 | 332 | 242 | 239 | 239 | 240 | 240 | 238 | 240 |
| 14 | 320 | 245 | 247 | 237 | 238 | 239 | 238 | 239 |
| 16 | 331 | 246 | 239 | 231 | 237 | 239 | 237 | 236 |
| 19 | 337 | 242 | 242 | 238 | 236 | 237 | 239 | 237 |
| 21 | | | | | | | | |

| | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|--|
| | | | | | | | | |
| 340 | 253 | 235 | 233 | 235 | 243 | 234 | 247 | |
| 400 | 266 | 254 | 256 | 256 | 278 | 276 | 283 | |
| 368 | 257 | 246 | 246 | 247 | 254 | 255 | 256 | |
| 336 | 256 | 246 | 243 | 247 | 267 | 251 | 256 | |
| 361 | 267 | 257 | 256 | 270 | 319 | 258 | 273 | |
| 319 | 249 | 243 | 244 | 256 | 271 | 252 | 255 | |
| 243 | 255 | 249 | 250 | 263 | 265 | 266 | 251 | |
| 347 | 261 | 248 | 250 | 254 | 252 | 267 | 239 | |
| 381 | 265 | 263 | 259 | 266 | 270 | 259 | 272 | |

dissolved oxygen (mg/L)

dissolved oxygen (mg/L)

| | | | | | | | | |
|----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 7.7 | 8.1 | 8.1 | 8.1 | 8.1 | 8.1 | 8.1 | 8.1 |
| 2 | 7.7 | 7.8 | 7.8 | 7.7 | 7.7 | 7.8 | 7.8 | 7.7 |
| 5 | 7.5 | 7.9 | 7.8 | 7.8 | 7.8 | 7.8 | 7.9 | 7.9 |
| 7 | 7.5 | 7.7 | 7.7 | 7.7 | 7.7 | 7.7 | 7.7 | 7.7 |
| 9 | 7.4 | 7.7 | 7.7 | 7.7 | 7.7 | 7.7 | 7.7 | 7.7 |
| 12 | 7.7 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |
| 14 | 7.7 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |
| 16 | 7.7 | 7.8 | 7.8 | 7.7 | 7.7 | 7.7 | 7.7 | 7.8 |
| 19 | 7.5 | 7.6 | 7.5 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 |
| 21 | | | | | | | | |

| | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|--|
| | | | | | | | | |
| 7.9 | 7.9 | 8.0 | 8.0 | 8.0 | 8.1 | 8.1 | 8.1 | |
| 7.8 | 7.9 | 8.0 | 8.0 | 8.0 | 7.9 | 8.0 | 8.0 | |
| 7.4 | 7.6 | 7.5 | 7.5 | 7.4 | 7.4 | 7.5 | 7.5 | |
| 7.5 | 7.5 | 7.6 | 7.6 | 7.6 | 7.5 | 7.7 | 7.7 | |
| 7.8 | 7.9 | 7.9 | 7.9 | 7.9 | 7.8 | 7.9 | 7.8 | |
| 7.6 | 7.6 | 7.7 | 7.6 | 7.6 | 7.6 | 7.8 | 7.9 | |
| 7.6 | 7.5 | 7.6 | 7.6 | 7.6 | 7.6 | 7.8 | 7.9 | |
| 7.8 | 7.7 | 7.7 | 7.7 | 7.6 | 7.6 | 7.2 | 7.2 | |
| 7.5 | 7.5 | 7.6 | 7.5 | 7.5 | 7.6 | 7.7 | 7.7 | |

temperature (°C)

temperature (°C)

| | | | | | | | | |
|----|------|------|------|------|------|------|------|------|
| 0 | 19.5 | 18.7 | 18.6 | 18.5 | 18.4 | 18.4 | 18.3 | 18.3 |
| 2 | 19.8 | 20.4 | 20.5 | 20.8 | 20.8 | 20.7 | 20.7 | 20.7 |
| 5 | 20.4 | 20.4 | 20.7 | 20.7 | 20.7 | 20.7 | 20.4 | 20.4 |
| 7 | 21.0 | 21.1 | 21.2 | 21.2 | 21.2 | 21.2 | 21.1 | 21.1 |
| 9 | 21.0 | 21.0 | 20.9 | 21.0 | 21.3 | 21.0 | 21.1 | 21.0 |
| 12 | 19.9 | 20.5 | 20.5 | 20.6 | 20.5 | 20.6 | 20.4 | 20.4 |
| 14 | 20.7 | 20.8 | 20.8 | 20.9 | 20.9 | 20.9 | 20.8 | 20.6 |
| 16 | 19.8 | 19.7 | 19.7 | 19.6 | 19.5 | 19.5 | 19.5 | 19.6 |
| 19 | 20.9 | 20.8 | 20.8 | 20.6 | 20.6 | 20.6 | 20.7 | 20.8 |
| 21 | | | | | | | | |

| | | | | | | | | |
|------|------|------|------|------|------|------|------|--|
| | | | | | | | | |
| 19.6 | 19.7 | 19.6 | 19.6 | 19.5 | 18.9 | 19.0 | 19.1 | |
| 19.9 | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 | |
| 21.2 | 20.6 | 20.6 | 20.6 | 20.5 | 20.5 | 20.4 | 20.4 | |
| 19.9 | 20.0 | 20.0 | 20.0 | 20.0 | 19.9 | 19.9 | 19.8 | |
| 19.2 | 19.1 | 19.2 | 19.1 | 19.0 | 18.9 | 19.5 | 19.4 | |
| 19.9 | 19.8 | 19.7 | 19.6 | 19.5 | 19.5 | 19.4 | 19.4 | |
| 19.7 | 19.5 | 19.5 | 19.3 | 19.3 | 19.2 | 19.2 | 19.4 | |
| 19.5 | 19.9 | 19.9 | 19.8 | 19.8 | 19.6 | 20.8 | 20.8 | |
| 19.5 | 19.5 | 19.6 | 19.6 | 19.5 | 19.5 | 19.5 | 19.6 | |

Daphnia Bench Sheet

Client MIN100 Sample SP1617-029
Biology (#, young produced; 0, no young; blank, dead)

| dose (ug/L) | Lab CTL | Site CTL | 5 | 10 | 20 | 40 | 80 | 160 | Lab CTL | Site CTL | 5 | 10 | 20 | 40 | 80 | 160 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|---------------|---|----|----|----|----|----|------|---------|----------|---|----|----|----|----|-----|----|----|---|---|---|---|---|----|---|---|---|---|----|----|---|---|---|----|---|---|---|---|----|----|----|----|---|---|---|---|----|----|---|----|---|---|----|---|---|---------------|---|---|----|----|---|---|---|---|---|----|---|---|---|---|----|---|---|----|---|---|---|---|---|---|------|---|----|---|---|---|---|---|---|----|----|----|----|----|----|----|----|---|---|--|--|--|--|--|--|--|--|
| replicate | | day 1 | | | | | | | | day 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | day 2 | | | | | | | | day 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 2 B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 4 D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 6 F | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 G | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 H | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 I | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 J | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | day 3 | | | | | | | | day 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | day 4 | | | | | | | | day 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>1</td><td>0</td><td>10</td><td>10</td><td>0</td><td>16</td><td>0</td><td>15</td><td>12</td></tr> <tr> <td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>12</td><td>0</td><td>0</td><td>0</td></tr> <tr> <td>3</td><td>16</td><td>13</td><td>0</td><td>0</td><td>0</td><td>13</td><td>0</td><td>0</td></tr> <tr> <td>4</td><td>0</td><td>14</td><td>14</td><td>12</td><td>12</td><td>0</td><td>0</td><td>0</td></tr> <tr> <td>5</td><td>10</td><td>13</td><td>0</td><td>13</td><td>0</td><td>0</td><td>12</td><td>0</td></tr> <tr> <td>6</td><td>10</td><td>0</td><td>0</td><td>12</td><td>12</td><td>0</td><td>0</td><td>0</td></tr> <tr> <td>7</td><td>0</td><td>13</td><td>0</td><td>0</td><td>0</td><td>0</td><td>16</td><td>0</td></tr> <tr> <td>8</td><td>14</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>12 m</td></tr> <tr> <td>9</td><td>14</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>11</td></tr> <tr> <td>10</td><td>15</td><td>13</td><td>10</td><td>14</td><td>14</td><td>15</td><td>0</td><td>0</td></tr> </table> | | | | | | | | 1 | 0 | 10 | 10 | 0 | 16 | 0 | 15 | 12 | 2 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 3 | 16 | 13 | 0 | 0 | 0 | 13 | 0 | 0 | 4 | 0 | 14 | 14 | 12 | 12 | 0 | 0 | 0 | 5 | 10 | 13 | 0 | 13 | 0 | 0 | 12 | 0 | 6 | 10 | 0 | 0 | 12 | 12 | 0 | 0 | 0 | 7 | 0 | 13 | 0 | 0 | 0 | 0 | 16 | 0 | 8 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 12 m | 9 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 10 | 15 | 13 | 10 | 14 | 14 | 15 | 0 | 0 | | | | | | | | |
| 1 | 0 | 10 | 10 | 0 | 16 | 0 | 15 | 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 16 | 13 | 0 | 0 | 0 | 13 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 0 | 14 | 14 | 12 | 12 | 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 10 | 13 | 0 | 13 | 0 | 0 | 12 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 10 | 0 | 0 | 12 | 12 | 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | 0 | 13 | 0 | 0 | 0 | 0 | 16 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 12 m | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | 15 | 13 | 10 | 14 | 14 | 15 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Daphnia Bench Sheet

Client MIN100 Sample SP1617-029

Biology (#, young produced; 0, no young; blank, dead)

| dose (ug/L) | Lab CTL | Site CTL | 5 | 10 | 20 | 40 | 80 | 160 | Lab CTL | Site CTL | 5 | 10 | 20 | 40 | 80 | 160 |
|-------------|---------|----------|----|----|----|----|----|-----|---------|----------|----|-----|----|-----|----|-----|
| replicate | day 9 | | | | | | | | day 13 | | | | | | | |
| 1 A | 9 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 29 | 0 | 0 | 0 | 0 |
| 2 B | 0 | 14 | 20 | 0 | 0 | 15 | 0 | 23 | 0 | 0 | 0 | 30 | 0 | 0 | 30 | 0 |
| 3 C | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 27 | 0 | 0 | 0 |
| 4 D | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 29 |
| 5 E | 0 | 0 | 0 | 21 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 0 | 0 |
| 6 F | 0 | 0 | 24 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 33 | 31 |
| 7 G | 0 | 0 | 0 | 19 | 0 | 13 | 0 | 0 | 0 | 33 | 0 | 0 | 29 | 0 | 0 | 0 |
| 8 H | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 0 | 26 | 28 | 30 | 0 |
| 9 I | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 23 | 0 | 30 | 29 | 0 |
| 10 J | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 15 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | day 10 | | | | | | | | day 14 | | | | | | | |
| 1 A | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 23 | 29 | 0 | 19 | 0 | 39 | 30 |
| 2 B | 0 | 0 | 0 | 11 | 0 | 0 | 24 | 0 | 17 | 0 | 0 | 0 | 17 | 0 | 0 | 0 |
| 3 C | 0 | 0 | 0 | 0 | 19 | 0 | 0 | 0 | 19 | 33 | 28 | 0 | 0 | 31 | 29 | 0 |
| 4 D | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 23 | 16 | 0 | 32 | 17 | 29 | 0 | 29 | 0 |
| 5 E | 0 | 0 | 0 | 0 | 0 | 23 | 0 | 0 | 13 | 20 | 24 | 0 | 25 | 0 | 32 | 31 |
| 6 F | 0 | 0 | 0 | 22 | 0 | 0 | 16 | 16 | 20 | 26 | 0 | 0 | 32 | 0 | 0 | 0 |
| 7 G | 13 | 26 | 0 | 0 | 22 | 0 | 0 | 0 | 19 | 0 | 17 | 0 | 0 | 0 | 29 | 25 |
| 8 H | 0 | 0 | 19 | 0 | 13 | 17 | 26 | 0 | 17 | 25 | 0 | 0 | 0 | 0 | 0 | 33 |
| 9 I | 0 | 0 | 20 | 18 | 19 | 18 | 25 | 0 | 14 | 20 | 0 | 0 | 23 | 0 | 0 | 31 |
| 10 J | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 20 | 25 | 27 | 0 | 32 | 0 |
| | day 11 | | | | | | | | day 15 | | | | | | | |
| 1 A | 0 | 17 | 30 | 0 | 23 | 0 | 36 | 26 | 20 | 0 | 0 | 0 | 0 | 35 | 0 | 0 |
| 2 B | 12 | 20 | 0 | 0 | 25 | 20 | 0 | 0 | 0 | 27 | 31 | 0 | 10 | 37 | 0 | 31 |
| 3 C | 12 | 31 | 28 | 0 | 0 | 20 | 25 | 0 | 0 | 0 | 0 | 37 | 0 | 160 | 0 | 34 |
| 4 D | 15 | 0 | 26 | 19 | 25 | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 36 | 0 | 0 |
| 5 E | 12 | 19 | 20 | 0 | 27 | 0 | 35 | 23 | 0 | 0 | 0 | 23 | 0 | 0 | 0 | 0 |
| 6 F | 13 | 27 | 0 | 0 | 27 | 0 | 32 | 0 | 0 | 0 | 31 | 0 | 0 | 37 | 30 | 0 |
| 7 G | 0 | 0 | 17 | 0 | 0 | 0 | 32 | 20 | 0 | 0 | 0 | 30 | 0 | 35 | 0 | 0 |
| 8 H | 9 | 15 | 0 | 0 | 0 | 0 | 0 | 34 | 0 | 0 | 0 | 34 | 0 | 0 | 0 | 0 |
| 9 I | 9 | 19 | 0 | 0 | 0 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 J | 0 | 19 | 25 | 24 | 31 | 0 | 31 | 27 | 0 | 0 | 0 | 0 | 0 | 29 | 0 | 32 |
| | day 12 | | | | | | | | day 16 | | | | | | | |
| 1 A | 13 | 0 | 0 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 132 | 0 | 0 | 0 | 0 |
| 2 B | 0 | 0 | 35 | 0 | 0 | 0 | 0 | 22* | 41 | 0 | 0 | 34 | 0 | 0 | 41 | 0 |
| 3 C | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 0 |
| 4 D | 0 | 0 | 0 | 0 | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 | 32 |
| 5 E | 0 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46 | 0 | 0 |
| 6 F | 0 | 0 | 28 | 0 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 33 | 0 | 0 | 0 | 40 |
| 7 G | 0 | 0 | 0 | 26 | 0 | 28 | 0 | 0 | 0 | 34 | 0 | 0 | 35 | 0 | 0 | 0 |
| 8 H | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 0 | 38 | 0 | 21 | 0 | 34 | 36 | 38 | 0 |
| 9 I | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34 | 0 | 27 | 36 | 0 | 37 | 34 | 0 |
| 10 J | 0 | 0 | 0 | 0 | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |

Day 12 *160 -> very faint neonates

Daphnia Bench Sheet

Client MIN100 Sample SP1617-029
Biology (#, young produced; 0, no young; blank, dead)

| dose (ug/L) | Lab CTL | Site CTL | 5 | 10 | 20 | 40 | 80 | 160 | Lab CTL | Site CTL | 5 | 10 | 20 | 40 | 80 | 160 |
|-------------|-----------|----------|-----|----|------|----|----|-----|-----------|----------|----|----|----|----|----|-----|
| replicate | 33 day 17 | | | | | | | | 43 day 20 | | | | | | | |
| 1 A | 0 | 26 | 32 | 0 | 26 | 0 | 38 | 41 | 0 | 34 | 32 | 0 | 22 | 0 | 43 | 38 |
| 2 B | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 C | 24 | 41 | 26 | 0 | 0 | 35 | 38 | 0 | 29 | 35 | 31 | 0 | 0 | 30 | 38 | 0 |
| 4 D | 22 | 0 | 23 | 26 | 32 | 0 | 0 | 0 | 26 | 0 | 29 | 17 | 28 | 0 | 31 | 0 |
| 5 E | 0 | 0 | 23 | 0 | 33 | 0 | 42 | 29 | 0 | 29 | 28 | 0 | 30 | 22 | 38 | 21 |
| 6 F | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 | 0 | 0 | 0 |
| 7 G | 24 | 0 | 24 | 0 | 0 | 0 | 30 | 35 | 26 | 37 | 24 | 0 | 0 | 0 | 33 | 37 |
| 8 H | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 34 | 0 | 34 | X | 0 | 0 | 36 | 0 | 28 |
| 9 I | 14 | 25 | 0 | 0 | 26 | 0 | 0 | 30 | 22 | 23 | 0 | 23 | 0 | X | 0 | 0 |
| 10 J | 0 | 26 | 27 | 35 | 0 | 0 | 37 | 0 | 20 | 22 | 31 | 0 | 33 | 0 | 35 | 0 |
| | 23 day 18 | | | | | | | | 19 day 21 | | | | | | | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | ↓ | 2128 | ↓ | 22 | 38 | ↓ | 0 | 0 | 0 | 30 | 0 | 0 | 19 | 32 | 0 | 0 |
| 3 | ↓ | 0 | ↓ | 26 | 0 | ↓ | 32 | ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 |
| 4 | ↓ | 0 | ↓ | 0 | ↓ | 30 | ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 31 | 0 | 0 |
| 5 | 15 | 22 | ↓ | 37 | ↓ | 0 | ↓ | ↓ | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 WH | 20 | 23 | ↓ | ↓ | 43 | ↓ | ↓ | ↓ | 19 | 35 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 CW | 20 | 0 | ↓ | ↓ | 3435 | ↓ | ↓ | ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | 21 | 0 | ↓ | 33 | ↓ | 0 | ↓ | ↓ | 22 | 0 | X | 26 | 0 | 0 | 0 | 0 |
| 9 | 0 | 0 | ↓ | 0 | ↓ | 0 | ↓ | ↓ | 0 | 0 | 0 | 0 | 0 | X | 0 | 31 |
| 10 | 0 | 0 | ↓ | 38 | ↓ | 37 | ↓ | 40 | 0 | 0 | 0 | 32 | 0 | 0 | 0 | 29 |
| | day 19 | | | | | | | | | | | | | | | |
| 1 | 24 | 0 | 0 | 28 | 0 | 40 | 0 | 0 | | | | | | | | |
| 2 | 0 | 0 | 39 | 35 | 0 | 0 | 30 | 20 | | | | | | | | |
| 3 | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 0 | | | | | | | | |
| 4 | ↓ | 30 | 0 | 0 | 0 | 0 | 0 | 32 | | | | | | | | |
| 5 | ↓ | 0 | 0 | 0 | 0 | 2 | 0 | 0 | | | | | | | | |
| 6 | ↓ | 0 | 28 | 19 | 0 | 0 | 31 | 31 | | | | | | | | |
| 7 | ↓ | 0 | 0 | 36 | 29 | 0 | 0 | 0 | | | | | | | | |
| 8 | ↓ | 0 | X18 | 0 | 32 | 0 | 35 | 0 | | | | | | | | |
| 9 | ↓ | 0 | 29 | 0 | 28 | X0 | 31 | 0 | | | | | | | | |
| 10 | ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

Comments:

20-8 = 34
 20-9 = 20

Day 19 death (5-8 + 40-9) → normal mortality observations, nothing stand-out.

CETIS Analytical Report

Report Date: 20 Jul-17 09:21 (p 1 of 2)
Test Code: SP1617-029 DA | 19-7681-6302

Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 03-5027-8011 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 20 Jul-17 9:21 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 24 May-17 | Protocol: ASTM E1193-97 (1997) | Diluent: Not Applicable |
| Ending Date: 14 Jun-17 | Species: Daphnia magna | Brine: |
| Duration: 21d 0h | Source: In-House Culture | Age: |
| Sample ID: 19-6851-8300 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 19d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|---------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 2069508 | 200 | Yes | Two-Point Interpolation |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.279 | 3.306 | 0.0559 | No Outliers Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|------|---------|---------|
| IC5 | >167 | n/a | n/a |
| IC10 | >167 | n/a | n/a |
| IC15 | >167 | n/a | n/a |
| IC20 | >167 | n/a | n/a |
| IC25 | >167 | n/a | n/a |
| IC40 | >167 | n/a | n/a |
| IC50 | >167 | n/a | n/a |

Reproduction Summary

Calculated Variate

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
|-----------|------|-------|-------|-----|-----|---------|---------|--------|---------|
| 0 | N | 10 | 75.1 | 56 | 96 | 3.501 | 11.07 | 14.74% | 0.00% |
| 16.6 | | 10 | 116.5 | 100 | 156 | 6.058 | 19.16 | 16.44% | -55.13% |
| 20.9 | | 10 | 113.3 | 95 | 134 | 4.31 | 13.63 | 12.03% | -50.87% |
| 25.6 | | 10 | 114.4 | 64 | 176 | 12.22 | 38.63 | 33.77% | -52.33% |
| 35.6 | | 10 | 114.6 | 105 | 133 | 3.347 | 10.59 | 9.24% | -52.60% |
| 53.8 | | 10 | 118.5 | 85 | 150 | 5.476 | 17.32 | 14.61% | -57.79% |
| 94.2 | | 10 | 140.9 | 122 | 171 | 5.078 | 16.06 | 11.40% | -87.62% |
| 167 | | 10 | 127.9 | 96 | 149 | 5.104 | 16.14 | 12.62% | -70.31% |

Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | N | 66 | 77 | 84 | 79 | 70 | 72 | 82 | 69 | 56 | 96 |
| 16.6 | | 110 | 119 | 156 | 103 | 100 | 115 | 144 | 116 | 101 | 101 |
| 20.9 | | 134 | 125 | 126 | 124 | 108 | 111 | 95 | 95 | 102 | 113 |
| 25.6 | | 92 | 110 | 108 | 93 | 152 | 71 | 111 | 176 | 64 | 167 |
| 35.6 | | 106 | 105 | 106 | 126 | 128 | 133 | 115 | 112 | 110 | 105 |
| 53.8 | | 122 | 150 | 116 | 136 | 117 | 125 | 111 | 117 | 85 | 106 |
| 94.2 | | 171 | 125 | 143 | 137 | 160 | 122 | 124 | 143 | 134 | 150 |
| 167 | | 149 | 96 | 136 | 116 | 116 | 118 | 133 | 141 | 131 | 143 |

CETIS Analytical Report

Report Date: 20 Jul-17 09:21 (p 1 of 2)
Test Code: SP1617-029 DA | 19-7681-6302

Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|--|-------------------------------------|
| Analysis ID: 20-6120-2709 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 20 Jul-17 9:21 | Analysis: Nonparametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 24 May-17 | Protocol: ASTM E1193-97 (1997) | Diluent: Not Applicable |
| Ending Date: 14 Jun-17 | Species: Daphnia magna | Brine: |
| Duration: 21d 0h | Source: In-House Culture | Age: |
| Sample ID: 19-6851-8300 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 19d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|-------|------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 167 | > 167 | n/a | | 28.0% |

Steel Many-One Rank Sum Test

| Control | vs | Conc-ug/L | Test Stat | Critical | Ties | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|------|----|--------|---------|------------------------|
| Negative Control | | 16.6 | 155 | 74 | 0 | 18 | Asymp | 1.0000 | Non-Significant Effect |
| | | 20.9 | 153 | 74 | 0 | 18 | Asymp | 1.0000 | Non-Significant Effect |
| | | 25.6 | 138 | 74 | 0 | 18 | Asymp | 1.0000 | Non-Significant Effect |
| | | 35.6 | 155 | 74 | 0 | 18 | Asymp | 1.0000 | Non-Significant Effect |
| | | 53.8 | 154 | 74 | 0 | 18 | Asymp | 1.0000 | Non-Significant Effect |
| | | 94.2 | 155 | 74 | 0 | 18 | Asymp | 1.0000 | Non-Significant Effect |
| | | 167 | 154.5 | 74 | 1 | 18 | Asymp | 1.0000 | Non-Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.279 | 3.306 | 0.0559 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|----------|--------------------|
| Between | 24469.6 | 3495.66 | 7 | 9.027 | <1.0E-37 | Significant Effect |
| Error | 27880.6 | 387.231 | 72 | | | |
| Total | 52350.2 | | 79 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 24.96 | 18.48 | 7.7E-04 | Unequal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9633 | 0.9579 | 0.0216 | Normal Distribution |

Reproduction Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|-----|-----|---------|--------|---------|
| 0 | N | 10 | 75.1 | 67.18 | 83.02 | 74.5 | 56 | 96 | 3.501 | 14.74% | 0.00% |
| 16.6 | | 10 | 116.5 | 102.8 | 130.2 | 112.5 | 100 | 156 | 6.058 | 16.44% | -55.13% |
| 20.9 | | 10 | 113.3 | 103.5 | 123.1 | 112 | 95 | 134 | 4.31 | 12.03% | -50.87% |
| 25.6 | | 10 | 114.4 | 86.77 | 142 | 109 | 64 | 176 | 12.22 | 33.77% | -52.33% |
| 35.6 | | 10 | 114.6 | 107 | 122.2 | 111 | 105 | 133 | 3.347 | 9.24% | -52.60% |
| 53.8 | | 10 | 118.5 | 106.1 | 130.9 | 117 | 85 | 150 | 5.476 | 14.61% | -57.79% |
| 94.2 | | 10 | 140.9 | 129.4 | 152.4 | 140 | 122 | 171 | 5.078 | 11.40% | -87.62% |
| 167 | | 10 | 127.9 | 116.4 | 139.4 | 132 | 96 | 149 | 5.104 | 12.62% | -70.31% |

Daphnia magna 21-d Survival and Reproduction Test

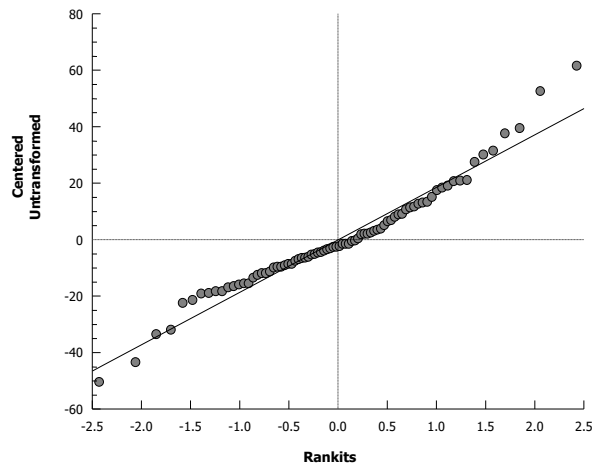
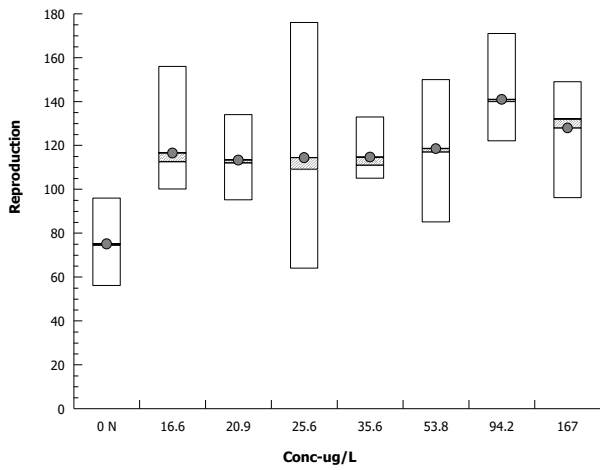
Nautilus Environmental Calgary

Analysis ID: 20-6120-2709 Endpoint: Reproduction CETIS Version: CETISv1.9.0
 Analyzed: 20 Jul-17 9:21 Analysis: Nonparametric-Control vs Treatments Official Results: Yes

Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | N | 66 | 77 | 84 | 79 | 70 | 72 | 82 | 69 | 56 | 96 |
| 16.6 | | 110 | 119 | 156 | 103 | 100 | 115 | 144 | 116 | 101 | 101 |
| 20.9 | | 134 | 125 | 126 | 124 | 108 | 111 | 95 | 95 | 102 | 113 |
| 25.6 | | 92 | 110 | 108 | 93 | 152 | 71 | 111 | 176 | 64 | 167 |
| 35.6 | | 106 | 105 | 106 | 126 | 128 | 133 | 115 | 112 | 110 | 105 |
| 53.8 | | 122 | 150 | 116 | 136 | 117 | 125 | 111 | 117 | 85 | 106 |
| 94.2 | | 171 | 125 | 143 | 137 | 160 | 122 | 124 | 143 | 134 | 150 |
| 167 | | 149 | 96 | 136 | 116 | 116 | 118 | 133 | 141 | 131 | 143 |

Graphics



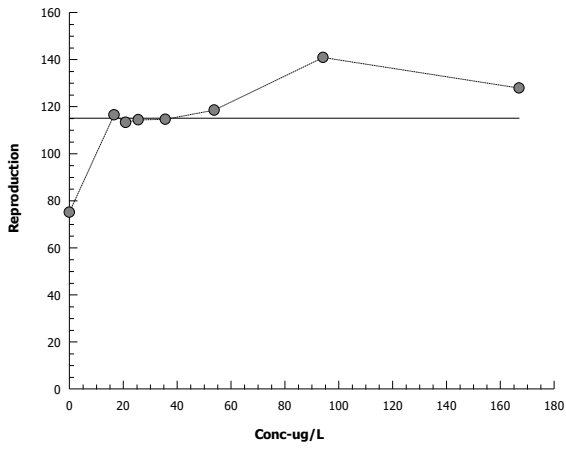
Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

Analysis ID: 03-5027-8011 Endpoint: Reproduction
Analyzed: 20 Jul-17 9:21 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 20 Jul-17 09:20 (p 1 of 2)
Test Code: SP1617-029 DA | 19-7681-6302

Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 17-4704-8721 | Endpoint: Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 20 Jul-17 9:20 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 24 May-17 | Protocol: ASTM E1193-97 (1997) | Diluent: Not Applicable |
| Ending Date: 14 Jun-17 | Species: Daphnia magna | Brine: |
| Duration: 21d 0h | Source: In-House Culture | Age: |
| Sample ID: 19-6851-8300 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 19d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|---------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 2054100 | 200 | Yes | Two-Point Interpolation |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|------|---------|---------|
| LC5 | >167 | n/a | n/a |
| LC10 | >167 | n/a | n/a |
| LC15 | >167 | n/a | n/a |
| LC20 | >167 | n/a | n/a |
| LC25 | >167 | n/a | n/a |
| LC40 | >167 | n/a | n/a |
| LC50 | >167 | n/a | n/a |

Survival Rate Summary

Calculated Variate(A/B)

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
|-----------|------|-------|--------|--------|--------|---------|---------|--------|---------|----|----|
| 0 | N | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |
| 16.6 | | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |
| 20.9 | | 10 | 0.9000 | 0.0000 | 1.0000 | 0.1000 | 0.3162 | 35.14% | 10.00% | 9 | 10 |
| 25.6 | | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |
| 35.6 | | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |
| 53.8 | | 10 | 0.9000 | 0.0000 | 1.0000 | 0.1000 | 0.3162 | 35.14% | 10.00% | 9 | 10 |
| 94.2 | | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |
| 167 | | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |

Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 16.6 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 20.9 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 1.0000 | 1.0000 |
| 25.6 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 35.6 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 53.8 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 1.0000 |
| 94.2 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 167 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | N | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 16.6 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 20.9 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 0/1 | 1/1 | 1/1 |
| 25.6 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 35.6 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 53.8 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 0/1 | 1/1 |
| 94.2 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 167 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |

Daphnia magna 21-d Survival and Reproduction Test

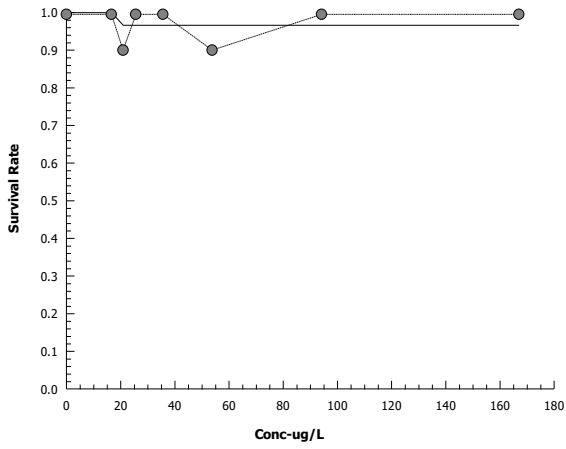
Nautilus Environmental Calgary

Analysis ID: 17-4704-8721
Analyzed: 20 Jul-17 9:20

Endpoint: Survival Rate
Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 20 Jul-17 09:19 (p 1 of 2)
Test Code: SP1617-029 DA | 19-7681-6302

Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 03-5304-5402 | Endpoint: Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 20 Jul-17 9:19 | Analysis: STP 2x2 Contingency Tables | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 24 May-17 | Protocol: ASTM E1193-97 (1997) | Diluent: Not Applicable |
| Ending Date: 14 Jun-17 | Species: Daphnia magna | Brine: |
| Duration: 21d 0h | Source: In-House Culture | Age: |
| Sample ID: 19-6851-8300 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 19d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|-------|------|----|------|
| Untransformed | C > T | n/a | n/a | n/a | 167 | > 167 | n/a | | n/a |

Fisher Exact/Bonferroni-Holm Test

| Control | vs | Group | Test Stat | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-------|-----------|--------|---------|------------------------|
| Negative Control | | 16.6 | 1.0000 | Exact | 1.0000 | Non-Significant Effect |
| | | 20.9 | 0.5000 | Exact | 1.0000 | Non-Significant Effect |
| | | 25.6 | 1.0000 | Exact | 1.0000 | Non-Significant Effect |
| | | 35.6 | 1.0000 | Exact | 1.0000 | Non-Significant Effect |
| | | 53.8 | 0.5000 | Exact | 1.0000 | Non-Significant Effect |
| | | 94.2 | 1.0000 | Exact | 1.0000 | Non-Significant Effect |
| | | 167 | 1.0000 | Exact | 1.0000 | Non-Significant Effect |

Data Summary

| Conc-ug/L | Code | NR | R | NR + R | Prop NR | Prop R | %Effect |
|-----------|------|----|---|--------|---------|--------|---------|
| 0 | N | 10 | 0 | 10 | 1 | 0 | 0.0% |
| 16.6 | | 10 | 0 | 10 | 1 | 0 | 0.0% |
| 20.9 | | 9 | 1 | 10 | 0.9 | 0.1 | 10.0% |
| 25.6 | | 10 | 0 | 10 | 1 | 0 | 0.0% |
| 35.6 | | 10 | 0 | 10 | 1 | 0 | 0.0% |
| 53.8 | | 9 | 1 | 10 | 0.9 | 0.1 | 10.0% |
| 94.2 | | 10 | 0 | 10 | 1 | 0 | 0.0% |
| 167 | | 10 | 0 | 10 | 1 | 0 | 0.0% |

Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 16.6 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 20.9 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 1.0000 | 1.0000 |
| 25.6 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 35.6 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 53.8 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 1.0000 |
| 94.2 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 167 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | N | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 16.6 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 20.9 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 0/1 | 1/1 | 1/1 |
| 25.6 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 35.6 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 53.8 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 0/1 | 1/1 |
| 94.2 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 167 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |

Daphnia magna 21-d Survival and Reproduction Test

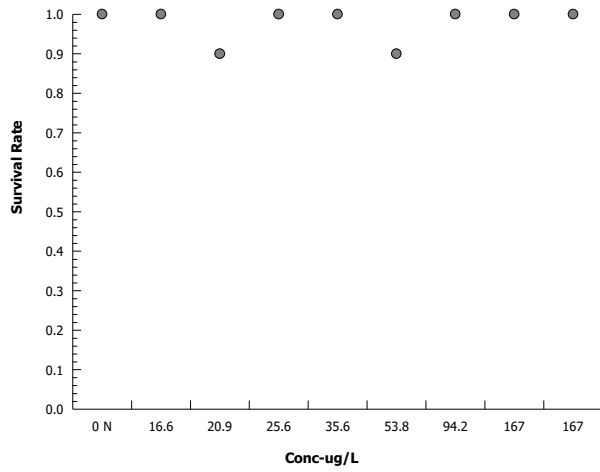
Nautilus Environmental Calgary

Analysis ID: 03-5304-5402
Analyzed: 20 Jul-17 9:19

Endpoint: Survival Rate
Analysis: STP 2x2 Contingency Tables

CETIS Version: CETISv1.9.0
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 10:19 (p 1 of 2)
Test Code: SP1617-029 DA | 21-0083-7862

Daphnia magna 21d Survival and Reproduction Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 10-4442-7238 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 10:18 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 06-9185-5354 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 24 May-17 | Protocol: ASTM E1193-97 (1997) | Diluent: |
| Ending Date: 14 Jun-17 | Species: Daphnia magna | Brine: |
| Duration: 21d 0h | Source: In-House Culture | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 19d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 251405 | 200 | Yes | Two-Point Interpolation |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.37 | 3.306 | 0.0383 | Outlier Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|------|---------|---------|
| IC5 | >149 | n/a | n/a |
| IC10 | >149 | n/a | n/a |
| IC15 | >149 | n/a | n/a |
| IC20 | >149 | n/a | n/a |
| IC25 | >149 | n/a | n/a |
| IC40 | >149 | n/a | n/a |
| IC50 | >149 | n/a | n/a |

Reproduction Summary

Calculated Variate

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
|-----------|------|-------|-------|-----|-----|---------|---------|--------|---------|
| 0 | N | 10 | 75.1 | 56 | 96 | 3.501 | 11.07 | 14.74% | 0.00% |
| 13.8 | | 10 | 116.5 | 100 | 156 | 6.058 | 19.16 | 16.44% | -55.13% |
| 18 | | 10 | 113.3 | 95 | 134 | 4.31 | 13.63 | 12.03% | -50.87% |
| 22.8 | | 10 | 114.4 | 92 | 167 | 7.296 | 23.07 | 20.17% | -52.33% |
| 31.3 | | 10 | 114.6 | 105 | 133 | 3.347 | 10.59 | 9.24% | -52.60% |
| 49 | | 10 | 118.5 | 85 | 150 | 5.476 | 17.32 | 14.61% | -57.79% |
| 83.6 | | 10 | 140.9 | 122 | 171 | 5.078 | 16.06 | 11.40% | -87.62% |
| 149 | | 10 | 127.9 | 96 | 149 | 5.104 | 16.14 | 12.62% | -70.31% |

Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | N | 66 | 77 | 84 | 79 | 70 | 72 | 82 | 69 | 56 | 96 |
| 13.8 | | 110 | 119 | 156 | 103 | 100 | 115 | 144 | 116 | 101 | 101 |
| 18 | | 134 | 125 | 126 | 124 | 108 | 111 | 95 | 95 | 102 | 113 |
| 22.8 | | 92 | 110 | 108 | 93 | 119 | 104 | 111 | 140 | 100 | 167 |
| 31.3 | | 106 | 105 | 106 | 126 | 128 | 133 | 115 | 112 | 110 | 105 |
| 49 | | 122 | 150 | 116 | 136 | 117 | 125 | 111 | 117 | 85 | 106 |
| 83.6 | | 171 | 125 | 143 | 137 | 160 | 122 | 124 | 143 | 134 | 150 |
| 149 | | 149 | 96 | 136 | 116 | 116 | 118 | 133 | 141 | 131 | 143 |

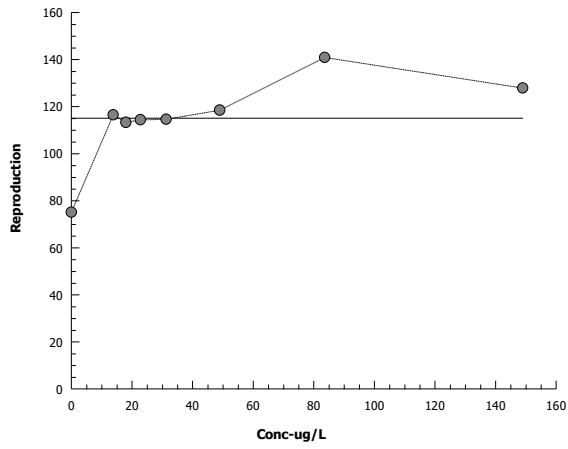
Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

Analysis ID: 10-4442-7238 Endpoint: Reproduction
Analyzed: 16 Aug-17 10:18 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 10:20 (p 1 of 2)
 Test Code: SP1617-029 DA | 21-0083-7862

Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 13-2583-7111 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 10:19 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 06-9185-5354 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 24 May-17 | Protocol: ASTM E1193-97 (1997) | Diluent: |
| Ending Date: 14 Jun-17 | Species: Daphnia magna | Brine: |
| Duration: 21d 0h | Source: In-House Culture | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 19d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|-------|------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 149 | > 149 | n/a | | 23.2% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 13.8 | -5.663 | 2.386 | 17.44 | 18 | CDF | 1.0000 | Non-Significant Effect |
| | | 18 | -5.225 | 2.386 | 17.44 | 18 | CDF | 1.0000 | Non-Significant Effect |
| | | 22.8 | -5.376 | 2.386 | 17.44 | 18 | CDF | 1.0000 | Non-Significant Effect |
| | | 31.3 | -5.403 | 2.386 | 17.44 | 18 | CDF | 1.0000 | Non-Significant Effect |
| | | 49 | -5.937 | 2.386 | 17.44 | 18 | CDF | 1.0000 | Non-Significant Effect |
| | | 83.6 | -9.001 | 2.386 | 17.44 | 18 | CDF | 1.0000 | Non-Significant Effect |
| | | 149 | -7.222 | 2.386 | 17.44 | 18 | CDF | 1.0000 | Non-Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.37 | 3.306 | 0.0383 | Outlier Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|----------|--------------------|
| Between | 24469.6 | 3495.66 | 7 | 13.08 | <1.0E-37 | Significant Effect |
| Error | 19240.6 | 267.231 | 72 | | | |
| Total | 43710.2 | | 79 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 8.226 | 18.48 | 0.3131 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9695 | 0.9579 | 0.0531 | Normal Distribution |

Reproduction Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|-----|-----|---------|--------|---------|
| 0 | N | 10 | 75.1 | 67.18 | 83.02 | | 56 | 96 | 3.501 | 14.74% | 0.00% |
| 13.8 | | 10 | 116.5 | 102.8 | 130.2 | | 100 | 156 | 6.058 | 16.44% | -55.13% |
| 18 | | 10 | 113.3 | 103.5 | 123.1 | | 95 | 134 | 4.31 | 12.03% | -50.87% |
| 22.8 | | 10 | 114.4 | 97.9 | 130.9 | | 92 | 167 | 7.296 | 20.17% | -52.33% |
| 31.3 | | 10 | 114.6 | 107 | 122.2 | | 105 | 133 | 3.347 | 9.24% | -52.60% |
| 49 | | 10 | 118.5 | 106.1 | 130.9 | | 85 | 150 | 5.476 | 14.61% | -57.79% |
| 83.6 | | 10 | 140.9 | 129.4 | 152.4 | | 122 | 171 | 5.078 | 11.40% | -87.62% |
| 149 | | 10 | 127.9 | 116.4 | 139.4 | | 96 | 149 | 5.104 | 12.62% | -70.31% |

CETIS Analytical Report

Report Date: 16 Aug-17 10:20 (p 2 of 2)
Test Code: SP1617-029 DA | 21-0083-7862

Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

Analysis ID: 13-2583-7111 Endpoint: Reproduction CETIS Version: CETISv1.9.0
Analyzed: 16 Aug-17 10:19 Analysis: Parametric-Control vs Treatments Official Results: Yes

Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | N | 66 | 77 | 84 | 79 | 70 | 72 | 82 | 69 | 56 | 96 |
| 13.8 | | 110 | 119 | 156 | 103 | 100 | 115 | 144 | 116 | 101 | 101 |
| 18 | | 134 | 125 | 126 | 124 | 108 | 111 | 95 | 95 | 102 | 113 |
| 22.8 | | 92 | 110 | 108 | 93 | 119 | 104 | 111 | 140 | 100 | 167 |
| 31.3 | | 106 | 105 | 106 | 126 | 128 | 133 | 115 | 112 | 110 | 105 |
| 49 | | 122 | 150 | 116 | 136 | 117 | 125 | 111 | 117 | 85 | 106 |
| 83.6 | | 171 | 125 | 143 | 137 | 160 | 122 | 124 | 143 | 134 | 150 |
| 149 | | 149 | 96 | 136 | 116 | 116 | 118 | 133 | 141 | 131 | 143 |

CETIS Analytical Report

Report Date: 16 Aug-17 10:17 (p 1 of 2)
Test Code: SP1617-029 DA | 21-0083-7862

Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 20-2240-3712 | Endpoint: Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 10:16 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 06-9185-5354 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 24 May-17 | Protocol: ASTM E1193-97 (1997) | Diluent: |
| Ending Date: 14 Jun-17 | Species: Daphnia magna | Brine: |
| Duration: 21d 0h | Source: In-House Culture | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 19d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 826116 | 200 | Yes | Two-Point Interpolation |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|------|---------|---------|
| LC5 | >149 | n/a | n/a |
| LC10 | >149 | n/a | n/a |
| LC15 | >149 | n/a | n/a |
| LC20 | >149 | n/a | n/a |
| LC25 | >149 | n/a | n/a |
| LC40 | >149 | n/a | n/a |
| LC50 | >149 | n/a | n/a |

Survival Rate Summary

Calculated Variate(A/B)

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
|-----------|------|-------|--------|--------|--------|---------|---------|--------|---------|----|----|
| 0 | N | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |
| 13.8 | | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |
| 18 | | 10 | 0.9000 | 0.0000 | 1.0000 | 0.1000 | 0.3162 | 35.14% | 10.00% | 9 | 10 |
| 22.8 | | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |
| 31.3 | | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |
| 49 | | 10 | 0.9000 | 0.0000 | 1.0000 | 0.1000 | 0.3162 | 35.14% | 10.00% | 9 | 10 |
| 83.6 | | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |
| 149 | | 10 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | 0.00% | 10 | 10 |

Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 13.8 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 18 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 1.0000 | 1.0000 |
| 22.8 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 31.3 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 49 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 1.0000 |
| 83.6 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 149 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | N | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 13.8 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 18 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 0/1 | 1/1 | 1/1 |
| 22.8 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 31.3 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 49 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 0/1 | 1/1 |
| 83.6 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 149 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |

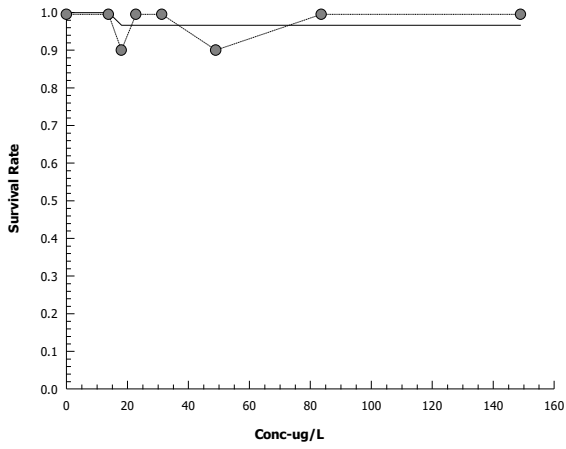
Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

Analysis ID: 20-2240-3712 Endpoint: Survival Rate
Analyzed: 16 Aug-17 10:16 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 10:17 (p 1 of 2)
Test Code: SP1617-029 DA | 21-0083-7862

Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 04-8243-0659 | Endpoint: Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 10:17 | Analysis: STP 2x2 Contingency Tables | Official Results: Yes |
| Batch ID: 06-9185-5354 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 24 May-17 | Protocol: ASTM E1193-97 (1997) | Diluent: |
| Ending Date: 14 Jun-17 | Species: Daphnia magna | Brine: |
| Duration: 21d 0h | Source: In-House Culture | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 19d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|-------|------|----|------|
| Untransformed | C > T | n/a | n/a | n/a | 149 | > 149 | n/a | | n/a |

Fisher Exact/Bonferroni-Holm Test

| Control | vs | Group | Test Stat | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-------|-----------|--------|---------|------------------------|
| Negative Control | | 13.8 | 1.0000 | Exact | 1.0000 | Non-Significant Effect |
| | | 18 | 0.5000 | Exact | 1.0000 | Non-Significant Effect |
| | | 22.8 | 1.0000 | Exact | 1.0000 | Non-Significant Effect |
| | | 31.3 | 1.0000 | Exact | 1.0000 | Non-Significant Effect |
| | | 49 | 0.5000 | Exact | 1.0000 | Non-Significant Effect |
| | | 83.6 | 1.0000 | Exact | 1.0000 | Non-Significant Effect |
| | | 149 | 1.0000 | Exact | 1.0000 | Non-Significant Effect |

Data Summary

| Conc-ug/L | Code | NR | R | NR + R | Prop NR | Prop R | %Effect |
|-----------|------|----|---|--------|---------|--------|---------|
| 0 | N | 10 | 0 | 10 | 1 | 0 | 0.0% |
| 13.8 | | 10 | 0 | 10 | 1 | 0 | 0.0% |
| 18 | | 9 | 1 | 10 | 0.9 | 0.1 | 10.0% |
| 22.8 | | 10 | 0 | 10 | 1 | 0 | 0.0% |
| 31.3 | | 10 | 0 | 10 | 1 | 0 | 0.0% |
| 49 | | 9 | 1 | 10 | 0.9 | 0.1 | 10.0% |
| 83.6 | | 10 | 0 | 10 | 1 | 0 | 0.0% |
| 149 | | 10 | 0 | 10 | 1 | 0 | 0.0% |

Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 13.8 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 18 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 1.0000 | 1.0000 |
| 22.8 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 31.3 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 49 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 1.0000 |
| 83.6 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 149 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | N | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 13.8 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 18 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 0/1 | 1/1 | 1/1 |
| 22.8 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 31.3 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 49 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 0/1 | 1/1 |
| 83.6 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |
| 149 | | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 | 1/1 |

CETIS Analytical Report

Report Date: 16 Aug-17 10:17 (p 2 of 2)
Test Code: SP1617-029 DA | 21-0083-7862

Daphnia magna 21-d Survival and Reproduction Test

Nautilus Environmental Calgary

Analysis ID: 04-8243-0659 **Endpoint:** Survival Rate
Analyzed: 16 Aug-17 10:17 **Analysis:** STP 2x2 Contingency Tables

CETIS Version: CETISv1.9.0
Official Results: Yes

APPENDIX C – *Pimephales promelas* Toxicity Test Data

Method FMD 32 Day ELS Client MIN100

Sample: SP1617-029

Organism Information

Source: AQUATON Batch: 20170525FMELS Egg Stage: 13 somites

Organisms Received in Good Condition: Yes No

Test Log

| Date | Day | Time | Technicians | Chem Cart Used | Fed | | Sample Pre-Aeration Time | Bench Sheet Review | |
|------------|-----|------|-------------|----------------|-----|----|--------------------------|--------------------|--------|
| | | | | | AM | PM | | First | Second |
| 2017/05/25 | 0 | 1430 | JW/NM/JN | 2 | - | - | 60 mins | JW | JN |
| 2017/05/26 | 1 | 1200 | NM/EP | 2 | - | - | 60 mins | JW | NM |
| 2017/05/27 | 2 | 1530 | LC/JW | 2 | - | - | 60 min | LC | JW |
| 2017/05/28 | 3 | 1400 | NM | 2 | - | - | 60 min | NM | SS |
| 2017/05/29 | 4 | 1340 | NM | 2 | - | ✓ | 60 min | JW | SS |
| 2017/05/30 | 5 | 1445 | LC/EP | 2 | ✓ | ✓ | 60 min | JW | EP |
| 2017/05/31 | 6 | 1430 | JW | 2 | ✓ | ✓ | 60 min | JW | NM |
| 2017/06/01 | 7 | 1400 | JW | 2 | ✓ | ✓ | 60 min | JW | LC |
| 2017/06/02 | 8 | 1415 | JW/EP | 2 | ✓ | ✓ | 60 min | LC | LC |
| 2017/06/03 | 9 | 1415 | LC | 2 | ✓ | ✓ | 60 min | LC | EP |
| 2017/06/04 | 10 | 1415 | NM/JW | 2 | ✓ | ✓ | 60 min | JW | NM |
| 2017/06/05 | 11 | 1450 | JW/EP | 2 | ✓ | ✓ | 60 mins | JW | EP |
| 2017/06/06 | 12 | 1400 | JW | 2 | ✓ | ✓ | 60 mins | JW | EP |
| 2017/06/07 | 13 | 1500 | JW/LC | 2 | ✓ | ✓ | 60 mins | JW | SS |
| 2017/06/08 | 14 | 1200 | JW | 2 | ✓ | ✓ | 60 mins | HS | SS |
| 2017/06/09 | 15 | 1220 | SS | 2 | ✓ | ✓ | 60 min | LC | EP |
| 2017/06/10 | 16 | 1400 | LC/HS | 2 | ✓ | ✓ | 60 min | HS | LC |
| 2017/06/11 | 17 | 1330 | SS/NM | 2 | ✓ | ✓ | 60 min | NM | SS |
| 2017/06/12 | 18 | 1330 | HS | 2 | ✓ | ✓ | 60 min | HS | SS |
| 2017/06/13 | 19 | 1130 | LC | 2 | ✓ | ✓ | 60 min | NM | EP |
| 2017/06/14 | 20 | 1200 | HS | 2 | ✓ | ✓ | 60 min | HS | JW |
| 2017/06/15 | 21 | 1100 | SS | 2 | ✓ | ✓ | 60 min | JW | LC |
| 2017/06/16 | 22 | 1530 | EP | 2 | ✓ | ✓ | 60 min | JW | LC |
| 2017/06/17 | 23 | 1200 | JW | 2 | ✓ | ✓ | 60 min | JW | LC |
| 2017/06/18 | 24 | 1430 | NM | 2 | ✓ | ✓ | 60 min | NM | SS |
| 2017/06/19 | 25 | 1200 | JW/NM | 2 | ✓ | ✓ | 60 min | JW | NM |
| 2017/06/20 | 26 | 1230 | SS/JW | 2 | ✓ | ✓ | 60 min | SS | JW |
| 2017/06/21 | 27 | 1230 | HS/JW | 2 | ✓ | ✓ | 60 min | HS | JW |
| 2017/06/22 | 28 | 1400 | JW/EP | 2 | ✓ | ✓ | 60 min | JW | EP |
| 2017/06/23 | 29 | 1400 | JW/HS | 2 | ✓ | ✓ | 60 min | HS | JW |
| 2017/06/24 | 30 | 1330 | EP | 2 | ✓ | ✓ | 60 min | EP | LC |
| 2017/06/25 | 31 | 1300 | SS | 2 | ✓ | ✓ | 60 min | HS | SS |
| 2017/06/26 | 32 | 1100 | JW/NM | 2 | - | - | - | JW | EP |

* feeding adj

Method FMD 32 Day ELS Client MIN100 Sample: SP1617-029

Control hatching success must be >66% (≥10 per replicate). Post hatch survival must be >70%.

Number of Alive Embryos and Hatched Organisms

| replicate | CTL | | SITE CTL | | 5 ug/L | | 10 ug/L | | 20 ug/L | | 40 ug/L | | 80 ug/L | | 160 ug/L | |
|-----------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|--------------|
| | Day 1 | | Day 1 | | Day 1 | | Day 1 | | Day 1 | | Day 1 | | Day 1 | | Day 1 | |
| | Alive Embryos | Dead Embryos | Alive Embryos | Dead Embryos | Alive Embryos | Dead Embryos | Alive Embryos | Dead Embryos | Alive Embryos | Dead Embryos | Alive Embryos | Dead Embryos | Alive Embryos | Dead Embryos | Alive Embryos | Dead Embryos |
| a | 13 | 2 | 14 | 1 | 13 | 2 | 14 | 1 | *12 | 3 | 13 | 2 | 15 | 0 | 14 | 1 |
| b | 15 | 0 | 15 | 0 | 14 | 1 | 13 | 2 | 14 | 1 | 14 | 1 | 13 | 2 | 15 | 0 |
| c | 15 | 0 | 13 | 2 | 14 | 1 | 13 | 2 | 13 | 2 | 15 | 0 | 15 | 0 | 13 | 2 |
| d | 15 | 0 | 13 | 2 | 12 | 3 | 14 | 1 | 12 | 3 | 13 | 2 | 12 | 3 | 13 | 2 |
| e | 29 | 1 | 29 | 1 | 27 | 3 | 25 | 5 | 26 | 4 | 25 | 5 | 25 | 5 | 26 | 4 |
| f | 28 | 2 | 27 | 3 | 28 | 2 | 26 | 3 | 27 | 3 | 27 | 3 | 30 | 0 | 29 | 1 |

Comments/Observations: * 1 hatched + alive

Number of Alive Embryos and Hatched Organisms

| replicate | CTL | | | SITE CTL | | | 5 ug/L | | | 10 ug/L | | |
|-----------|---------------|--------------|------------|---------------|--------------|------------|---------------|--------------|------------|---------------|--------------|------------|
| | Alive Embryos | Dead Embryos | Cull to 15 | Alive Embryos | Dead Embryos | Cull to 15 | Alive Embryos | Dead Embryos | Cull to 15 | Alive Embryos | Dead Embryos | Cull to 15 |
| a | 13 | 0 | 15 | 14 | 0 | 15 | 12 | 1 | 15 | 14 | 0 | 15 |
| b | 15 | 0 | 15 | 15 | 0 | 15 | 14 | 0 | 15 | 13 | 0 | 15 |
| c | 14 | 1 | 15 | 13 | 0 | 15 | 14 | 0 | 15 | 12 | 1 | 15 |
| d | 15 | 0 | 15 | 13 | 0 | 15 | 12 | 0 | 15 | 13 | 1 | 15 |
| e | 29 | 0 | | 26 | 3 | | 25 | 2 | | 23 | 2 | |
| f | 28 | 0 | | 27 | 0 | | 26 | 2 | | 25 | 1 | |

| replicate | 20 ug/L | | | 40 ug/L | | | 80 ug/L | | | 160 ug/L | | |
|-----------|---------------|--------------|------------|---------------|--------------|------------|---------------|--------------|------------|---------------|--------------|------------|
| | Alive Embryos | Dead Embryos | Cull to 15 | Alive Embryos | Dead Embryos | Cull to 15 | Alive Embryos | Dead Embryos | Cull to 15 | Alive Embryos | Dead Embryos | Cull to 15 |
| a | 11 | 1 | 15 | 13 | 0 | 15 | 15 | 0 | 15 | 12 | 2 | 15 |
| b | 14 | 0 | 15 | 13 | 1 | 15 | 12 | 1 | 15 | 14 | 1 | 15 |
| c | 13 | 0 | 15 | 15 | 0 | 15 | 15 | 0 | 15 | 13 | 0 | 15 |
| d | 11 | 1 | 15 | 12 | 1 | 15 | 12 | 0 | 15 | 13 | 0 | 15 |
| e | 23 | 3 | | 25 | 0 | | 25 | 0 | | 26 | 0 | |
| f | 23 | 4 | | 21 | 0 | | 30 | 0 | | 29 | 0 | |

Day 2 - Poor looking and dead embryos in replicates a, b, c and d are replaced with healthy embryos from replicates e and f. Replicates e and f are discarded after day 2

Comments/Observations:

Method FMD 32 Day ELS Client MIN100 Sample: SP1617-029

Number of Alive Embryos and Hatched Organisms

| replicate | CTL | | SITE CTL | | 5 ug/L | | 10 ug/L | | 20 ug/L | | 40 ug/L | | 80 ug/L | | 160 ug/L | |
|-----------|---------------|---------------|---------------|----------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------|---------------|------------------|
| | Day 3 | | Day 3 | | Day 3 | | Day 3 | | Day 3 | | Day 3 | | Day 3 | | Day 3 | |
| | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched |
| a | 8 | 7 | 2 | 13 | 2 | 13 | 4 | 11 | 0 | 15 | 6 | 9 | 4 | 9 | 4 | 10 ¹¹ |
| b | 11 | 4 | 8 | 5 ⁶ | 2 | 13 | 5 | 10 | 4 | 11 | 6 | 9 | 9 | 6 | 3 | 12 |
| c | 9 | 6 | 8 | 7 | 7 | 8 | 7 | 8 | 4 | 11 | 7 | 8 | 4 | 11 | 7 | 8 |
| d | 11 | 4 | 7 | 7 | 7 | 8 | 5 | 10 | 6 | 9 | 7 | 8 | 8 | 5 ⁷ | 5 | 8 |

Comments/Observations: For days 3-6 record if the dead organisms was an embryo (e), partially hatched (p) or hatched (h)

| replicate | CTL | | SITE CTL | | 5 ug/L | | 10 ug/L | | 20 ug/L | | 40 ug/L | | 80 ug/L | | 160 ug/L | |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 4 | | Day 4 | | Day 4 | | Day 4 | | Day 4 | | Day 4 | | Day 4 | | Day 4 | |
| | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched | Alive Embryos | Alive Hatched |
| a | 0 | 15 | 0 | 15 | 0 | 14 | 0 | 15 | 0 | 15 | 0 | 15 | 0 | 11 | 0 | 15 |
| b | 0 | 15 | 0 | 15 | 0 | 15 | 0 | 15 | 0 | 15 | 0 | 15 | 0 | 15 | 0 | 15 |
| c | 0 | 14 | 0 | 15 | 0 | 15 | 0 | 15 | 0 | 15 | 0 | 15 | 0 | 13 | 0 | 15 |
| d | 1 | 13 | 0 | 14 | 0 | 14 | 0 | 15 | 0 | 15 | 1 | 14 | 0 | 15 | 0 | 13 |

Comments/Observations: For days 3-6 record if the dead organisms was an embryo (e), partially hatched (p) or hatched (h)
 CTL D - clear hatched, HDH → clear embryo, 50 ug/L → clear embryos, 80 ug/L → clear embryos, 160 ug/L → clear embryos.

| replicate | CTL | | SITE CTL | | 5 ug/L | | 10 ug/L | | 20 ug/L | | 40 ug/L | | 80 ug/L | | 160 ug/L | |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 5 | | Day 5 | | Day 5 | | Day 5 | | Day 5 | | Day 5 | | Day 5 | | Day 5 | |
| | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 15 | 15 | 15 | 15 | 14 | 15 | 15 | 15 | 15 | 15 | 15 | 11 | 15 | 15 | 15 | 15 |
| b | 15 | 15 | 13 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 14 | 15 | 15 | 15 | 15 | 15 |
| c | 14 | 15 | 15 | 15 | 15(1) | 15 | 15 | 15 | 15 | 15 | 15 | 13 | 15 | 15 | 15 | 15 |
| d | 15 | 14 | 14 | 14 | 14 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 13 |

Comments/Observations: For days 3-6 record if the dead organisms was an embryo (e), partially hatched (p) or hatched (h)

| replicate | CTL | | SITE CTL | | 5 ug/L | | 10 ug/L | | 20 ug/L | | 40 ug/L | | 80 ug/L | | 160 ug/L | |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 6 | | Day 6 | | Day 6 | | Day 6 | | Day 6 | | Day 6 | | Day 6 | | Day 6 | |
| | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 15 | 15 | 15 | 15 | 14 | 15 | 15 | 15 | 15 | 15 | 15 | 11 | 15 | 15 | 15 | 15 |
| b | 15 | 15 | 13 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 14 | 15 | 15 | 15 | 15 | 15 |
| c | 14 | 15 | 15(1) | 15 | 15(1) | 15 | 15 | 15 | 15 | 15 | 15 | 13 | 15 | 15 | 15 | 15 |
| d | 14 | 15 | 14 | 14 | 14 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 13 |

Comments/Observations: For days 3-6 record if the dead organisms was an embryo (e), partially hatched (p) or hatched (h)

Method FMD 32 Day ELS Client MIN100

Sample: SP1617-029

Number of Alive Embryos and Hatched Organisms

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|--------------------|---------------|
| | Day 7 | Day 7 | Day 7 | Day 7 | Day 7 | Day 7 | Day 7 | Day 7 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 15 | 14* | 14 | 15 | 15 | 15 | 15 11 ^m | 15 |
| b | 15 | 13 | 15 | 15 | 15 | 14 | 13 15 | 15 |
| c | 14 | 15(1) | 15 | 15 | 15 | 15 | 15 13 | 15 |
| d | 14 | 14 | 14 | 15 | 15 | 15 | 13 15 | 13 |

Comments/Observations: * some microbial growth on dead PM in site CTLA

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|-----------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 8 | Day 8 | Day 8 | Day 8 | Day 8 | Day 8 | Day 8 | Day 8 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 15 | 9* | 13 | 15 | 15 | 15 | 11 | 15 |
| b | 15 | 12 | 15 | 15 | 15 | 14 | 14 | 15 |
| c | 14 | 15(1) | 15(1) | 15 | 15(1) | 15 | 13 | 15 |
| d | 14 | 13 ^m | 14 | 15 | 14 15 | 15 | 14 | 13 |

Comments/Observations: * microbial growth/death

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 9 | Day 9 | Day 9 | Day 9 | Day 9 | Day 9 | Day 9 | Day 9 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 15 | 6* | 13 | 15 | 15 15 | 15 | 11 | 15 |
| b | 15 | 12 | 15 | 15 | 15 | 14 | 14 | 15 |
| c | 14 | 15(1) | 14 | 15 | 15(1) | 15 | 13 | 15 |
| d | 14 | 13 | 14 | 15 | 14 15 | 15 | 14 | 13 |

Comments/Observations: * microbial growth/dead

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|-----------------|---------------|
| | Day 10 | Day 10 | Day 10 | Day 10 | Day 10 | Day 10 | Day 10 | Day 10 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 15 | 6 | 13 | 15 | 15 OK | 15 | 10 ^m | 15 |
| b | 15 | 12 | 15 | 15 | 15 OK | 14(1) | 14 | 15 |
| c | 14 | 15 | 14 | 15 | 14 | 15 | 13 | 15 |
| d | 14 | 13(1) | 14 | 15 | 14 15 | 15 | 14 | 13 |

Comments/Observations:

Method FMD 32 Day ELS Client MIN100

Sample: SP1617-029

Number of Alive Embryos and Hatched Organisms

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 11 | Day 11 | Day 11 | Day 11 | Day 11 | Day 11 | Day 11 | Day 11 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 15 | 6 | 13 | 15 | 15 | 15 | 10 | 15 |
| b | 15 | 12 | 15 | 15 | 15 | 14 | 14 | 15 |
| c | 14 | 15 | 14 | 15 | 14(1) | 15 | 13 | 15 |
| d | 14 | 13(1) | 14 | 15 | 15 | 15 | 14 | 13 |

Comments/Observations:

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 12 | Day 12 | Day 12 | Day 12 | Day 12 | Day 12 | Day 12 | Day 12 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 15 | 6 | 13 | 15 | 15 | 15 | 10 | 15 |
| b | 15 | 12 | 15 | 15 | 15 | 14 | 14 | 15 |
| c | 14 | 15 | 14 | 15 | 14(1) | 15 | 13 | 15 |
| d | 14 | 13 | 14 | 15 | 15 | 15 | 14 | 13 |

Comments/Observations:

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 13 | Day 13 | Day 13 | Day 13 | Day 13 | Day 13 | Day 13 | Day 13 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 15 | 6 | 13 | 15 | 15 | 15 | 10 | 15 |
| b | 15 | 12 | 15 | 15 | 15 | 14 | 14 | 15 |
| c | 14 | 15 | 14 | 15 | 14 | 15 | 13 | 15 |
| d | 14 | 12 | 14 | 15 | 15 | 15 | 14 | 13 |

Comments/Observations:

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 14 | Day 14 | Day 14 | Day 14 | Day 14 | Day 14 | Day 14 | Day 14 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 15 | 6 | 13(1) | 15 | 15(2) | 15(1) | 10 | 15 |
| b | 15 | 11 | 15 | 15 | 15 | 13 | 14(1) | 15 |
| c | 14 | 15 | 14 | 15 | 14 | 15 | 13 | 15 |
| d | 13 | 11 | 14 | 15 | 15 | 15 | 14 | 13 |

Comments/Observations:

* random stressed ones indicated are all more faint - not swimming or swimming weakly.

Method FMD 32 Day ELS Client MIN100

Sample: SP1617-029

| | | Number of Alive Embryos and Hatched Organisms | | | | | | | |
|-----------|--|---|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| | | Day 15 | Day 15 | Day 15 | Day 15 | Day 15 | Day 15 | Day 15 | Day 15 |
| replicate | | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | | 15 | 6 | 13 | 14 | 14 | 14 | 10 | 15 |
| b | | 15 | 11 | 15 | 15 | 15 | 13 | 14(1) | 15 |
| c | | 13 | 15 | 14 | 15 | 14 | 15 | 13 | 15 |
| d | | 14 | 11 | 14 | 15 | 15 | 15 | 14 | 13 |

Comments/Observations:

| | | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | Day 16 | Day 16 | Day 16 | Day 16 | Day 16 | Day 16 | Day 16 | Day 16 |
| replicate | | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | | 15 | 6 | 13 | 14 | 14 | 14 | 10 | 15 |
| b | | 15 | 11 | 15 | 15 | 15 | 13 | 14 | 15 |
| c | | 13 | 15 | 14 | 15 | 14 | 15 | 13 | 15 |
| d | | 14 | 11 | 14 | 15 | 14 | 15 | 14 | 13 |

Comments/Observations:

| | | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | Day 17 | Day 17 | Day 17 | Day 17 | Day 17 | Day 17 | Day 17 | Day 17 |
| replicate | | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | | 15 | 6 | 13 | 14 | 14 | 13 | 9 | 15 |
| b | | 15 | 11 | 15 | 15 | 15 | 13 | 14 | 15 |
| c | | 13 | 15 | 14 | 15 | 14 | 15 | 13 | 14 |
| d | | 14 | 11 | 14 | 15 | 15 | 15 | 13 | 13 |

Comments/Observations:

| | | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | Day 18 | Day 18 | Day 18 | Day 18 | Day 18 | Day 18 | Day 18 | Day 18 |
| replicate | | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | | 15(1) | 6 | 13 | 14 | 14 | 13 | 9 | 15 |
| b | | 15 | 11 | 15 | 15 | 15 | 13 | 14 | 15 |
| c | | 13(1) | 15 | 14 | 15 | 14 | 15 | 13 | 14 |
| d | | 14(1) | 11 | 14 | 15 | 15 | 15(1) | 13 | 13 |

Comments/Observations:

Method FMD 32 Day ELS Client MIN100 Sample: SP1617-029

Number of Alive Embryos and Hatched Organisms

| replicate | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 19 | Day 19 | Day 19 | Day 19 | Day 19 | Day 19 | Day 19 | Day 19 |
| | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 14.5(1) | 6 | 13 | 14 | 14 | 13 | 9 | 15 |
| b | 15 | 11 | 15 | 15 | 15 | 13 | 14 | 15 |
| c | 13 | 15 | 14 | 15 | 14 | 15 | 13 | 14 |
| d | 14(1) | 11 | 14 | 15 | 15(1) | 15(1) | 13 | 13 |

Comments/Observations:

| replicate | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 20 | Day 20 | Day 20 | Day 20 | Day 20 | Day 20 | Day 20 | Day 20 |
| | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 14 | 6 | 13 | 14 | 13 | 13 | 9 | 15 |
| b | 15 | 11 | 15 | 15 | 15 | 13 | 14 | 15 |
| c | 13 | 15 | 14 | 15 | 14 | 15 | 13 | 14 |
| d | 14 | 11 | 14 | 15 | 15 | 15 | 13 | 13 |

Comments/Observations:

| replicate | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 21 | Day 21 | Day 21 | Day 21 | Day 21 | Day 21 | Day 21 | Day 21 |
| | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 14 | 6 | 13 | 14 | 13 | 13 | 9 | 15 |
| b | 15 | 11 | 15 | 15 | 15 | 13 | 14 | 15 |
| c | 13 | 15 | 14 | 15 | 14 | 15 | 13 | 14 |
| d | 14 | 11 | 14 | 15 | 15 | 15 | 13 | 13 |

Comments/Observations:

| replicate | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 22 | Day 22 | Day 22 | Day 22 | Day 22 | Day 22 | Day 22 | Day 22 |
| | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 14 | 6 | 13 | 14 | 12 | 13 | 9 | 15 |
| b | 14.5 | 11 | 15 | 15 | 15 | 13 | 14 | 15 |
| c | 13 | 15 | 14 | 15 | 14 | 14 | 13 | 14 |
| d | 14 | 11 | 14 | 15 | 15 | 14 | 13 | 13 |

Comments/Observations:

Method FMD 32 Day ELS Client MIN100 Sample: SP1617-029

| | | Number of Alive Embryos and Hatched Organisms | | | | | | | |
|-----------|--|---|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| | | Day 23 | Day 23 | Day 23 | Day 23 | Day 23 | Day 23 | Day 23 | Day 23 |
| replicate | | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | | 14 | 6 | 13 | 13 | 12 | 13 | 9 | 15(1) |
| b | | 15 | 11 | 13* | 14* | 15 | 13 | 14 | 15 |
| c | | 13 | 15 | 14 | 14 | 14 | 14 | 13 | 14 |
| d | | 14 | 11 | 14 | 14 | 15(1) | 14 | 13 | 13 |

Comments/Observations: * NO DOCHES, only 13/15 - checked decanted H2O TWICE. 10B - ONE FM dead stuck on jar - dried out

| | | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | Day 24 | Day 24 | Day 24 | Day 24 | Day 24 | Day 24 | Day 24 | Day 24 |
| replicate | | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | | 14 | 6 | 13 | 13 | 10 | 13 | 9 | 14 |
| b | | 15 | 11 | 13 | 14 | 15 | 13 | 14 | 15 |
| c | | 13 | 15 | 14 | 14 | 14 | 14 | 13 | 14 |
| d | | 14 | 11 | 14 | 14 | 15(1) | 14 | 13 | 13 |

Comments/Observations:

| | | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|--|---------------|-------------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | Day 25 | Day 25 | Day 25 | Day 25 | Day 25 | Day 25 | Day 25 | Day 25 |
| replicate | | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | | 14 | 13 ³ 6 | 13 | 13 | 10 | 13 | 8 | 14 |
| b | | 15 | 11 | 13 | 14 | 15 | 13 | 14 | 15 |
| c | | 13 | 15 | 14 | 14 | 14 | 14 | 13 | 14 |
| d | | 14 | 10 | 14 | 14 | 15(1) | 14 | 13 | 13 |

Comments/Observations:

| | | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | Day 26 | Day 26 | Day 26 | Day 26 | Day 26 | Day 26 | Day 26 | Day 26 |
| replicate | | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | | 14 | 6 | 13 | 13 | 10 | 13 | 8 | 14 |
| b | | 15 | 11 | 13 | 14 | 14 | 13 | 14 | 14(1) |
| c | | 13 | 15 | 14 | 14 | 14 | 14 | 13 | 14 |
| d | | 14 | 10 | 14 | 14 | 15 | 14 | 13 | 13 |

Comments/Observations:

Method FMD 32 Day ELS Client MIN100

Sample: SP1617-029

Number of Alive Embryos and Hatched Organisms

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 27 | Day 27 | Day 27 | Day 27 | Day 27 | Day 27 | Day 27 | Day 27 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 14 | 6 | 13 | 13 | 10 | 13 | 8 | 14 |
| b | 15 | 11 | 13 | 14 | 14 | 13 | 14 | 14 |
| c | 13 | 15 | 14 | 14 | 14 | 14 | 13 | 14(1) |
| d | 14 | 10 | 14 | 14 | 15(1) | 14 | 13 | 13 |

Comments/Observations:

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|--------------------|---------------|---------------|
| | Day 28 | Day 28 | Day 28 | Day 28 | Day 28 | Day 28 | Day 28 | Day 28 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 14 | 6 | 13 | 13 | 10 | 13 | 8 | 14 |
| b | 15 | 11 | 13 | 14 | 14 | 14 13 ^m | 14 | 14 |
| c | 13 | 15 | 14 | 14 | 13 | 14 | 13 | 14(1) |
| d | 14 | 10 | 14 | 14 | 15(1) | 14 | 13 | 13 |

Comments/Observations:

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 29 | Day 29 | Day 29 | Day 29 | Day 29 | Day 29 | Day 29 | Day 29 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 14(1) | 6 | 13 | 13(1) | 10 | 13 | 8 | 14 |
| b | 15 | 11(1) | 13 | 14 | 14 | 13 | 14 | 14 |
| c | 13 | 15 | 13(1) | 14 | 13 | 14 | 12 | 14(1) |
| d | 14 | 10 | 14 | 14 | 15(1) | 14 | 13 | 13 |

Comments/Observations:

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 30 | Day 30 | Day 30 | Day 30 | Day 30 | Day 30 | Day 30 | Day 30 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 14(1) | 6 | 13 | 13(1) | 10 | 13 | 8 | 14 |
| b | 15 | 11(1) | 13 | 14 | 14 | 13 | 14 | 14 |
| c | 13 | 15 | 13(1) | 14 | 13 | 14 | 12 | 14(1) |
| d | 14 | 10 | 14 | 14 | 15(1) | 14 | 13 | 13 |

Comments/Observations:

Method FMD 32 Day ELS Client MIN100

Sample: SP1617-029

Number of Alive Embryos and Hatched Organisms

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|-------------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 31 | Day 31 | Day 31 | Day 31 | Day 31 | Day 31 | Day 31 | Day 31 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 14 ³ 14 13 | 6 | 13(1) | 12 | 10 | 13 | 8 | 14 |
| b | 14 | 11(1) | 14(1) | 14(1) | 14 | 13 | 12 | 14 |
| c | 13 | 15 | 13(1) | 14 | 13 | 14 | 12 | 14(1) |
| d | 14 | 10 | 14 | 13 | 15(1) | 14 | 13 | 13 |

Comments/Observations:

| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Day 32 | Day 32 | Day 32 | Day 32 | Day 32 | Day 32 | Day 32 | Day 32 |
| replicate | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched | Alive Hatched |
| a | 13 | 6 | 12(1) | 12 | 10 | 13 | 8 | 14 |
| b | 14 | 11 | 13 | 14(1) | 13 | 13 | 12 | 14 |
| c | 13 | 15 | 12 | 14 | 13 | 14 | 12 | 14 |
| d | 14 | 10 | 14 | 13 | 15 | 13 | 13 | 12 |

Comments/Observations:

Method FMD 32 Day ELS

Client MIN100

Sample SP1617-029

| New Solutions | | | | | | | | |
|---------------|------------|----------|--------|---------|---------|---------|---------|----------|
| Conc. (%) | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| Day | | | | | | | | |
| | pH (units) | | | | | | | |
| 0 | 8.2 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 7.9 | 8.0 |
| 1 | 8.1 | 7.8 | 7.9 | 8.1 | 8.1 | 8.0 | 8.1 | 8.1 |
| 2 | 8.1 | 8.0 | 8.0 | 8.0 | 8.1 | 8.1 | 8.1 | 8.1 |
| 3 | 8.1 | 8.3 | 8.1 | 8.1 | 8.1 | 8.1 | 8.1 | 8.1 |
| 4 | 8.2 | 8.0 | 7.9 | 7.9 | 8.0 | 8.0 | 7.9 | 7.9 |
| 5 | 8.2 | 8.0 | 8.0 | 8.0 | 8.0 | 8.1 | 8.1 | 8.1 |
| 6 | 8.3 | 8.3 | 8.0 | 8.0 | 8.0 | 8.1 | 8.1 | 8.0 |
| 7 | 8.3 | 8.2 | 8.1 | 8.0 | 8.1 | 8.2 | 8.0 | 8.1 |
| 8 | 8.3 | 8.2 | 8.1 | 8.1 | 8.1 | 8.1 | 8.1 | 8.1 |

| Conductance (µS/cm) | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 450 | 219 | 216 | 212 | 215 | 214 | 215 | 214 |
| 1 | 449 | 225 | 218 | 213 | 215 | 213 | 216 | 214 |
| 2 | 425 | 219 | 215 | 214 | 215 | 214 | 214 | 214 |
| 3 | 425 | 221 | 215 | 214 | 213 | 214 | 215 | 214 |
| 4 | 445 | 226 | 214 | 214 | 214 | 213 | 214 | 214 |
| 5 | 446 | 222 | 215 | 214 | 214 | 214 | 215 | 214 |
| 6 | 443 | 240 | 225 | 223 | 222 | 222 | 223 | 222 |
| 7 | 451 | 237 | 226 | 224 | 223 | 222 | 222 | 223 |
| 8 | 448 | 231 | 225 | 226 | 222 | 225 | 225 | 224 |

| Dissolved Oxygen (mg/L) (40-100% saturation) | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.2 |
| 1 | 7.2 | 7.2 | 7.2 | 7.2 | 7.3 | 7.3 | 7.3 | 7.3 |
| 2 | 7.1 | 7.1 | 7.2 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 |
| 3 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 |
| 4 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 |
| 5 | 7.2 | 7.1 | 7.2 | 7.2 | 7.1 | 7.2 | 7.2 | 7.1 |
| 6 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 |
| 7 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 |
| 8 | 7.3 | 7.3 | 7.3 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |

| Temperature (°C) | | | | | | | | |
|------------------|------|------|------|------|------|------|------|------|
| 0 | 23.9 | 23.9 | 24.2 | 24.1 | 24.2 | 24.2 | 24.4 | 24.2 |
| 1 | 24.7 | 25.0 | 24.9 | 24.5 | 24.0 | 24.8 | 24.9 | 24.1 |
| 2 | 26.0 | 25.8 | 24.4 | 26.2 | 26.1 | 25.8 | 26.0 | 26.0 |
| 3 | 24.0 | 26.0 | 26.2 | 26.0 | 25.5 | 25.6 | 25.9 | 25.9 |
| 4 | 26.1 | 26.1 | 26.1 | 26.1 | 26.1 | 26.2 | 26.1 | 26.1 |
| 5 | 25.4 | 25.3 | 25.4 | 25.4 | 25.3 | 25.3 | 25.4 | 25.8 |
| 6 | 26.1 | 25.9 | 26.0 | 26.2 | 26.2 | 26.0 | 26.2 | 26.4 |
| 7 | 25.7 | 25.9 | 26.1 | 26.2 | 26.3 | 26.3 | 26.4 | 26.4 |
| 8 | 24.4 | 24.3 | 24.4 | 24.6 | 24.9 | 24.6 | 24.6 | 24.9 |

DO Levels (60-100% saturation) -
4.4 to 7.3 mg/L at 24°C
4.5 to 7.2 mg/L at 25°C
4.3 to 7.1 mg/L at 26°C

| Old Solutions | | | | | | | | |
|---------------|------------|--------|---------|---------|---------|---------|----------|-----|
| CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L | |
| | pH (units) | | | | | | | |
| 0 | | 7.7 | | | | | | |
| 1 | 8.0 | 7.7 | 7.6 | 7.6 | 7.6 | 7.5 | 7.6 | 7.6 |
| 2 | 8.1 | 7.8 | 7.6 | 7.6 | 7.7 | 7.7 | 7.7 | 7.8 |
| 3 | 8.1 | 7.9 | 7.9 | 8.0 | 7.9 | 7.9 | 7.8 | 7.9 |
| 4 | 8.1 | 7.9 | 7.8 | 7.8 | 7.7 | 7.7 | 7.7 | 7.8 |
| 5 | 8.0 | 7.9 | 7.8 | 7.8 | 8.0 | 7.9 | 7.8 | 7.8 |
| 6 | 8.1 | 7.9 | 7.8 | 7.7 | 7.7 | 7.7 | 7.7 | 7.7 |
| 7 | 8.2 | 8.1 | 7.9 | 7.8 | 7.9 | 7.9 | 7.8 | 7.9 |
| 8 | 8.2 | 8.1 | 7.9 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |

| Conductance (µS/cm) | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | | | | | | | | |
| 1 | 479 | 229 | 223 | 220 | 220 | 220 | 218 | 220 |
| 2 | 452 | 235 | 222 | 224 | 220 | 220 | 219 | 220 |
| 3 | 408 | 230 | 221 | 220 | 223 | 219 | 222 | 225 |
| 4 | 439 | 238 | 224 | 219 | 220 | 222 | 220 | 225 |
| 5 | 385 | 221 | 221 | 221 | 224 | 222 | 221 | 224 |
| 6 | 478 | 254 | 235 | 231 | 230 | 229 | 230 | 229 |
| 7 | 497 | 252 | 233 | 229 | 231 | 232 | 229 | 230 |
| 8 | 475 | 251 | 236 | 227 | 233 | 231 | 228 | 232 |

| Dissolved Oxygen (mg/L) (40-100% saturation) | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | | | | | | | | |
| 1 | 6.3 | 6.3 | 6.3 | 6.2 | 6.2 | 6.0 | 6.1 | 6.3 |
| 2 | 6.6 | 6.6 | 6.6 | 6.5 | 6.5 | 6.5 | 6.6 | 6.2 |
| 3 | 6.7 | 6.5 | 6.6 | 6.5 | 6.6 | 6.5 | 6.4 | 6.4 |
| 4 | 7.1 | 7.0 | 6.7 | 6.7 | 6.6 | 6.5 | 6.5 | 6.5 |
| 5 | 7.1 | 6.3 | 6.0 | 6.0 | 6.2 | 6.2 | 6.2 | 6.3 |
| 6 | 6.9 | 6.9 | 6.7 | 6.5 | 6.5 | 6.4 | 6.3 | 6.3 |
| 7 | 6.8 | 6.8 | 6.6 | 6.7 | 6.9 | 6.5 | 6.4 | 6.3 |
| 8 | 6.8 | 6.8 | 6.9 | 6.8 | 6.7 | 6.5 | 6.4 | 6.5 |

| Temperature (°C) | | | | | | | | |
|------------------|------|------|------|------|------|------|------|------|
| 0 | | | | | | | | |
| 1 | 24.8 | 24.8 | 24.8 | 25.1 | 25.1 | 25.0 | 25.0 | 24.9 |
| 2 | 25.1 | 25.2 | 25.2 | 25.6 | 25.8 | 25.8 | 26.0 | 25.9 |
| 3 | 24.0 | 24.6 | 25.2 | 24.7 | 24.7 | 25.1 | 25.1 | 25.1 |
| 4 | 25.0 | 24.9 | 24.9 | 24.9 | 25.1 | 25.2 | 25.3 | 25.2 |
| 5 | 24.9 | 25.4 | 25.5 | 25.5 | 25.4 | 25.4 | 25.5 | 25.3 |
| 6 | 25.0 | 25.0 | 25.3 | 25.4 | 25.3 | 25.2 | 25.7 | 25.6 |
| 7 | 24.5 | 24.6 | 24.6 | 24.6 | 24.9 | 25.1 | 25.0 | 25.2 |
| 8 | 24.0 | 24.0 | 24.0 | 24.1 | 24.2 | 25.0 | 24.9 | 24.8 |

Comments:

Method FMD 32 Day ELS

Client MIN100

Sample SP1617-029

| New Solutions | | | | | | | | |
|---------------|-----|----------|--------|---------|---------|---------|---------|----------|
| Conc. (%) | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| Day | | | | | | | | |

| Old Solutions | | | | | | | |
|---------------|----------|--------|---------|---------|---------|---------|----------|
| CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |

u 7.9

| pH (units) | | | | | | | |
|------------|-----|-----|-----|-----|-----|-----|-----|
| 9 | 8.1 | 8.1 | 8.1 | 8.0 | 8.1 | 8.1 | 8.1 |
| 10 | 8.1 | 7.9 | 7.8 | 7.8 | 7.9 | 7.9 | 7.9 |
| 11 | 7.8 | 7.7 | 7.6 | 7.6 | 7.6 | 7.7 | 7.6 |
| 12 | 8.0 | 7.9 | 7.8 | 7.8 | 7.9 | 7.9 | 7.9 |
| 13 | 7.8 | 7.9 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |
| 14 | 7.9 | 7.9 | 7.8 | 7.8 | 7.9 | 7.9 | 7.9 |
| 15 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 |
| 16 | 7.8 | 7.8 | 7.8 | 7.7 | 7.8 | 7.8 | 7.8 |
| 17 | 8.0 | 7.9 | 7.8 | 7.8 | 7.9 | 8.0 | 7.9 |

| pH (units) | | | | | | | |
|------------|-----|-----|-----|-----|-----|-----|-----|
| 9 | 8.1 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |
| 10 | 7.6 | 7.4 | 7.4 | 7.3 | 7.3 | 7.4 | 7.3 |
| 11 | 7.4 | 7.2 | 7.1 | 7.1 | 7.1 | 7.1 | 7.2 |
| 12 | 7.8 | 7.8 | 7.6 | 7.4 | 7.4 | 7.4 | 7.4 |
| 13 | 7.9 | 7.9 | 7.5 | 7.4 | 7.4 | 7.4 | 7.4 |
| 14 | 7.6 | 7.6 | 7.5 | 7.5 | 7.5 | 7.4 | 7.6 |
| 15 | 7.6 | 7.5 | 7.4 | 7.3 | 7.3 | 7.3 | 7.4 |
| 16 | 7.6 | 7.4 | 7.3 | 7.3 | 7.3 | 7.3 | 7.4 |
| 17 | 7.5 | 7.5 | 7.3 | 7.2 | 7.2 | 7.2 | 7.2 |

| Conductance (uS/cm) | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| 9 | 430 | 230 | 226 | 224 | 223 | 223 | 225 | 224 |
| 10 | 441 | 227 | 225 | 222 | 212 | 234 | 226 | 225 |
| 11 | 422 | 227 | 224 | 224 | 224 | 226 | 224 | 224 |
| 12 | 408 | 226 | 224 | 224 | 223 | 223 | 223 | 224 |
| 13 | 441 | 237 | 235 | 236 | 234 | 236 | 236 | 235 |
| 14 | 435 | 243 | 236 | 234 | 233 | 233 | 234 | 234 |
| 15 | 474 | 231 | 236 | 234 | 235 | 233 | 234 | 233 |
| 16 | 489 | 234 | 234 | 234 | 234 | 233 | 235 | 232 |
| 17 | 452 | 238 | 235 | 234 | 233 | 234 | 234 | 233 |

| Conductance (uS/cm) | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| 9 | 477 | 250 | 236 | 237 | 235 | 235 | 232 | 232 |
| 10 | 457 | 252 | 245 | 236 | 239 | 229 | 226 | 240 |
| 11 | 463 | 240 | 234 | 231 | 226 | 230 | 227 | 232 |
| 12 | 438 | 255 | 234 | 233 | 231 | 233 | 227 | 250 |
| 13 | 454 | 265 | 240 | 247 | 242 | 242 | 242 | 246 |
| 14 | 451 | 266 | 247 | 242 | 247 | 244 | 247 | 249 |
| 15 | 442 | 254 | 246 | 242 | 245 | 243 | 242 | 244 |
| 16 | 443 | 252 | 244 | 243 | 245 | 244 | 248 | 245 |
| 17 | 501 | 253 | 245 | 241 | 253 | 264 | 250 | 248 |

| Dissolved Oxygen (mg/L) (40-100% saturation) | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|-----|
| 9 | 7.3 | 7.3 | 7.3 | 7.2 | 7.2 | 7.3 | 7.3 | 7.2 |
| 10 | 7.1 | 7.2 | 7.2 | 7.2 | 7.3 | 7.3 | 7.2 | 7.2 |
| 11 | 7.1 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 12 | 7.1 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 13 | 7.2 | 7.3 | 7.2 | 7.2 | 7.1 | 7.3 | 7.3 | 7.2 |
| 14 | 7.2 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 |
| 15 | 7.3 | 7.1 | 7.1 | 7.3 | 7.2 | 7.2 | 7.2 | 7.1 |
| 16 | 7.3 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 17 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.2 |

| Dissolved Oxygen (mg/L) (40-100% saturation) | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|-----|
| 9 | 6.8 | 6.0 | 6.4 | 6.3 | 6.0 | 6.0 | 6.0 | 6.0 |
| 10 | 6.0 | 6.0 | 6.0 | 5.9 | 5.6 | 5.4 | 5.5 | 5.4 |
| 11 | 6.5 | 6.3 | 6.1 | 5.9 | 5.8 | 5.8 | 5.9 | 5.9 |
| 12 | 6.6 | 6.6 | 6.5 | 6.1 | 6.2 | 6.2 | 6.2 | 6.2 |
| 13 | 6.6 | 6.6 | 6.4 | 6.3 | 6.2 | 6.2 | 6.2 | 6.2 |
| 14 | 6.4 | 6.3 | 6.3 | 6.1 | 6.1 | 6.2 | 6.0 | 6.1 |
| 15 | 6.4 | 6.2 | 6.2 | 6.0 | 6.0 | 6.0 | 6.0 | 5.9 |
| 16 | 6.4 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| 17 | 6.2 | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 | 6.2 | 5.9 |

| Temperature (°C) | | | | | | | | |
|------------------|------|------|------|------|------|------|------|------|
| 9 | 23.9 | 24.4 | 24.4 | 25.1 | 25.2 | 24.4 | 24.4 | 25.1 |
| 10 | 24.9 | 24.7 | 24.7 | 25.1 | 24.1 | 24.4 | 25.3 | 25.3 |
| 11 | 25.1 | 24.9 | 24.9 | 25.1 | 25.1 | 25.2 | 25.4 | 25.4 |
| 12 | 25.5 | 24.9 | 25.2 | 25.3 | 25.3 | 24.4 | 25.2 | 25.4 |
| 13 | 24.8 | 24.4 | 25.4 | 25.4 | 24.5 | 24.7 | 24.2 | 25.4 |
| 14 | 24.6 | 25.5 | 25.5 | 25.5 | 25.5 | 25.5 | 25.6 | 25.8 |
| 15 | 24.1 | 25.1 | 25.1 | 24.3 | 25.4 | 24.8 | 24.9 | 25.9 |
| 16 | 24.0 | 24.7 | 25.0 | 25.0 | 25.2 | 25.0 | 25.3 | 25.3 |
| 17 | 24.4 | 24.4 | 24.4 | 24.4 | 24.4 | 24.4 | 25.1 | 25.1 |

| Temperature (°C) | | | | | | | | |
|------------------|------|------|------|------|------|------|------|------|
| 9 | 24.0 | 24.3 | 24.4 | 24.5 | 24.8 | 25.1 | 25.3 | 25.3 |
| 10 | 25.2 | 25.2 | 25.2 | 26.4 | 26.4 | 26.4 | 26.3 | 26.4 |
| 11 | 24.4 | 24.7 | 25.5 | 25.4 | 25.1 | 24.8 | 24.4 | 24.4 |
| 12 | 24.9 | 25.0 | 25.3 | 25.2 | 25.1 | 25.2 | 25.3 | 25.3 |
| 13 | 24.9 | 24.9 | 25.0 | 25.1 | 25.2 | 25.3 | 25.3 | 25.3 |
| 14 | 24.6 | 24.6 | 24.5 | 24.4 | 24.4 | 24.5 | 24.5 | 24.5 |
| 15 | 24.0 | 24.0 | 24.0 | 24.1 | 24.1 | 24.0 | 24.1 | 24.0 |
| 16 | 24.0 | 24.0 | 24.7 | 25.0 | 25.4 | 24.2 | 24.2 | 24.2 |
| 17 | 23.8 | 24.1 | 24.1 | 24.2 | 24.2 | 24.2 | 24.3 | 24.2 |

DO Levels (60-100% saturation) -
4.4 to 7.3 mg/L at 24°C
4.5 to 7.2 mg/L at 25°C
4.3 to 7.1 mg/L at 26°C

Comments:

Method FMD 32 Day ELS

Client MIN100

Sample SP1617-029

| New Solutions | | | | | | | | |
|---------------|-----|----------|--------|---------|---------|---------|---------|----------|
| Conc. (%) | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| Day | | | | | | | | |

| Old Solutions | | | | | | | |
|---------------|----------|--------|---------|---------|---------|---------|----------|
| CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |

80

| pH (units) | | | | | | | | |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
| 18 | 7.6 | 7.8 | 7.7 | 7.7 | 7.8 | 7.8 | 7.6 | 7.6 |
| 19 | 7.7 | 7.9 | 7.8 | 7.8 | 7.6 | 7.8 | 7.8 | 7.8 |
| 20 | 7.8 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| 21 | 8.1 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.8 | 7.9 |
| 22 | 8.0 | 7.9 | 7.9 | 7.9 | 7.8 | 7.8 | 7.9 | 7.9 |
| 23 | 8.1 | 7.8 | 7.9 | 7.9 | 8.0 | 8.0 | 8.0 | 7.9 |
| 24 | 7.6 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| 25 | 8.2 | 7.9 | 7.8 | 7.8 | 7.9 | 7.9 | 7.8 | 7.8 |
| 26 | 8.0 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |

| pH (units) | | | | | | | | |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
| 18 | 7.5 | 7.6 | 7.4 | 7.3 | 7.3 | 7.2 | 7.2 | 7.3 |
| 19 | 7.6 | 7.6 | 7.4 | 7.4 | 7.3 | 7.1 | 7.1 | 7.1 |
| 20 | 7.8 | 7.9 | 7.7 | 7.6 | 7.5 | 7.5 | 7.5 | 7.5 |
| 21 | 7.4 | 7.3 | 7.3 | 7.3 | 7.2 | 7.2 | 7.2 | 7.4 |
| 22 | 7.5 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.7 | 7.6 |
| 23 | 7.4 | 7.4 | 7.3 | 7.4 | 7.3 | 7.3 | 7.1 | 7.2 |
| 24 | 7.6 | 7.5 | 7.2 | 7.1 | 7.1 | 7.2 | 7.2 | 7.3 |
| 25 | 7.9 | 7.8 | 7.6 | 7.4 | 7.4 | 7.4 | 7.4 | 7.5 |
| 26 | 7.6 | 7.4 | 7.2 | 7.3 | 7.1 | 7.0 | 7.1 | 7.2 |

| Conductance (µS/cm) | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| 18 | 515 | 241 | 235 | 234 | 233 | 234 | 235 | 233 |
| 19 | 424 | 241 | 235 | 235 | 234 | 235 | 232 | 234 |
| 20 | 420 | 234 | 236 | 234 | 235 | 235 | 234 | 235 |
| 21 | 431 | 236 | 232 | 235 | 235 | 234 | 235 | 224 |
| 22 | 425 | 232 | 234 | 240 | 241 | 240 | 240 | 233 |
| 23 | 421 | 241 | 237 | 236 | 235 | 236 | 237 | 236 |
| 24 | 416 | 236 | 237 | 233 | 236 | 238 | 239 | 233 |
| 25 | 431 | 238 | 236 | 234 | 234 | 235 | 235 | 236 |
| 26 | 434 | 240 | 237 | 236 | 235 | 235 | 236 | 235 |

| Conductance (µS/cm) | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| 18 | 459 | 261 | 249 | 245 | 249 | 251 | 255 | 249 |
| 19 | 490 | 263 | 250 | 246 | 245 | 247 | 248 | 249 |
| 20 | 480 | 261 | 252 | 247 | 247 | 247 | 246 | 246 |
| 21 | 488 | 252 | 242 | 244 | 246 | 244 | 241 | 239 |
| 22 | 480 | 270 | 253 | 240 | 249 | 249 | 246 | 249 |
| 23 | 446 | 242 | 244 | 242 | 249 | 241 | 246 | 247 |
| 24 | 444 | 256 | 246 | 247 | 241 | 241 | 247 | 245 |
| 25 | 447 | 259 | 252 | 246 | 243 | 244 | 241 | 245 |
| 26 | 444 | 271 | 245 | 257 | 235 | 226 | 243 | 250 |

7.3, 7.3

| Dissolved Oxygen (mg/L) (40-100% saturation) | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|-----|
| 18 | 7.3 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 19 | 7.1 | 7.2 | 7.2 | 7.2 | 7.1 | 7.2 | 7.1 | 7.2 |
| 20 | 7.2 | 7.1 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 21 | 7.4 | 7.4 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 22 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 23 | 7.2 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 |
| 24 | 7.1 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 |
| 25 | 7.2 | 7.3 | 7.3 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 26 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |

| Dissolved Oxygen (mg/L) (40-100% saturation) | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|-----|
| 18 | 5.7 | 5.8 | 5.8 | 5.7 | 5.6 | 5.4 | 5.4 | 5.3 |
| 19 | 5.8 | 5.8 | 5.7 | 5.7 | 5.4 | 5.3 | 5.3 | 5.2 |
| 20 | 5.8 | 6.0 | 6.1 | 6.1 | 6.0 | 5.9 | 6.1 | 6.1 |
| 21 | 6.2 | 6.2 | 5.9 | 5.9 | 5.9 | 5.5 | 5.5 | 5.9 |
| 22 | 6.1 | 6.0 | 6.0 | 6.0 | 5.9 | 5.7 | 5.7 | 5.7 |
| 23 | 6.2 | 6.0 | 6.1 | 5.9 | 5.9 | 5.8 | 5.6 | 5.6 |
| 24 | 6.1 | 6.1 | 6.1 | 6.0 | 6.1 | 6.1 | 6.1 | 6.1 |
| 25 | 6.5 | 6.4 | 6.2 | 5.9 | 5.7 | 5.7 | 5.8 | 5.8 |
| 26 | 6.5 | 6.3 | 6.2 | 6.1 | 5.2 | 5.4 | 5.1 | 5.3 |

| Temperature (°C) | | | | | | | | |
|------------------|------|------|------|------|------|------|------|------|
| 18 | 23.8 | 24.5 | 24.9 | 25.1 | 24.9 | 24.9 | 25.3 | 25.1 |
| 19 | 24.4 | 24.7 | 25.1 | 25.2 | 25.5 | 25.4 | 25.5 | 25.4 |
| 20 | 24.2 | 24.4 | 24.4 | 24.4 | 24.4 | 24.4 | 24.6 | 24.6 |
| 21 | 24.1 | 24.7 | 25.2 | 25.3 | 25.3 | 25.3 | 25.1 | 25.2 |
| 22 | 24.5 | 24.5 | 24.6 | 24.7 | 25.1 | 25.1 | 25.1 | 25.1 |
| 23 | 24.9 | 24.1 | 24.2 | 24.4 | 24.3 | 24.1 | 24.3 | 24.0 |
| 24 | 24.1 | 24.1 | 24.0 | 24.0 | 24.3 | 24.3 | 24.1 | 24.2 |
| 25 | 24.4 | 24.4 | 24.4 | 25.4 | 25.4 | 25.4 | 25.4 | 25.4 |
| 26 | 24.2 | 24.7 | 24.7 | 24.7 | 24.8 | 24.8 | 24.9 | 24.5 |

| Temperature (°C) | | | | | | | | |
|------------------|------|------|------|------|------|------|------|------|
| 18 | 23.9 | 24.1 | 24.1 | 24.2 | 24.4 | 24.8 | 24.9 | 24.9 |
| 19 | 23.9 | 24.4 | 24.6 | 25.3 | 25.3 | 25.4 | 25.9 | 25.9 |
| 20 | 23.9 | 23.9 | 23.9 | 24.0 | 24.1 | 24.1 | 24.1 | 24.1 |
| 21 | 23.8 | 23.8 | 23.9 | 23.9 | 23.8 | 23.9 | 24.0 | 24.0 |
| 22 | 23.9 | 24.0 | 24.1 | 24.1 | 24.1 | 24.1 | 24.1 | 24.1 |
| 23 | 23.6 | 23.6 | 23.7 | 23.6 | 23.7 | 23.6 | 23.7 | 23.5 |
| 24 | 23.6 | 23.6 | 23.8 | 23.8 | 23.7 | 23.8 | 23.6 | 23.6 |
| 25 | 23.6 | 23.7 | 23.6 | 23.6 | 23.6 | 23.6 | 23.5 | 23.6 |
| 26 | 23.5 | 24.2 | 24.4 | 24.5 | 24.2 | 24.1 | 24.3 | 24.3 |

DO Levels (60-100% saturation) -
4.4 to 7.3 mg/L at 24°C
4.5 to 7.2 mg/L at 25°C
4.3 to 7.1 mg/L at 26°C

Comments:

Method FMD 32 Day ELS

Client MIN100

Sample SP1617-029

| Conc. (%) Day | New Solutions | | | | | | | |
|------------------|---------------|----------|--------|---------|---------|---------|---------|----------|
| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| | pH (units) | | | | | | | |
| 27 | 8.3 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| 28 | 7.9 | 7.6 | 7.4 | 7.5 | 7.6 | 7.6 | 7.6 | 7.5 |
| 29 | 8.0 | 7.6 | 7.7 | 7.7 | 7.7 | 7.7 | 7.7 | 7.7 |
| 30 | 8.0 | 7.7 | 7.7 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |
| 31 | 7.9 | 7.9 | 7.7 | 7.7 | 7.8 | 7.8 | 7.8 | 7.8 |
| 32 | | | | | | | | |

| Conc. (%) Day | New Solutions | | | | | | | |
|------------------|---------------------|----------|--------|---------|---------|---------|---------|----------|
| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| | Conductance (µS/cm) | | | | | | | |
| 27 | 427 | 233 | 230 | 230 | 229 | 229 | 229 | 228 |
| 28 | 397 | 230 | 228 | 229 | 228 | 227 | 231 | 218 |
| 29 | 408 | 228 | 228 | 227 | 226 | 226 | 227 | 226 |
| 30 | 404 | 237 | 232 | 232 | 235 | 230 | 229 | 230 |
| 31 | 414 | 237 | 227 | 228 | 227 | 227 | 227 | 229 |
| 32 | | | | | | | | |

| Conc. (%) Day | New Solutions | | | | | | | |
|------------------|--|----------|--------|---------|---------|---------|---------|----------|
| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| | Dissolved Oxygen (mg/L) (40-100% saturation) | | | | | | | |
| 27 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.1 |
| 28 | 7.1 | 7.1 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.1 |
| 29 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 30 | 7.3 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 31 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 32 | | | | | | | | |

| Conc. (%) Day | New Solutions | | | | | | | |
|------------------|------------------|----------|--------|---------|---------|---------|---------|----------|
| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| | Temperature (°C) | | | | | | | |
| 27 | 24.5 | 24.9 | 24.9 | 24.9 | 25.1 | 25.3 | 25.3 | 25.5 |
| 28 | 25.6 | 25.1 | 25.4 | 25.7 | 25.4 | 25.4 | 25.3 | 26.1 |
| 29 | 24.8 | 25.0 | 25.1 | 25.3 | 25.3 | 25.3 | 25.4 | 25.3 |
| 30 | 24.0 | 24.9 | 24.8 | 24.8 | 24.8 | 24.8 | 24.8 | 24.8 |
| 31 | 25.4 | 25.3 | 25.1 | 25.2 | 25.0 | 25.8 | 25.7 | 25.4 |
| 32 | | | | | | | | |

| Conc. (%) Day | Old Solutions | | | | | | | |
|------------------|---------------|----------|--------|---------|---------|---------|---------|----------|
| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| | pH (units) | | | | | | | |
| 27 | 8.1 | 7.9 | 7.7 | 7.8 | 7.6 | 7.5 | 7.4 | 7.5 |
| 28 | 8.1 | 8.0 | 7.5 | 7.9 | 7.7 | 7.6 | 7.6 | 7.6 |
| 29 | 7.4 | 7.4 | 7.2 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 |
| 30 | 7.5 | 7.6 | 7.7 | 7.7 | 7.7 | 7.7 | 7.6 | 7.6 |
| 31 | 7.6 | 7.2 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| 32 | 8.0 | 7.9 | 7.6 | 7.3 | 7.3 | 7.2 | 7.3 | 7.4 |

| Conc. (%) Day | Old Solutions | | | | | | | |
|------------------|---------------------|----------|--------|---------|---------|---------|---------|----------|
| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| | Conductance (µS/cm) | | | | | | | |
| 27 | 412 | 251 | 243 | 244 | 241 | 257 | 288 | 238 |
| 28 | 422 | 248 | 238 | 240 | 239 | 239 | 239 | 240 |
| 29 | 438 | 258 | 241 | 241 | 242 | 242 | 240 | 243 |
| 30 | 432 | 244 | 241 | 242 | 242 | 245 | 246 | 246 |
| 31 | 425 | 246 | 235 | 232 | 235 | 238 | 234 | 238 |
| 32 | 460 | 264 | 231 | 221 | 236 | 233 | 231 | 232 |

| Conc. (%) Day | Old Solutions | | | | | | | |
|------------------|--|----------|--------|---------|---------|---------|---------|----------|
| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| | Dissolved Oxygen (mg/L) (40-100% saturation) | | | | | | | |
| 27 | 6.4 | 6.3 | 6.5 | 6.0 | 6.0 | 6.0 | 5.7 | 5.5 |
| 28 | 6.4 | 6.4 | 6.4 | 6.1 | 6.1 | 6.1 | 5.8 | 5.7 |
| 29 | 5.9 | 5.9 | 5.5 | 5.7 | 5.0 | 5.1 | 5.0 | 5.0 |
| 30 | 6.0 | 6.0 | 6.0 | 6.0 | 6.1 | 6.0 | 6.0 | 6.0 |
| 31 | 5.8 | 5.8 | 5.7 | 5.7 | 5.2 | 5.1 | 5.0 | 5.0 |
| 32 | 6.2 | 6.1 | 5.6 | 5.3 | 5.1 | 5.0 | 5.0 | 5.2 |

| Conc. (%) Day | Old Solutions | | | | | | | |
|------------------|------------------|----------|--------|---------|---------|---------|---------|----------|
| | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| | Temperature (°C) | | | | | | | |
| 27 | 24.6 | 24.6 | 24.4 | 24.1 | 24.2 | 24.2 | 24.7 | 24.2 |
| 28 | 24.6 | 24.7 | 24.5 | 24.4 | 24.4 | 24.4 | 24.9 | 24.3 |
| 29 | 24.0 | 23.9 | 23.8 | 23.8 | 24.0 | 23.9 | 23.6 | 23.5 |
| 30 | 24.5 | 24.5 | 24.5 | 24.6 | 24.6 | 24.5 | 24.5 | 24.8 |
| 31 | 24.9 | 25.0 | 25.0 | 25.0 | 25.2 | 25.4 | 25.8 | 25.3 |
| 32 | 25.2 | 25.1 | 25.1 | 24.7 | 25.0 | 24.8 | 24.8 | 24.7 |

DO Levels (60-100% saturation) -
4.4 to 7.3 mg/L at 24°C
4.5 to 7.2 mg/L at 25°C
4.3 to 7.1 mg/L at 26°C

Comments:

Method FMD 32 Day ELS Client MIN100 Sample: SP1617-029

Test Termination

For normal/abnormal column, use the following notation:

N=Normal, A= Abnormal And note location: H=head, O=oral, E=eyes, G=gills, F=fins, S=spine

Conc.

| CTL | Replicate # <u>A</u> | | | Replicate # <u>B</u> | | | Replicate # <u>C</u> | | | Replicate # <u>D</u> | | |
|-----|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|
| | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal |
| | 1 | 10 | N | 1 | 9 | N | 1 | 9 | N | 1 | 10 | N |
| | 2 | 10 | | 2 | 10 | | 2 | 10 | | 2 | 9 | |
| | 3 | 11 | | 3 | 9 | | 3 | 9 | | 3 | 8 | |
| | 4 | 9 | | 4 | 9 | | 4 | 9 | | 4 | 9 | |
| | 5 | 10 | | 5 | 9 | | 5 | 9 | | 5 | 9 | |
| | 6 | 10 | | 6 | 10 | | 6 | 9 | | 6 | 9 | |
| | 7 | 9 | | 7 | 9 | | 7 | 10 | | 7 | 10 | |
| | 8 | 10 | | 8 | 9 | | 8 | 10 | | 8 | 9 | |
| | 9 | 11 | | 9 | 9 | | 9 | 9 | | 9 | 11 | |
| | 10 | 10 | | 10 | 11 | | 10 | 9 | | 10 | 11 | |
| | 11 | 10 | | 11 | 10 | | 11 | 10 | | 11 | 10 | |
| | 12 | 9 | | 12 | 9 | | 12 | 10 | | 12 | 12 | |
| | 13 | 10 | | 13 | 9 | | 13 | 10 | | 13 | 9 | |
| | 14 | - | | 14 | 9 | | 14 | - | | 14 | 10 | |
| | 15 | - | | 15 | - | | 15 | - | | 15 | - | |

Comments

| SITE CTL | Replicate # <u>A</u> | | | Replicate # <u>B</u> | | | Replicate # <u>C</u> | | | Replicate # <u>D</u> | | |
|----------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|
| | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal |
| | 1 | 10 | N | 1 | 8 | N | 1 | 10 | N | 1 | 10 | N |
| | 2 | 11 | | 2 | 11 | | 2 | 9 | | 2 | 10 | |
| | 3 | 12 | | 3 | 10 | | 3 | 7 | | 3 | 10 | |
| | 4 | 11 | | 4 | 10 | | 4 | 8 | | 4 | 10 | |
| | 5 | 10 | | 5 | 9 | | 5 | 10 | | 5 | 9 | |
| | 6 | 12 | | 6 | 10 | | 6 | 9 | | 6 | 10 | |
| | 7 | - | | 7 | 11 | | 7 | 9 | | 7 | 10 | |
| | 8 | - | | 8 | 11 | | 8 | 10 | | 8 | 9 | |
| | 9 | - | | 9 | 9 | | 9 | 8 | | 9 | 8 | |
| | 10 | - | | 10 | 10 | | 10 | 9 | | 10 | 11 | |
| | 11 | - | | 11 | 9 | | 11 | 10 | | 11 | - | |
| | 12 | - | | 12 | - | | 12 | 9 | | 12 | - | |
| | 13 | - | | 13 | - | | 13 | 9 | | 13 | - | |
| | 14 | - | | 14 | - | | 14 | 8 | | 14 | - | |
| | 15 | - | | 15 | - | | 15 | 10 | | 15 | - | |

Comments

Method FMD 32 Day ELS

Client MIN100

Sample: SP1617-029

Test Termination

For normal/abnormal column, use the following notation:

N=Normal, A= Abnormal And note location: H=head, O=oral, E=eyes, G=gills, F=fins, S=spine

Conc.

5 ug/L

| Replicate # <u>A</u> | | | Replicate # <u>B</u> | | | Replicate # <u>C</u> | | | Replicate # <u>D</u> | | |
|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|
| Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal |
| 1 | 9 | N | 1 | 8 | N | 1 | 3 | N | 1 | 8 | N |
| 2 | 9 | ↓ | 2 | 10 | ↓ | 2 | 11 | ↓ | 2 | 9 | ↓ |
| 3 | 10 | ↓ | 3 | 9 | ↓ | 3 | 8 | ↓ | 3 | 11 | ↓ |
| 4 | 9 | ↓ | 4 | 7 | ↓ | 4 | 10 | ↓ | 4 | 9 | ↓ |
| 5 | 10 | ↓ | 5 | 8 | ↓ | 5 | 8 | ↓ | 5 | 9 | ↓ |
| 6 | 9 | ↓ | 6 | 6 | ↓ | 6 | 9 | ↓ | 6 | 9 | ↓ |
| 7 | 12 | ↓ | 7 | 8 | ↓ | 7 | 9 | ↓ | 7 | 9 | ↓ |
| 8 | 8 | ↓ | 8 | 10 | ↓ | 8 | 9 | ↓ | 8 | 10 | ↓ |
| 9 | 9 | ↓ | 9 | 9 | ↓ | 9 | 10 | ↓ | 9 | 9 | ↓ |
| 10 | 9 | ↓ | 10 | 11 | ↓ | 10 | 10 | ↓ | 10 | 10 | ↓ |
| 11 | 9 | ↓ | 11 | 9 | ↓ | 11 | 9 | ↓ | 11 | 10 | ↓ |
| 12 | 8 | ↓ | 12 | 11 | ↓ | 12 | 8 | ↓ | 12 | 7 | ↓ |
| 13 | 8 | ↓ | 13 | 10 | ↓ | 13 | - | ↓ | 13 | 9 | ↓ |
| 14 | - | ↓ | 14 | - | ↓ | 14 | - | ↓ | 14 | - | ↓ |
| 15 | - | ↓ | 15 | - | ↓ | 15 | - | ↓ | 15 | - | ↓ |

Comments

10 ug/L

| Replicate # <u>A</u> | | | Replicate # <u>B</u> | | | Replicate # <u>C</u> | | | Replicate # <u>D</u> | | |
|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|
| Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal |
| 1 | 9 | N | 1 | 10 | N | 1 | 9 | N | 1 | 9 | N |
| 2 | 9 | ↓ | 2 | 9 | ↓ | 2 | 7 | ↓ | 2 | 8 | ↓ |
| 3 | 8 | ↓ | 3 | 10 | ↓ | 3 | 10 | ↓ | 3 | 10 | ↓ |
| 4 | 8 | ↓ | 4 | 8 | ↓ | 4 | 9 | ↓ | 4 | 9 | ↓ |
| 5 | 10 | ↓ | 5 | 10 | ↓ | 5 | 9 | ↓ | 5 | 10 | ↓ |
| 6 | 9 | ↓ | 6 | 9 | ↓ | 6 | 9 | ↓ | 6 | 9 | ↓ |
| 7 | 9 | ↓ | 7 | 8 | ↓ | 7 | 9 | ↓ | 7 | 9 | ↓ |
| 8 | 11 | ↓ | 8 | 9 | ↓ | 8 | 8 | ↓ | 8 | 10 | ↓ |
| 9 | 10 | ↓ | 9 | 9 | ↓ | 9 | 10 | ↓ | 9 | 9 | ↓ |
| 10 | 8 | ↓ | 10 | 10 | ↓ | 10 | 11 | ↓ | 10 | 9 | ↓ |
| 11 | 10 | ↓ | 11 | 8 | ↓ | 11 | 10 | ↓ | 11 | 9 | ↓ |
| 12 | 9 | ↓ | 12 | 9 | ↓ | 12 | 9 | ↓ | 12 | 7 | ↓ |
| 13 | - | ↓ | 13 | 8 | ↓ | 13 | 9 | ↓ | 13 | 10 | ↓ |
| 14 | - | ↓ | 14 | 9 | ↓ | 14 | 7 | ↓ | 14 | - | ↓ |
| 15 | - | ↓ | 15 | - | ↓ | 15 | - | ↓ | 15 | - | ↓ |

Comments

Method FMD 32 Day ELS Client MIN100 Sample: SP1617-029

Test Termination

For normal/abnormal column, use the following notation:

N=Normal, A= Abnormal And note location: H=head, O=oral, E=eyes, G=gills, F=fins, S=spine

| Conc. | Replicate # <u>A</u> | | | Replicate # <u>B</u> | | | Replicate # <u>C</u> | | | Replicate # <u>D</u> | | |
|----------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|
| | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal |
| 20 ug/L | 1 | 9 | N | 1 | 9 | N | 1 | 9 | N | 1 | 9 | N |
| | 2 | 8 | | 2 | 10 | | 2 | 10 | | 2 | 8 | |
| | 3 | 10 | | 3 | 11 | | 3 | 10 | | 3 | 10 | |
| | 4 | 10 | | 4 | 8 | | 4 | 11 | | 4 | 10 | |
| | 5 | 10 | | 5 | 10 | | 5 | 8 | | 5 | 10 | |
| | 6 | 10 | | 6 | 10 | | 6 | 9 | | 6 | 9 | |
| | 7 | 11 | | 7 | 8 | | 7 | 10 | | 7 | 9 | |
| | 8 | 9 | | 8 | 10 | | 8 | 10 | | 8 | 10 | |
| | 9 | 9 | | 9 | 9 | | 9 | 12 | | 9 | 10 | |
| | 10 | 10 | ↓ | 10 | 8 | | 10 | 9 | | 10 | 9 | |
| | 11 | | - | 11 | 9 | | 11 | 9 | | 11 | 10 | |
| | 12 | | - | 12 | 8 | | 12 | 9 | | 12 | 8 | |
| | 13 | | - | 13 | 9 | ↓ | 13 | 9 | ↓ | 13 | 9 | |
| | 14 | | - | 14 | | - | 14 | | - | 14 | 9 | |
| | 15 | | - | 15 | | - | 15 | | - | 15 | 9 | ↓ |
| Comments | | | | | | | | | | | | |
| 40 ug/L | Replicate # <u>A</u> | | | Replicate # <u>B</u> | | | Replicate # <u>C</u> | | | Replicate # <u>D</u> | | |
| | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal |
| | 1 | 9 | N | 1 | 9 | | 1 | 11 | N | 1 | 9 | N |
| | 2 | 7 | | 2 | 9 | | 2 | 9 | | 2 | 10 | |
| | 3 | 9 | | 3 | 11 | | 3 | 9 | | 3 | 9 | |
| | 4 | 9 | | 4 | 9 | | 4 | 9 | | 4 | 9 | |
| | 5 | 10 | | 5 | 9 | | 5 | 9 | | 5 | 9 | |
| | 6 | 9 | | 6 | 9 | | 6 | 9 | | 6 | 9 | |
| | 7 | 8 | | 7 | 9 | | 7 | 9 | | 7 | 10 | |
| | 8 | 9 | | 8 | 9 | | 8 | 8 | | 8 | 10 | |
| | 9 | 9 | | 9 | 8 | | 9 | 9 | | 9 | 9 | |
| | 10 | 10 | | 10 | 9 | | 10 | 10 | | 10 | 8 | |
| | 11 | 10 | | 11 | 10 | | 11 | 8 | | 11 | 9 | |
| | 12 | 9 | | 12 | 8 | | 12 | 9 | | 12 | 9 | |
| | 13 | 9 | ↓ | 13 | 9 | | 13 | 8 | | 13 | 8 | ↓ |
| 14 | | - | 14 | | - | 14 | 9 | ↓ | 14 | | - | |
| 15 | | - | 15 | | - | 15 | | - | 15 | | - | |
| Comments | | | | | | | | | | | | |

Method FMD 32 Day ELS Client MIN100 Sample: SP1617-029

Test Termination

For normal/abnormal column, use the following notation:

N=Normal, A= Abnormal And note location: H=head, O=oral, E=eyes, G=gills, F=fins, S=spine

Conc
80 ug/L

| Replicate # <u>A</u> | | | Replicate # <u>B</u> | | | Replicate # <u>C</u> | | | Replicate # <u>D</u> | | |
|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|
| Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal |
| 1 | 9 | N | 1 | 9 | N | 1 | 9 | N | 1 | 8 | N |
| 2 | | | 2 | | | 2 | 11 | | 2 | 9 | |
| 3 | | | 3 | | | 3 | 9 | | 3 | 9 | |
| 4 | | | 4 | | | 4 | 8 | | 4 | 9 | |
| 5 | | | 5 | | | 5 | 9 | | 5 | 9 | |
| 6 | | | 6 | | | 6 | 8 | | 6 | 9 | |
| 7 | | | 7 | | | 7 | 9 | | 7 | 8 | |
| 8 | | | 8 | | | 8 | 8 | | 8 | 10 | |
| 9 | | | 9 | | | 9 | 10 | | 9 | 8 | |
| 10 | | | 10 | | | 10 | 10 | | 10 | 9 | |
| 11 | | | 11 | | | 11 | 9 | | 11 | 11 | |
| 12 | | | 12 | | | 12 | 7 | | 12 | 9 | |
| 13 | | | 13 | | | 13 | | | 13 | 9 | |
| 14 | | | 14 | | | 14 | | | 14 | | |
| 15 | | | 15 | | | 15 | | | 15 | | |

Comments

Conc
160 ug/L

| Replicate # <u>A</u> | | | Replicate # <u>B</u> | | | Replicate # <u>C</u> | | | Replicate # <u>D</u> | | |
|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|----------------------|-------------|-----------------|
| Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal | Fish | Length (mm) | Normal/Abnormal |
| 1 | 9 | N | 1 | 9 | N | 1 | 9 | N | 1 | 9 | N |
| 2 | | | 2 | | | 2 | | | 2 | 9 | |
| 3 | | | 3 | | | 3 | | | 3 | 9 | |
| 4 | | | 4 | | | 4 | | | 4 | 9 | |
| 5 | | | 5 | | | 5 | | | 5 | 9 | |
| 6 | | | 6 | | | 6 | | | 6 | 9 | |
| 7 | | | 7 | | | 7 | | | 7 | 9 | |
| 8 | | | 8 | | | 8 | | | 8 | 9 | |
| 9 | | | 9 | | | 9 | | | 9 | 9 | |
| 10 | | | 10 | | | 10 | | | 10 | 9 | |
| 11 | | | 11 | | | 11 | | | 11 | 9 | |
| 12 | | | 12 | | | 12 | | | 12 | 9 | |
| 13 | | | 13 | | | 13 | | | 13 | 9 | |
| 14 | | | 14 | | | 14 | | | 14 | 9 | |
| 15 | | | 15 | | | 15 | | | 15 | 9 | |

Comments



Fathead Minnow Reftox Log

| Date/Time/ Initials | Age of Organisms (Days from Fertilization) | Biology | | | | | | | | | | |
|---------------------------------|---|---------------|----|----|------------------|------------------|----|----|----|------------------|----|----|
| | | Replicate | A | B | C | D | E | F | G | H | I | J |
| 2017/05/25 1430 JN/NM/ FW | 0 | Alive Embryos | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| | | Dead Embryos | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Alive Hatched | - | - | - | - | - | - | - | - | - | - |
| | | Alive Dead | - | - | - | - | - | - | - | - | - | - |
| 2017/05/26 1245 DM/EP | 1 | Alive Embryos | 37 | 44 | 40 | 41 | 45 | 44 | 50 | 45 | 42 | 46 |
| | | Dead Embryos | 10 | 6 | 8 | 9 | 2 | 6 | 0 | 5 | 8 | 4 |
| | | Alive Hatched | 0 | 0 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| | | Alive Dead | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2017/05/27 1445 LC | 2 | Alive Embryos | 34 | 44 | 28 ³³ | 34 | 38 | 43 | 47 | 42 ⁴⁴ | 38 | 46 |
| | | Dead Embryos | 0 | 0 | 2 | 8 ² | 5 | 1 | 1 | 0 | 0 | 0 |
| | | Alive Hatched | 3 | 0 | 3 | 5 | 4 | 0 | 2 | 3 | 3 | 0 |
| | | Alive Dead | 0 | 0 | 4 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 2017/05/28 DM 1445 | 3 | Alive Embryos | 23 | 19 | 14 | 32 ²⁸ | 36 | 42 | 36 | 28 ³¹ | 28 | 8 |
| | | Dead Embryos | 0 | 0 | 2 | 0 ^{DM} | 0 | 0 | 1 | 0 ² | 1 | 2 |
| | | Alive Hatched | 14 | 25 | 6 | 6 | 6 | 1 | 10 | 20 | 11 | 34 |
| | | Alive Dead | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 2017/05/29 FW 1345 | 4 | Alive Embryos | 0 | 1 | 16 ⁴ | 9 | 7 | 4 | 0 | 1 | 2 | 0 |
| | | Dead Embryos | 1 | 0 | 10 ⁴ | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| | | Alive Hatched | 36 | 43 | 16 | 30 | 34 | 39 | 45 | 48 | 36 | 42 |
| | | Alive Dead | 0 | 0 | 20 ⁴ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5 | Alive Embryos | | | | | | | | | | |
| | | Dead Embryos | | | | | | | | | | |
| | | Alive Hatched | | | | | | | | | | |
| | | Alive Dead | | | | | | | | | | |

Each replicate is replenished daily with de-chlorinated tap water, dead organisms are removed daily

Comments

Method FMD 32 Day ELS Client MIN100 Sample SP1617-029

Date of change 2017/05/29 Day of change

| Volume (mL) of <i>Artemia</i> Fed to Each Test Replicate of Each Sample / Concentration | | | | | | | | |
|---|-----|----------|--------|---------|---------|---------|---------|----------|
| Replicate | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| A | 1mL | → | → | → | → | → | → | → |
| B | ↓ | → | → | → | → | → | → | → |
| C | ↓ | → | → | → | → | → | → | → |
| D | ↓ | → | → | → | → | → | → | → |

Date of change 2017/06/07 Day of change

| Volume (mL) of <i>Artemia</i> Fed to Each Test Replicate of Each Sample / Concentration | | | | | | | | |
|---|-------|----------|--------|---------|---------|---------|---------|----------|
| Replicate | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| A | 1.5mL | 1mL | 1.5mL | 1.5mL | 1.5mL | 1.5mL | 1.5mL | 1.5mL |
| B | ↓ | 1.5mL | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| C | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| D | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |

Date of change Day of change

| Volume (mL) of <i>Artemia</i> Fed to Each Test Replicate of Each Sample / Concentration | | | | | | | | |
|---|-----|----------|--------|---------|---------|---------|---------|----------|
| Replicate | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| A | | | | | | | | |
| B | | | | | | | | |
| C | | | | | | | | |
| D | | | | | | | | |

Date of change Day of change

| Volume (mL) of <i>Artemia</i> Fed to Each Test Replicate of Each Sample / Concentration | | | | | | | | |
|---|-----|----------|--------|---------|---------|---------|---------|----------|
| Replicate | CTL | SITE CTL | 5 ug/L | 10 ug/L | 20 ug/L | 40 ug/L | 80 ug/L | 160 ug/L |
| A | | | | | | | | |
| B | | | | | | | | |
| C | | | | | | | | |
| D | | | | | | | | |

*Feeding volume is maintained following a feeding change until a new feeding regime is recorded

Organism Weights Bench Sheet

Client MINILO Sample SP1617-029 Organism FM (30day)

Initial Weight (mg) (dried pan)

Date: 2017/06/05 Initials: SS Balance*: Mettler #1

| Conc. | CTL | SITE CTL | 5 | 10 | 20 | 40 | 80 | 160 |
|-------|-----|----------|---|----|----|----|----|-----|
|-------|-----|----------|---|----|----|----|----|-----|

| Replicate | 40 | | | | | | | |
|-----------|---------|---------|---------|-----------------------|---------|---------|-----------------------|---------|
| a | 1004.67 | 1009.57 | 1004.24 | 998.26 | 1008.37 | 1004.88 | 1005.96 ^{su} | 1006.44 |
| b | 1004.58 | 1006.40 | 1005.94 | 1002.66 | 1012.07 | 1005.94 | 1001.94 | 1007.23 |
| c | 999.35 | 998.45 | 1008.48 | 1007.31 | 1015.75 | 1011.18 | 992.53 | 1001.79 |
| d | 1011.77 | 1004.71 | 1007.79 | 1006.58 ^{su} | 1009.48 | 1013.00 | 1006.01 | 1000.46 |
| e | | | | 5 | | | | |

Final Weight (mg) (dried pan+organisms)

Date: 2017/07/05 Initials: SS Balance*: Mettler #1

| Conc. | CTL | SITE CTL | 5 | 10 | 20 | 40 | 80 | 160 |
|-------|-----|----------|---|----|----|----|----|-----|
|-------|-----|----------|---|----|----|----|----|-----|

| Replicate | *1022.17 ^{uo} | | | | | | | |
|-----------|------------------------|---------|---------------------------------|---------|--------------------|---------------------------------|---------|-----------------------|
| a | 1019.93 | 1024.19 | 1019.42^{su} | 1011.26 | 1022.23 | 1018.00 | 1018.63 | 1018.64 |
| b | 1029.78 | 1021.96 | 1019.52 | 1017.36 | 1026.55 | 1022.05^{su} | 1013.56 | 1018.44 |
| c | 1014.74 | 1014.09 | 1022.03 | 1023.13 | 1033.01 | 1024.52 | 1006.08 | 1017.30 |
| d | 1029.78 | 1019.46 | 1022.37^{su} | 1019.61 | 1027.34 | 1028.47 | 1027.67 | 1016.82 ^{su} |
| e | | | 1019.42 | | | | | |

Test Validity Met: Yes/No/NA

Results are Logical**: Yes/No

**no negative numbers, consistent values across replicates

*Same balance must be used for initial and final weights

*For FM/HA/CT must use scale with 0.01 mg accuracy

| Balance Calibration Check: | | Initial | Final |
|-----------------------------|--|---------|---------|
| first pan weighed: | | CTL D | CTL B |
| weight of first pan: | | 1011.77 | 1019.93 |
| re-weigh of first pan after | | | |
| all weights measured : | | 1011.73 | 1019.87 |
| % difference <5%: | | Yes/No | Yes/No |

Calculation: % difference = [(initial weight-reweight)/((initial weight+reweight)/2)]x100

If "no" is circled for any parameter, notify Lab Supervisor/QA Group to determine appropriate action

CETIS Analytical Report

Report Date: 25 Jul-17 14:41 (p 1 of 2)
 Test Code: SP1617-029 FMD | 10-7819-7001

Fathead Minnow 32-d Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 12-4253-2770 | Endpoint: Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 25 Jul-17 14:40 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: Not Applicable |
| Ending Date: | Species: Pimephales promelas | Brine: |
| Duration: n/a | Source: Aquatox, AR | Age: <24 |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: | Station: Minto | |

Non-Linear Regression Options

| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
|---|----------------------|--------------------|---------|---------|
| 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$ | Normal: $\omega = 1$ | Off: $\mu^* = \mu$ | None | None |

Regression Summary

| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|-------|--------|--------|--------|--------|----------|--------|----------|---------|-----------------------------|
| 19 | 62.12 | -117.4 | -113.9 | 0.0234 | Yes | 0.4532 | 2.621 | 0.8068 | Non-Significant Lack of Fit |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|----------|-----------|-----------|
| IC5 | 0.07638 | n/a | 48610 |
| IC10 | 15.28 | 1.235E-05 | 2406 |
| IC15 | 406.1 | n/a | 729300 |
| IC20 | 4800 | n/a | 2.436E+10 |
| IC25 | 36910 | n/a | n/a |
| IC40 | 5032000 | n/a | n/a |
| IC50 | 89200000 | n/a | n/a |

Regression Parameters

| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
|-----------|----------|-----------|-----------|-----------|--------|----------|---------------------------|
| α | 1.103 | 0.07418 | 0.9513 | 1.255 | 14.87 | <1.0E-37 | Significant Parameter |
| γ | 0.141 | 0.3305 | -0.535 | 0.8171 | 0.4266 | 0.6728 | Non-Significant Parameter |
| δ | 89200000 | 2.953E+09 | -5.95E+09 | 6.129E+09 | 0.0302 | 0.9761 | Non-Significant Parameter |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Model | 31.56 | 10.52 | 3 | 477.8 | <1.0E-37 | Significant |
| Lack of Fit | 0.05508 | 0.01102 | 5 | 0.4532 | 0.8068 | Non-Significant |
| Pure Error | 0.5833 | 0.02431 | 24 | | | |
| Residual | 0.6384 | 0.02201 | 29 | | | |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|---------------|----------------------------------|-----------|----------|---------|--------------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.34 | 2.938 | 0.0068 | Outlier Detected |
| Variances | Mod Levene Equality of Variance | 0.7355 | 2.423 | 0.6442 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9191 | 0.9338 | 0.0196 | Non-Normal Distribution |
| | Anderson-Darling A2 Normality Te | 0.6929 | 2.492 | 0.0704 | Normal Distribution |

Fathead Minnow 32-d Survival and Growth Test

Nautilus Environmental Calgary

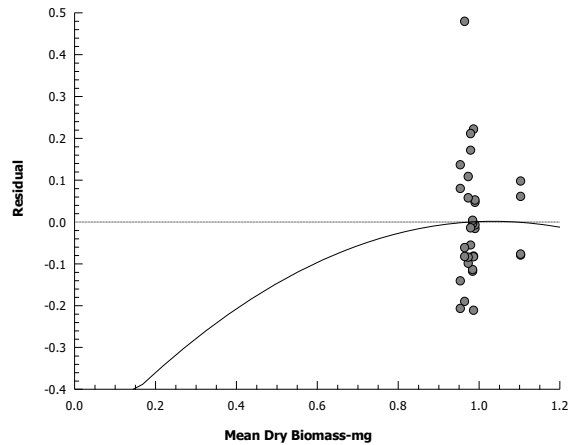
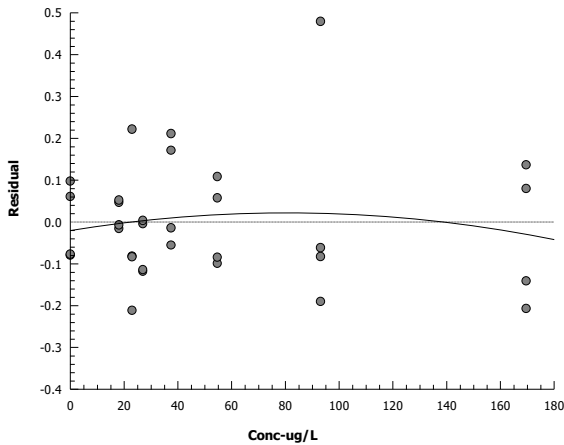
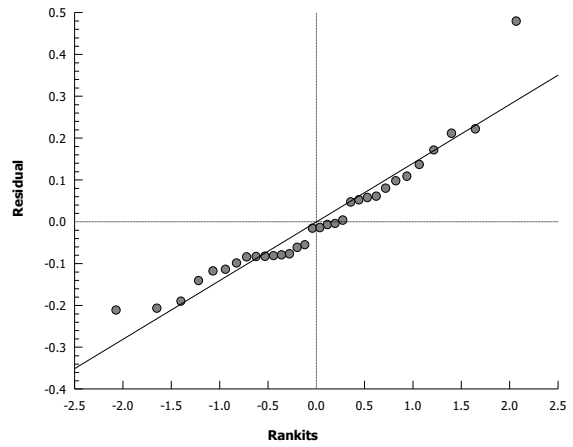
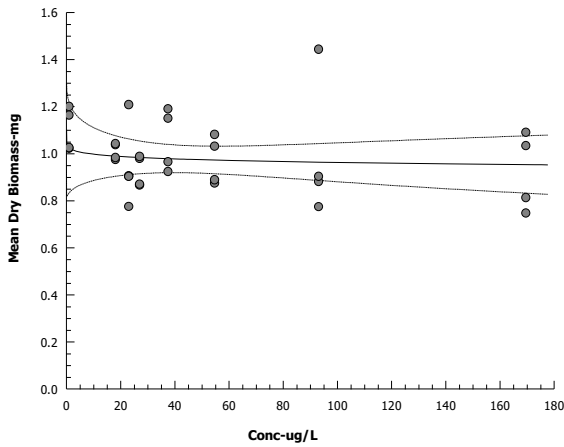
Analysis ID: 12-4253-2770 Endpoint: Mean Dry Biomass-mg CETIS Version: CETISv1.9.0
 Analyzed: 25 Jul-17 14:40 Analysis: Nonlinear Regression (NLR) Official Results: Yes

| Mean Dry Biomass-mg Summary | | | Calculated Variate | | | | | | |
|-----------------------------|------|-------|--------------------|--------|-------|---------|---------|--------|---------|
| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
| 0 | N | 4 | 1.103 | 1.023 | 1.201 | 0.04613 | 0.09226 | 8.36% | 0.00% |
| 18.1 | | 4 | 1.01 | 0.9747 | 1.043 | 0.01773 | 0.03546 | 3.51% | 8.52% |
| 23 | | 4 | 0.9482 | 0.7753 | 1.209 | 0.092 | 0.184 | 19.41% | 14.08% |
| 27 | | 4 | 0.9263 | 0.8667 | 0.988 | 0.03334 | 0.06669 | 7.20% | 16.05% |
| 37.5 | | 4 | 1.058 | 0.924 | 1.191 | 0.06629 | 0.1326 | 12.53% | 4.15% |
| 54.7 | | 4 | 0.9693 | 0.8747 | 1.082 | 0.05156 | 0.1031 | 10.64% | 12.16% |
| 93.1 | | 4 | 1.001 | 0.7747 | 1.444 | 0.1503 | 0.3007 | 30.04% | 9.29% |
| 169.6 | | 4 | 0.9213 | 0.7473 | 1.091 | 0.08332 | 0.1666 | 18.09% | 16.51% |

| Mean Dry Biomass-mg Detail | | | | | |
|----------------------------|------|--------|--------|--------|--------|
| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
| 0 | N | 1.164 | 1.023 | 1.026 | 1.201 |
| 18.1 | | 0.9747 | 1.037 | 1.043 | 0.9833 |
| 23 | | 1.209 | 0.9053 | 0.9033 | 0.7753 |
| 27 | | 0.8667 | 0.98 | 0.988 | 0.8707 |
| 37.5 | | 0.924 | 0.9653 | 1.151 | 1.191 |
| 54.7 | | 0.8747 | 1.082 | 0.8893 | 1.031 |
| 93.1 | | 0.882 | 0.7747 | 0.9033 | 1.444 |
| 169.6 | | 0.8133 | 0.7473 | 1.034 | 1.091 |

Graphics Model: 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$

Distribution: Normal [$\omega = 1$]



CETIS Analytical Report

Report Date: 25 Jul-17 14:36 (p 1 of 2)
 Test Code: SP1617-029 FMD | 10-7819-7001

Fathead Minnow 32-d Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 20-8847-4197 | Endpoint: Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 25 Jul-17 14:35 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: Not Applicable |
| Ending Date: | Species: Pimephales promelas | Brine: |
| Duration: n/a | Source: Aquatox, AR | Age: <24 |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|-------|---------|------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 169.6 | > 169.6 | n/a | | 24.8% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 18.1 | 0.8527 | 2.482 | 0.274 | 6 | CDF | 0.5498 | Non-Significant Effect |
| | | 23 | 1.409 | 2.482 | 0.274 | 6 | CDF | 0.3025 | Non-Significant Effect |
| | | 27 | 1.607 | 2.482 | 0.274 | 6 | CDF | 0.2304 | Non-Significant Effect |
| | | 37.5 | 0.4158 | 2.482 | 0.274 | 6 | CDF | 0.7413 | Non-Significant Effect |
| | | 54.7 | 1.217 | 2.482 | 0.274 | 6 | CDF | 0.3824 | Non-Significant Effect |
| | | 93.1 | 0.9298 | 2.482 | 0.274 | 6 | CDF | 0.5137 | Non-Significant Effect |
| | | 169.6 | 1.652 | 2.482 | 0.274 | 6 | CDF | 0.2156 | Non-Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.229 | 2.938 | 0.0124 | Outlier Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 0.11549 | 0.0164986 | 7 | 0.6788 | 0.6883 | Non-Significant Effect |
| Error | 0.583338 | 0.0243058 | 24 | | | |
| Total | 0.698829 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 13.55 | 18.48 | 0.0597 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9278 | 0.9081 | 0.0339 | Normal Distribution |

Mean Dry Biomass-mg Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|-------|---------|--------|---------|
| 0 | N | 4 | 1.103 | 0.9567 | 1.25 | | 1.023 | 1.201 | 0.04613 | 8.36% | 0.00% |
| 18.1 | | 4 | 1.01 | 0.9531 | 1.066 | | 0.9747 | 1.043 | 0.01773 | 3.51% | 8.52% |
| 23 | | 4 | 0.9482 | 0.6554 | 1.241 | | 0.7753 | 1.209 | 0.092 | 19.41% | 14.08% |
| 27 | | 4 | 0.9263 | 0.8202 | 1.032 | | 0.8667 | 0.988 | 0.03334 | 7.20% | 16.05% |
| 37.5 | | 4 | 1.058 | 0.8467 | 1.269 | | 0.924 | 1.191 | 0.06629 | 12.53% | 4.15% |
| 54.7 | | 4 | 0.9693 | 0.8053 | 1.133 | | 0.8747 | 1.082 | 0.05156 | 10.64% | 12.16% |
| 93.1 | | 4 | 1.001 | 0.5226 | 1.479 | | 0.7747 | 1.444 | 0.1503 | 30.04% | 9.29% |
| 169.6 | | 4 | 0.9213 | 0.6562 | 1.186 | | 0.7473 | 1.091 | 0.08332 | 18.09% | 16.51% |

CETIS Analytical Report

Report Date: 25 Jul-17 14:36 (p 2 of 2)
Test Code: SP1617-029 FMD | 10-7819-7001

Fathead Minnow 32-d Survival and Growth Test

Nautilus Environmental Calgary

Analysis ID: 20-8847-4197 Endpoint: Mean Dry Biomass-mg CETIS Version: CETISv1.9.0
Analyzed: 25 Jul-17 14:35 Analysis: Parametric-Control vs Treatments Official Results: Yes

Mean Dry Biomass-mg Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|--------|--------|--------|--------|
| 0 | N | 1.164 | 1.023 | 1.026 | 1.201 |
| 18.1 | | 0.9747 | 1.037 | 1.043 | 0.9833 |
| 23 | | 1.209 | 0.9053 | 0.9033 | 0.7753 |
| 27 | | 0.8667 | 0.98 | 0.988 | 0.8707 |
| 37.5 | | 0.924 | 0.9653 | 1.151 | 1.191 |
| 54.7 | | 0.8747 | 1.082 | 0.8893 | 1.031 |
| 93.1 | | 0.882 | 0.7747 | 0.9033 | 1.444 |
| 169.6 | | 0.8133 | 0.7473 | 1.034 | 1.091 |

CETIS Analytical Report

Report Date: 16 Aug-17 09:55 (p 1 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 13-7595-1313 | Endpoint: Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:55 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: |
| Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 277030 | 200 | Yes | Two-Point Interpolation |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.735 | 2.938 | 0.1164 | No Outliers Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|------|---------|---------|
| LC5 | >168 | n/a | n/a |
| LC10 | >168 | n/a | n/a |
| LC15 | >168 | n/a | n/a |
| LC20 | >168 | n/a | n/a |
| LC25 | >168 | n/a | n/a |
| LC40 | >168 | n/a | n/a |
| LC50 | >168 | n/a | n/a |

Survival Rate Summary

Calculated Variate(A/B)

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
|-----------|------|-------|--------|--------|--------|---------|---------|--------|---------|----|----|
| 0 | N | 4 | 0.9667 | 0.9333 | 1.0000 | 0.0192 | 0.0385 | 3.98% | 0.00% | 58 | 60 |
| 14 | | 4 | 0.9500 | 0.8667 | 1.0000 | 0.0319 | 0.0638 | 6.72% | 1.72% | 57 | 60 |
| 19.9 | | 4 | 0.9667 | 0.9333 | 1.0000 | 0.0192 | 0.0385 | 3.98% | 0.00% | 58 | 60 |
| 24.2 | | 4 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | -3.45% | 60 | 60 |
| 32.9 | | 4 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | -3.45% | 60 | 60 |
| 51.4 | | 4 | 0.9833 | 0.9333 | 1.0000 | 0.0167 | 0.0333 | 3.39% | -1.72% | 59 | 60 |
| 95.1 | | 4 | 0.9000 | 0.7333 | 1.0000 | 0.0638 | 0.1277 | 14.18% | 6.90% | 54 | 60 |
| 168 | | 4 | 0.9667 | 0.8667 | 1.0000 | 0.0333 | 0.0667 | 6.90% | 0.00% | 58 | 60 |

Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|--------|--------|--------|--------|
| 0 | N | 1.0000 | 1.0000 | 0.9333 | 0.9333 |
| 14 | | 1.0000 | 0.8667 | 1.0000 | 0.9333 |
| 19.9 | | 0.9333 | 1.0000 | 1.0000 | 0.9333 |
| 24.2 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 32.9 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 51.4 | | 1.0000 | 0.9333 | 1.0000 | 1.0000 |
| 95.1 | | 0.7333 | 1.0000 | 0.8667 | 1.0000 |
| 168 | | 1.0000 | 1.0000 | 1.0000 | 0.8667 |

CETIS Analytical Report

Report Date: 16 Aug-17 09:55 (p 2 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

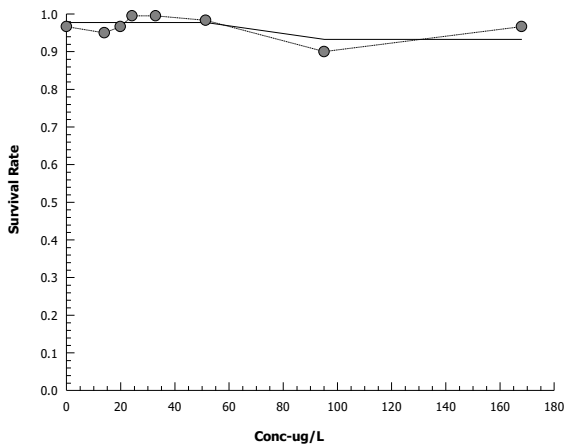
Analysis ID: 13-7595-1313 Endpoint: Survival Rate
Analyzed: 16 Aug-17 9:55 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
Official Results: Yes

Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | 15/15 | 15/15 | 14/15 | 14/15 |
| 14 | | 15/15 | 13/15 | 15/15 | 14/15 |
| 19.9 | | 14/15 | 15/15 | 15/15 | 14/15 |
| 24.2 | | 15/15 | 15/15 | 15/15 | 15/15 |
| 32.9 | | 15/15 | 15/15 | 15/15 | 15/15 |
| 51.4 | | 15/15 | 14/15 | 15/15 | 15/15 |
| 95.1 | | 11/15 | 15/15 | 13/15 | 15/15 |
| 168 | | 15/15 | 15/15 | 15/15 | 13/15 |

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 09:56 (p 1 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 00-0174-0126 | Endpoint: Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:55 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: |
| Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|---------------------|---------|--------|------|-------|------|-------|------|----|-------|
| Angular (Corrected) | C > T | n/a | n/a | n/a | 168 | > 168 | n/a | | 10.6% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 14 | 0.3852 | 2.482 | 0.181 | 6 | CDF | 0.7531 | Non-Significant Effect |
| | | 19.9 | 0 | 2.482 | 0.181 | 6 | CDF | 0.8750 | Non-Significant Effect |
| | | 24.2 | -0.9008 | 2.482 | 0.181 | 6 | CDF | 0.9868 | Non-Significant Effect |
| | | 32.9 | -0.9008 | 2.482 | 0.181 | 6 | CDF | 0.9868 | Non-Significant Effect |
| | | 51.4 | -0.4504 | 2.482 | 0.181 | 6 | CDF | 0.9547 | Non-Significant Effect |
| | | 95.1 | 1.348 | 2.482 | 0.181 | 6 | CDF | 0.3270 | Non-Significant Effect |
| | | 168 | -0.06519 | 2.482 | 0.181 | 6 | CDF | 0.8905 | Non-Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.735 | 2.938 | 0.1164 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 0.0802069 | 0.0114581 | 7 | 1.072 | 0.4108 | Non-Significant Effect |
| Error | 0.256496 | 0.0106873 | 24 | | | |
| Total | 0.336703 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|--------------------------------------|-----------|----------|---------|---------------------|
| Variances | Levene Equality of Variance Test | 7.869 | 3.496 | 5.7E-05 | Unequal Variances |
| Variances | Mod Levene Equality of Variance Test | 3.101 | 3.496 | 0.0178 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9469 | 0.9081 | 0.1173 | Normal Distribution |

Survival Rate Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 0 | N | 4 | 0.9667 | 0.9054 | 1.0000 | | 0.9333 | 1.0000 | 0.0192 | 3.98% | 0.00% |
| 14 | | 4 | 0.9500 | 0.8484 | 1.0000 | | 0.8667 | 1.0000 | 0.0319 | 6.72% | 1.72% |
| 19.9 | | 4 | 0.9667 | 0.9054 | 1.0000 | | 0.9333 | 1.0000 | 0.0192 | 3.98% | 0.00% |
| 24.2 | | 4 | 1.0000 | 1.0000 | 1.0000 | | 1.0000 | 1.0000 | 0.0000 | 0.00% | -3.45% |
| 32.9 | | 4 | 1.0000 | 1.0000 | 1.0000 | | 1.0000 | 1.0000 | 0.0000 | 0.00% | -3.45% |
| 51.4 | | 4 | 0.9833 | 0.9303 | 1.0000 | | 0.9333 | 1.0000 | 0.0167 | 3.39% | -1.72% |
| 95.1 | | 4 | 0.9000 | 0.6969 | 1.0000 | | 0.7333 | 1.0000 | 0.0638 | 14.18% | 6.90% |
| 168 | | 4 | 0.9667 | 0.8606 | 1.0000 | | 0.8667 | 1.0000 | 0.0333 | 6.90% | 0.00% |

CETIS Analytical Report

Report Date: 16 Aug-17 09:56 (p 2 of 2)
 Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

Analysis ID: 00-0174-0126 Endpoint: Survival Rate CETIS Version: CETISv1.9.0
 Analyzed: 16 Aug-17 9:55 Analysis: Parametric-Control vs Treatments Official Results: Yes

Angular (Corrected) Transformed Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|-------|-------|---------|--------|---------|
| 0 | N | 4 | 1.375 | 1.254 | 1.496 | | 1.31 | 1.441 | 0.03802 | 5.53% | 0.00% |
| 14 | | 4 | 1.347 | 1.16 | 1.535 | | 1.197 | 1.441 | 0.05894 | 8.75% | 2.05% |
| 19.9 | | 4 | 1.375 | 1.254 | 1.496 | | 1.31 | 1.441 | 0.03802 | 5.53% | 0.00% |
| 24.2 | | 4 | 1.441 | 1.441 | 1.442 | | 1.441 | 1.441 | 0 | 0.00% | -4.79% |
| 32.9 | | 4 | 1.441 | 1.441 | 1.442 | | 1.441 | 1.441 | 0 | 0.00% | -4.79% |
| 51.4 | | 4 | 1.408 | 1.304 | 1.513 | | 1.31 | 1.441 | 0.03292 | 4.68% | -2.39% |
| 95.1 | | 4 | 1.277 | 0.9556 | 1.598 | | 1.028 | 1.441 | 0.101 | 15.81% | 7.16% |
| 168 | | 4 | 1.38 | 1.186 | 1.575 | | 1.197 | 1.441 | 0.06108 | 8.85% | -0.35% |

Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|--------|--------|--------|--------|
| 0 | N | 1.0000 | 1.0000 | 0.9333 | 0.9333 |
| 14 | | 1.0000 | 0.8667 | 1.0000 | 0.9333 |
| 19.9 | | 0.9333 | 1.0000 | 1.0000 | 0.9333 |
| 24.2 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 32.9 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 51.4 | | 1.0000 | 0.9333 | 1.0000 | 1.0000 |
| 95.1 | | 0.7333 | 1.0000 | 0.8667 | 1.0000 |
| 168 | | 1.0000 | 1.0000 | 1.0000 | 0.8667 |

Angular (Corrected) Transformed Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | | | | |
| 14 | | | | | |
| 19.9 | | | | | |
| 24.2 | | | | | |
| 32.9 | | | | | |
| 51.4 | | | | | |
| 95.1 | | | | | |
| 168 | | | | | |

CETIS Analytical Report

Report Date: 09 Aug-17 14:08 (p 1 of 2)
 Test Code: SP1617-029 FM | 03-6991-1553

| Larval Fish 32-d Survival and Growth Test | | | Nautilus Environmental Calgary | | |
|---|---|-------------------------------------|--------------------------------|--|--|
| Analysis ID: 02-2652-3806 | Endpoint: Mean Length-mm | CETIS Version: CETISv1.9.0 | | | |
| Analyzed: 09 Aug-17 14:07 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes | | | |
| Batch ID: 09-2303-4928 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek | | | |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: Not Applicable | | | |
| Ending Date: 06 Jul-17 | Species: Pimephales promelas | Brine: | | | |
| Duration: 42d 0h | Source: Aquatox, AR | Age: | | | |
| Sample ID: 03-3414-4083 | Code: SP1617-029 | Client: Minnow Environmental | | | |
| Sample Date: 05 May-17 | Material: Total Copper | Project: | | | |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | | | | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | | | | |

| Non-Linear Regression Options | | | | |
|--|--------------------|------------------|---------|---------|
| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
| 3P Cumulative Log-Normal: $\mu=\alpha \cdot [1 - \Phi[\log[x/\delta]/\gamma]]$ | Normal: $\omega=1$ | Off: $\mu^*=\mu$ | None | None |

| Regression Summary | | | | | | | | | |
|--------------------|--------|--------|--------|--------|----------|--------|----------|---------|-----------------------------|
| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
| 7 | 27.2 | -47.55 | -44.01 | 0.2676 | Yes | 1.849 | 2.621 | 0.1412 | Non-Significant Lack of Fit |

| Point Estimates | | | |
|-----------------|-------|---------|---------|
| Level | ug/L | 95% LCL | 95% UCL |
| IC5 | 50.54 | 23.57 | 87.18 |
| IC10 | 161.9 | 68.66 | 305.7 |
| IC15 | 355.2 | 69.25 | 1013 |
| IC20 | 663.2 | 51.59 | 2847 |
| IC25 | 1133 | 31.09 | 7356 |
| IC40 | 4370 | n/a | 152300 |
| IC50 | 9844 | n/a | n/a |

| Regression Parameters | | | | | | | |
|-----------------------|----------|-----------|---------|---------|--------|----------|---------------------------|
| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
| α | 9.658 | 0.2162 | 9.216 | 10.1 | 44.66 | <1.0E-37 | Significant Parameter |
| γ | 3.205 | 1.524 | 0.08914 | 6.321 | 2.104 | 0.0442 | Significant Parameter |
| δ | 9844 | 19230 | -29480 | 49170 | 0.512 | 0.6125 | Non-Significant Parameter |

| ANOVA Table | | | | | | |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
| Model | 2728 | 909.2 | 3 | 4657 | <1.0E-37 | Significant |
| Lack of Fit | 1.575 | 0.3149 | 5 | 1.849 | 0.1412 | Non-Significant |
| Pure Error | 4.088 | 0.1703 | 24 | | | |
| Residual | 5.662 | 0.1952 | 29 | | | |

| Residual Analysis | | | | | |
|-------------------|----------------------------------|-----------|----------|---------|--------------------------|
| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
| Extreme Value | Grubbs Extreme Value Test | 3.698 | 2.938 | 7.3E-04 | Outlier Detected |
| Variances | Mod Levene Equality of Variance | 1.794 | 2.423 | 0.1350 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.8628 | 0.9338 | 7.9E-04 | Non-Normal Distribution |
| | Anderson-Darling A2 Normality Te | 1.334 | 2.492 | 0.0013 | Non-Normal Distribution |

Larval Fish 32-d Survival and Growth Test

Nautilus Environmental Calgary

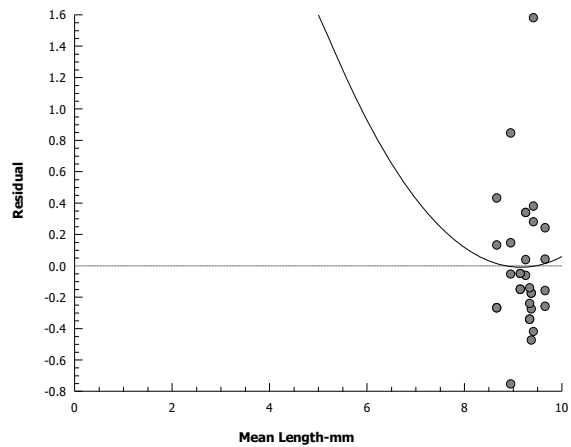
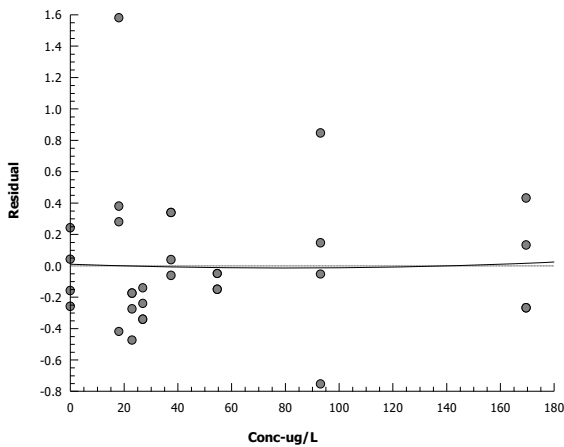
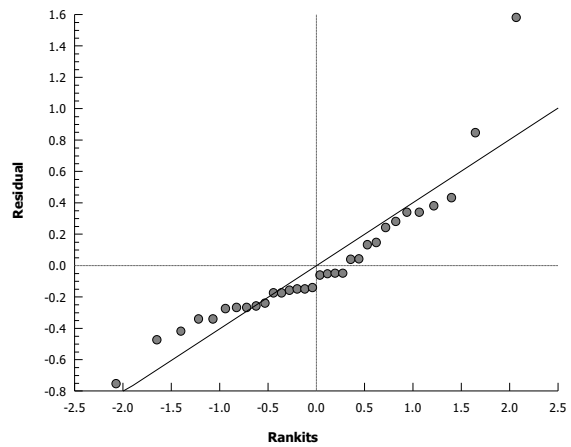
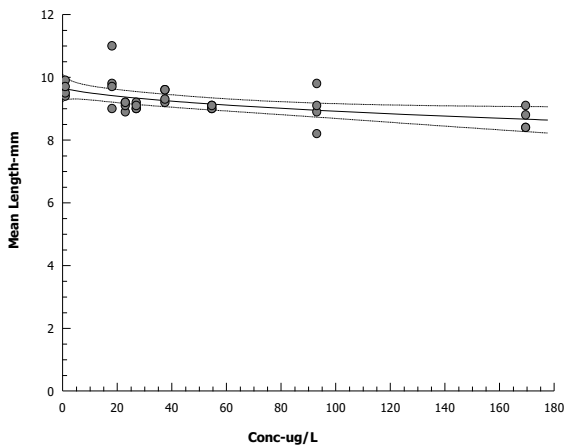
Analysis ID: 02-2652-3806 Endpoint: Mean Length-mm CETIS Version: CETISv1.9.0
 Analyzed: 09 Aug-17 14:07 Analysis: Nonlinear Regression (NLR) Official Results: Yes

| Mean Length-mm Summary | | | Calculated Variate | | | | | | |
|------------------------|------|-------|--------------------|-----|-----|---------|---------|-------|---------|
| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
| 0 | N | 4 | 9.625 | 9.4 | 9.9 | 0.1109 | 0.2217 | 2.30% | 0.00% |
| 18.1 | | 4 | 9.875 | 9 | 11 | 0.4151 | 0.8302 | 8.41% | -2.60% |
| 23 | | 4 | 9.1 | 8.9 | 9.2 | 0.07071 | 0.1414 | 1.55% | 5.45% |
| 27 | | 4 | 9.075 | 9 | 9.2 | 0.04787 | 0.09574 | 1.06% | 5.71% |
| 37.5 | | 4 | 9.425 | 9.2 | 9.6 | 0.1031 | 0.2062 | 2.19% | 2.08% |
| 54.7 | | 4 | 9.05 | 9 | 9.1 | 0.02886 | 0.05773 | 0.64% | 5.97% |
| 93.1 | | 4 | 9 | 8.2 | 9.8 | 0.3291 | 0.6583 | 7.31% | 6.49% |
| 169.6 | | 4 | 8.675 | 8.4 | 9.1 | 0.1702 | 0.3403 | 3.92% | 9.87% |

| Mean Length-mm Detail | | | | | |
|-----------------------|------|-------|-------|-------|-------|
| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
| 0 | N | 9.9 | 9.4 | 9.5 | 9.7 |
| 18.1 | | 11 | 9.8 | 9 | 9.7 |
| 23 | | 9.2 | 8.9 | 9.1 | 9.2 |
| 27 | | 9.2 | 9 | 9 | 9.1 |
| 37.5 | | 9.6 | 9.2 | 9.6 | 9.3 |
| 54.7 | | 9 | 9.1 | 9 | 9.1 |
| 93.1 | | 9.8 | 8.2 | 8.9 | 9.1 |
| 169.6 | | 8.8 | 8.4 | 8.4 | 9.1 |

Graphics Model: 3P Cumulative Log-Normal: $\mu = \alpha \cdot [1 - \Phi[\log(x/\delta)/\gamma]]$

Distribution: Normal [$\omega=1$]



CETIS Analytical Report

Report Date: 09 Aug-17 14:15 (p 1 of 2)
 Test Code: SP1617-029 FM | 03-6991-1553

Larval Fish 32-d Survival and Growth Test **Nautilus Environmental Calgary**

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 14-4361-3524 | Endpoint: Mean Length-mm | CETIS Version: CETISv1.9.0 |
| Analyzed: 09 Aug-17 14:14 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Pimephales promelas | Brine: |
| Duration: 42d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 03-3414-4083 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|-------|-------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 93.1 | 169.6 | 125.7 | | 7.52% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 18.1 | -0.8567 | 2.482 | 0.724 | 6 | CDF | 0.9850 | Non-Significant Effect |
| | | 23 | 1.799 | 2.482 | 0.724 | 6 | CDF | 0.1721 | Non-Significant Effect |
| | | 27 | 1.885 | 2.482 | 0.724 | 6 | CDF | 0.1498 | Non-Significant Effect |
| | | 37.5 | 0.6854 | 2.482 | 0.724 | 6 | CDF | 0.6270 | Non-Significant Effect |
| | | 54.7 | 1.97 | 2.482 | 0.724 | 6 | CDF | 0.1297 | Non-Significant Effect |
| | | 93.1 | 2.142 | 2.482 | 0.724 | 6 | CDF | 0.0959 | Non-Significant Effect |
| | | 169.6* | 3.255 | 2.482 | 0.724 | 6 | CDF | 0.0093 | Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.098 | 2.938 | 0.0239 | Outlier Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 4.17719 | 0.596741 | 7 | 3.504 | 0.0099 | Significant Effect |
| Error | 4.0875 | 0.170313 | 24 | | | |
| Total | 8.26469 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|-------------------------|
| Variances | Bartlett Equality of Variance Test | 25.82 | 18.48 | 5.4E-04 | Unequal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.8789 | 0.9081 | 0.0019 | Non-Normal Distribution |

Mean Length-mm Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|-----|-----|---------|-------|---------|
| 0 | N | 4 | 9.625 | 9.272 | 9.978 | | 9.4 | 9.9 | 0.1109 | 2.30% | 0.00% |
| 18.1 | | 4 | 9.875 | 8.554 | 11.2 | | 9 | 11 | 0.4151 | 8.41% | -2.60% |
| 23 | | 4 | 9.1 | 8.875 | 9.325 | | 8.9 | 9.2 | 0.07071 | 1.55% | 5.45% |
| 27 | | 4 | 9.075 | 8.923 | 9.227 | | 9 | 9.2 | 0.04787 | 1.06% | 5.71% |
| 37.5 | | 4 | 9.425 | 9.097 | 9.753 | | 9.2 | 9.6 | 0.1031 | 2.19% | 2.08% |
| 54.7 | | 4 | 9.05 | 8.958 | 9.142 | | 9 | 9.1 | 0.02886 | 0.64% | 5.97% |
| 93.1 | | 4 | 9 | 7.953 | 10.05 | | 8.2 | 9.8 | 0.3291 | 7.31% | 6.49% |
| 169.6 | | 4 | 8.675 | 8.133 | 9.217 | | 8.4 | 9.1 | 0.1702 | 3.92% | 9.87% |

CETIS Analytical Report

Report Date: 09 Aug-17 14:15 (p 2 of 2)
Test Code: SP1617-029 FM | 03-6991-1553

Larval Fish 32-d Survival and Growth Test

Nautilus Environmental Calgary

Analysis ID: 14-4361-3524 Endpoint: Mean Length-mm
Analyzed: 09 Aug-17 14:14 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.9.0
Official Results: Yes

Mean Length-mm Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | 9.9 | 9.4 | 9.5 | 9.7 |
| 18.1 | | 11 | 9.8 | 9 | 9.7 |
| 23 | | 9.2 | 8.9 | 9.1 | 9.2 |
| 27 | | 9.2 | 9 | 9 | 9.1 |
| 37.5 | | 9.6 | 9.2 | 9.6 | 9.3 |
| 54.7 | | 9 | 9.1 | 9 | 9.1 |
| 93.1 | | 9.8 | 8.2 | 8.9 | 9.1 |
| 169.6 | | 8.8 | 8.4 | 8.4 | 9.1 |

CETIS Analytical Report

Report Date: 25 Jul-17 13:50 (p 1 of 2)
Test Code: SP1617-029 FMD | 10-7819-7001

Fathead Minnow 32-d Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 14-5361-7061 | Endpoint: Overall Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 25 Jul-17 13:50 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: Not Applicable |
| Ending Date: | Species: Pimephales promelas | Brine: |
| Duration: n/a | Source: Aquatox, AR | Age: <24 |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|---------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 1453355 | 200 | Yes | Two-Point Interpolation |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.986 | 2.938 | 0.0404 | Outlier Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|--------|---------|---------|
| LC5 | 7.132 | n/a | n/a |
| LC10 | >169.6 | n/a | n/a |
| LC15 | >169.6 | n/a | n/a |
| LC20 | >169.6 | n/a | n/a |
| LC25 | >169.6 | n/a | n/a |
| LC40 | >169.6 | n/a | n/a |
| LC50 | >169.6 | n/a | n/a |

Overall Survival Rate Summary

Calculated Variate(A/B)

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
|-----------|------|-------|--------|--------|--------|---------|---------|--------|---------|----|----|
| 0 | N | 4 | 0.9000 | 0.8667 | 0.9333 | 0.0193 | 0.0385 | 4.28% | 0.00% | 54 | 60 |
| 18.1 | | 4 | 0.7000 | 0.4000 | 1.0000 | 0.1232 | 0.2465 | 35.21% | 22.22% | 42 | 60 |
| 23 | | 4 | 0.8667 | 0.8000 | 0.9333 | 0.0272 | 0.0544 | 6.28% | 3.70% | 52 | 60 |
| 27 | | 4 | 0.8833 | 0.8000 | 0.9333 | 0.0319 | 0.0638 | 7.23% | 1.85% | 53 | 60 |
| 37.5 | | 4 | 0.8500 | 0.6667 | 1.0000 | 0.0687 | 0.1374 | 16.17% | 5.56% | 51 | 60 |
| 54.7 | | 4 | 0.8833 | 0.8667 | 0.9333 | 0.0167 | 0.0333 | 3.77% | 1.85% | 53 | 60 |
| 93.1 | | 4 | 0.7500 | 0.5333 | 0.8667 | 0.0739 | 0.1478 | 19.71% | 16.67% | 45 | 60 |
| 169.6 | | 4 | 0.9000 | 0.8000 | 0.9333 | 0.0333 | 0.0667 | 7.41% | 0.00% | 54 | 60 |

Overall Survival Rate

| Detail Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|------------------|------|--------|--------|--------|--------|
| 0 | N | 0.8667 | 0.9333 | 0.8667 | 0.9333 |
| 18.1 | | 0.4000 | 0.7333 | 1.0000 | 0.6667 |
| 23 | | 0.8667 | 0.8667 | 0.8000 | 0.9333 |
| 27 | | 0.8000 | 0.9333 | 0.9333 | 0.8667 |
| 37.5 | | 0.6667 | 0.8667 | 0.8667 | 1.0000 |
| 54.7 | | 0.8667 | 0.8667 | 0.9333 | 0.8667 |
| 93.1 | | 0.5333 | 0.8000 | 0.8000 | 0.8667 |
| 169.6 | | 0.9333 | 0.9333 | 0.9333 | 0.8000 |

CETIS Analytical Report

Report Date: 25 Jul-17 13:50 (p 2 of 2)
Test Code: SP1617-029 FMD | 10-7819-7001

Fathead Minnow 32-d Survival and Growth Test

Nautilus Environmental Calgary

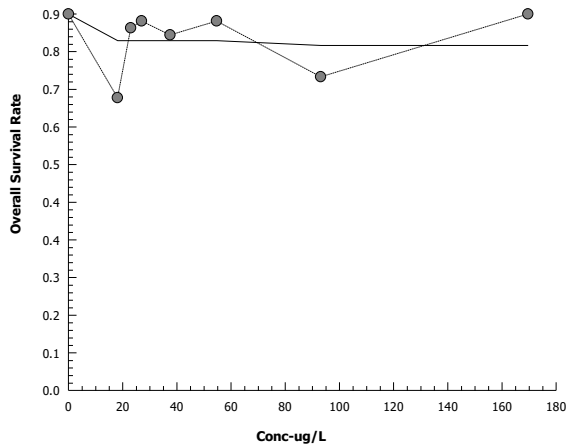
Analysis ID: 14-5361-7061 Endpoint: Overall Survival Rate
Analyzed: 25 Jul-17 13:50 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
Official Results: Yes

Overall Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | 13/15 | 14/15 | 13/15 | 14/15 |
| 18.1 | | 6/15 | 11/15 | 15/15 | 10/15 |
| 23 | | 13/15 | 13/15 | 12/15 | 14/15 |
| 27 | | 12/15 | 14/15 | 14/15 | 13/15 |
| 37.5 | | 10/15 | 13/15 | 13/15 | 15/15 |
| 54.7 | | 13/15 | 13/15 | 14/15 | 13/15 |
| 93.1 | | 8/15 | 12/15 | 12/15 | 13/15 |
| 169.6 | | 14/15 | 14/15 | 14/15 | 12/15 |

Graphics



CETIS Analytical Report

Report Date: 25 Jul-17 13:49 (p 1 of 2)
 Test Code: SP1617-029 FMD | 10-7819-7001

Fathead Minnow 32-d Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 06-6798-4520 | Endpoint: Overall Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 25 Jul-17 13:48 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: Not Applicable |
| Ending Date: | Species: Pimephales promelas | Brine: |
| Duration: n/a | Source: Aquatox, AR | Age: <24 |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|---------------------|---------|--------|------|-------|-------|---------|------|----|-------|
| Angular (Corrected) | C > T | n/a | n/a | n/a | 169.6 | > 169.6 | n/a | | 23.7% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 18.1 | 2.028 | 2.482 | 0.277 | 6 | CDF | 0.1175 | Non-Significant Effect |
| | | 23 | 0.4543 | 2.482 | 0.277 | 6 | CDF | 0.7261 | Non-Significant Effect |
| | | 27 | 0.2016 | 2.482 | 0.277 | 6 | CDF | 0.8176 | Non-Significant Effect |
| | | 37.5 | 0.4995 | 2.482 | 0.277 | 6 | CDF | 0.7076 | Non-Significant Effect |
| | | 54.7 | 0.2527 | 2.482 | 0.277 | 6 | CDF | 0.8008 | Non-Significant Effect |
| | | 93.1 | 1.757 | 2.482 | 0.277 | 6 | CDF | 0.1838 | Non-Significant Effect |
| | | 169.6 | -0.05111 | 2.482 | 0.277 | 6 | CDF | 0.8873 | Non-Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.986 | 2.938 | 0.0404 | Outlier Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 0.221379 | 0.0316256 | 7 | 1.274 | 0.3045 | Non-Significant Effect |
| Error | 0.595915 | 0.0248298 | 24 | | | |
| Total | 0.817295 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 13.39 | 18.48 | 0.0631 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9322 | 0.9081 | 0.0452 | Normal Distribution |

Overall Survival Rate Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 0 | N | 4 | 0.9000 | 0.8388 | 0.9612 | | 0.8667 | 0.9333 | 0.0193 | 4.28% | 0.00% |
| 18.1 | | 4 | 0.7000 | 0.3078 | 1.0000 | | 0.4000 | 1.0000 | 0.1232 | 35.21% | 22.22% |
| 23 | | 4 | 0.8667 | 0.7801 | 0.9533 | | 0.8000 | 0.9333 | 0.0272 | 6.28% | 3.70% |
| 27 | | 4 | 0.8833 | 0.7818 | 0.9849 | | 0.8000 | 0.9333 | 0.0319 | 7.23% | 1.85% |
| 37.5 | | 4 | 0.8500 | 0.6313 | 1.0000 | | 0.6667 | 1.0000 | 0.0687 | 16.17% | 5.56% |
| 54.7 | | 4 | 0.8833 | 0.8303 | 0.9364 | | 0.8667 | 0.9333 | 0.0167 | 3.77% | 1.85% |
| 93.1 | | 4 | 0.7500 | 0.5148 | 0.9852 | | 0.5333 | 0.8667 | 0.0739 | 19.71% | 16.67% |
| 169.6 | | 4 | 0.9000 | 0.7939 | 1.0000 | | 0.8000 | 0.9333 | 0.0333 | 7.41% | 0.00% |

CETIS Analytical Report

Report Date: 25 Jul-17 13:49 (p 2 of 2)
Test Code: SP1617-029 FMD | 10-7819-7001

Fathead Minnow 32-d Survival and Growth Test **Nautilus Environmental Calgary**

Analysis ID: 06-6798-4520 **Endpoint:** Overall Survival Rate **CETIS Version:** CETISv1.9.0
Analyzed: 25 Jul-17 13:48 **Analysis:** Parametric-Control vs Treatments **Official Results:** Yes

Angular (Corrected) Transformed Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|--------|-------|---------|--------|---------|
| 0 | N | 4 | 1.253 | 1.15 | 1.357 | | 1.197 | 1.31 | 0.03251 | 5.19% | 0.00% |
| 18.1 | | 4 | 1.027 | 0.5293 | 1.525 | | 0.6847 | 1.441 | 0.1565 | 30.47% | 18.03% |
| 23 | | 4 | 1.203 | 1.071 | 1.335 | | 1.107 | 1.31 | 0.04146 | 6.90% | 4.04% |
| 27 | | 4 | 1.231 | 1.075 | 1.387 | | 1.107 | 1.31 | 0.04904 | 7.97% | 1.79% |
| 37.5 | | 4 | 1.198 | 0.8819 | 1.513 | | 0.9553 | 1.441 | 0.09921 | 16.57% | 4.44% |
| 54.7 | | 4 | 1.225 | 1.136 | 1.315 | | 1.197 | 1.31 | 0.02816 | 4.60% | 2.25% |
| 93.1 | | 4 | 1.058 | 0.7954 | 1.32 | | 0.8188 | 1.197 | 0.08236 | 15.58% | 15.62% |
| 169.6 | | 4 | 1.259 | 1.098 | 1.42 | | 1.107 | 1.31 | 0.05062 | 8.04% | -0.45% |

Overall Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|--------|--------|--------|--------|
| 0 | N | 0.8667 | 0.9333 | 0.8667 | 0.9333 |
| 18.1 | | 0.4000 | 0.7333 | 1.0000 | 0.6667 |
| 23 | | 0.8667 | 0.8667 | 0.8000 | 0.9333 |
| 27 | | 0.8000 | 0.9333 | 0.9333 | 0.8667 |
| 37.5 | | 0.6667 | 0.8667 | 0.8667 | 1.0000 |
| 54.7 | | 0.8667 | 0.8667 | 0.9333 | 0.8667 |
| 93.1 | | 0.5333 | 0.8000 | 0.8000 | 0.8667 |
| 169.6 | | 0.9333 | 0.9333 | 0.9333 | 0.8000 |

CETIS Analytical Report

Report Date: 25 Jul-17 14:05 (p 1 of 2)
Test Code: SP1617-029 FMD | 10-7819-7001

Fathead Minnow 32-d Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 15-3309-8262 | Endpoint: Post Hatch Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 25 Jul-17 14:05 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: Not Applicable |
| Ending Date: | Species: Pimephales promelas | Brine: |
| Duration: n/a | Source: Aquatox, AR | Age: <24 |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 370153 | 200 | Yes | Two-Point Interpolation |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.835 | 2.938 | 0.0777 | No Outliers Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|--------|---------|---------|
| LC5 | 6.173 | n/a | n/a |
| LC10 | >169.6 | n/a | n/a |
| LC15 | >169.6 | n/a | n/a |
| LC20 | >169.6 | n/a | n/a |
| LC25 | >169.6 | n/a | n/a |
| LC40 | >169.6 | n/a | n/a |
| LC50 | >169.6 | n/a | n/a |

Post Hatch Survival Rate Summary

Calculated Variate(A/B)

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
|-----------|------|-------|--------|--------|--------|---------|---------|--------|---------|----|----|
| 0 | N | 4 | 0.9321 | 0.8667 | 1.0000 | 0.0272 | 0.0545 | 5.85% | 0.00% | 54 | 58 |
| 18.1 | | 4 | 0.7401 | 0.4000 | 1.0000 | 0.1275 | 0.2550 | 34.46% | 20.60% | 42 | 57 |
| 23 | | 4 | 0.8988 | 0.8000 | 1.0000 | 0.0427 | 0.0855 | 9.51% | 3.58% | 52 | 58 |
| 27 | | 4 | 0.8833 | 0.8000 | 0.9333 | 0.0319 | 0.0638 | 7.23% | 5.24% | 53 | 60 |
| 37.5 | | 4 | 0.8500 | 0.6667 | 1.0000 | 0.0687 | 0.1374 | 16.17% | 8.81% | 51 | 60 |
| 54.7 | | 4 | 0.8988 | 0.8667 | 0.9333 | 0.0186 | 0.0372 | 4.14% | 3.58% | 53 | 59 |
| 93.1 | | 4 | 0.8293 | 0.7273 | 0.9231 | 0.0423 | 0.0846 | 10.20% | 11.04% | 45 | 54 |
| 169.6 | | 4 | 0.9308 | 0.9231 | 0.9333 | 0.0026 | 0.0051 | 0.55% | 0.15% | 54 | 58 |

Post Hatch Survival Rate

| Detail Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|------------------|------|--------|--------|--------|--------|
| 0 | N | 0.8667 | 0.9333 | 0.9286 | 1.0000 |
| 18.1 | | 0.4000 | 0.8462 | 1.0000 | 0.7143 |
| 23 | | 0.9286 | 0.8667 | 0.8000 | 1.0000 |
| 27 | | 0.8000 | 0.9333 | 0.9333 | 0.8667 |
| 37.5 | | 0.6667 | 0.8667 | 0.8667 | 1.0000 |
| 54.7 | | 0.8667 | 0.9286 | 0.9333 | 0.8667 |
| 93.1 | | 0.7273 | 0.8000 | 0.9231 | 0.8667 |
| 169.6 | | 0.9333 | 0.9333 | 0.9333 | 0.9231 |

CETIS Analytical Report

Report Date: 25 Jul-17 14:05 (p 2 of 2)
Test Code: SP1617-029 FMD | 10-7819-7001

Fathead Minnow 32-d Survival and Growth Test

Nautilus Environmental Calgary

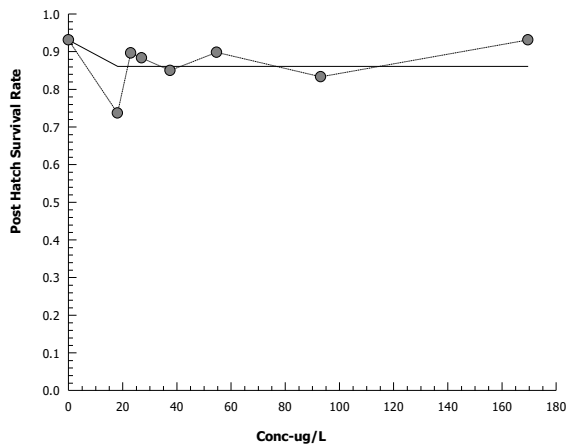
Analysis ID: 15-3309-8262 Endpoint: Post Hatch Survival Rate
Analyzed: 25 Jul-17 14:05 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
Official Results: Yes

Post Hatch Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | 13/15 | 14/15 | 13/14 | 14/14 |
| 18.1 | | 6/15 | 11/13 | 15/15 | 10/14 |
| 23 | | 13/14 | 13/15 | 12/15 | 14/14 |
| 27 | | 12/15 | 14/15 | 14/15 | 13/15 |
| 37.5 | | 10/15 | 13/15 | 13/15 | 15/15 |
| 54.7 | | 13/15 | 13/14 | 14/15 | 13/15 |
| 93.1 | | 8/11 | 12/15 | 12/13 | 13/15 |
| 169.6 | | 14/15 | 14/15 | 14/15 | 12/13 |

Graphics



CETIS Analytical Report

Report Date: 25 Jul-17 14:07 (p 1 of 2)
Test Code: SP1617-029 FMD | 10-7819-7001

Fathead Minnow 32-d Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 12-3771-5242 | Endpoint: Post Hatch Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 25 Jul-17 14:07 | Analysis: Parametric-Control vs Ord.Treatments | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: Not Applicable |
| Ending Date: | Species: Pimephales promelas | Brine: |
| Duration: n/a | Source: Aquatox, AR | Age: <24 |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|---------------------|---------|--------|------|-------|-------|---------|------|----|-------|
| Angular (Corrected) | C > T | n/a | n/a | n/a | 169.6 | > 169.6 | n/a | | 14.2% |

Williams Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 18.1 | 2.13 | 1.711 | 0.189 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 23 | 1.294 | 1.791 | 0.198 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 27 | 1.104 | 1.818 | 0.201 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 37.5 | 1.084 | 1.83 | 0.203 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 54.7 | 0.9752 | 1.838 | 0.203 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 93.1 | 1.42 | 1.843 | 0.204 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 169.6 | 0.9074 | 1.846 | 0.204 | 6 | CDF | >0.05 | Non-Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.835 | 2.938 | 0.0777 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 0.175675 | 0.0250964 | 7 | 1.024 | 0.4398 | Non-Significant Effect |
| Error | 0.587932 | 0.0244972 | 24 | | | |
| Total | 0.763607 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 21.72 | 18.48 | 0.0028 | Unequal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9564 | 0.9081 | 0.2179 | Normal Distribution |

Post Hatch Survival Rate Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 0 | N | 4 | 0.9321 | 0.8454 | 1.0000 | | 0.8667 | 1.0000 | 0.0272 | 5.85% | 0.00% |
| 18.1 | | 4 | 0.7401 | 0.3343 | 1.0000 | | 0.4000 | 1.0000 | 0.1275 | 34.46% | 20.60% |
| 23 | | 4 | 0.8988 | 0.7628 | 1.0000 | | 0.8000 | 1.0000 | 0.0427 | 9.51% | 3.58% |
| 27 | | 4 | 0.8833 | 0.7818 | 0.9849 | | 0.8000 | 0.9333 | 0.0319 | 7.23% | 5.24% |
| 37.5 | | 4 | 0.8500 | 0.6313 | 1.0000 | | 0.6667 | 1.0000 | 0.0687 | 16.17% | 8.81% |
| 54.7 | | 4 | 0.8988 | 0.8397 | 0.9579 | | 0.8667 | 0.9333 | 0.0186 | 4.14% | 3.58% |
| 93.1 | | 4 | 0.8293 | 0.6947 | 0.9638 | | 0.7273 | 0.9231 | 0.0423 | 10.20% | 11.04% |
| 169.6 | | 4 | 0.9308 | 0.9226 | 0.9389 | | 0.9231 | 0.9333 | 0.0026 | 0.55% | 0.15% |

CETIS Analytical Report

Report Date: 25 Jul-17 14:07 (p 2 of 2)
 Test Code: SP1617-029 FMD | 10-7819-7001

Fathead Minnow 32-d Survival and Growth Test

Nautilus Environmental Calgary

Analysis ID: 12-3771-5242 Endpoint: Survival Rate CETIS Version: CETISv1.9.0
 Analyzed: 25 Jul-17 14:07 Analysis: Parametric-Control vs Ord.Treatments Official Results: Yes

Angular (Corrected) Transformed Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|--------|-------|---------|--------|---------|
| 0 | N | 4 | 1.311 | 1.155 | 1.467 | | 1.197 | 1.437 | 0.0491 | 7.49% | 0.00% |
| 18.1 | | 4 | 1.075 | 0.5722 | 1.578 | | 0.6847 | 1.441 | 0.1581 | 29.40% | 17.98% |
| 23 | | 4 | 1.26 | 1.035 | 1.486 | | 1.107 | 1.437 | 0.07083 | 11.24% | 3.86% |
| 27 | | 4 | 1.231 | 1.075 | 1.387 | | 1.107 | 1.31 | 0.04904 | 7.97% | 6.11% |
| 37.5 | | 4 | 1.198 | 0.8819 | 1.513 | | 0.9553 | 1.441 | 0.09921 | 16.57% | 8.64% |
| 54.7 | | 4 | 1.251 | 1.152 | 1.35 | | 1.197 | 1.31 | 0.03122 | 4.99% | 4.57% |
| 93.1 | | 4 | 1.154 | 0.9699 | 1.338 | | 1.021 | 1.29 | 0.05779 | 10.02% | 11.98% |
| 169.6 | | 4 | 1.305 | 1.289 | 1.32 | | 1.29 | 1.31 | 0.00497 | 0.76% | 0.48% |

Post Hatch Survival Rate

| Detail Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|------------------|------|--------|--------|--------|--------|
| 0 | N | 0.8667 | 0.9333 | 0.9286 | 1.0000 |
| 18.1 | | 0.4000 | 0.8462 | 1.0000 | 0.7143 |
| 23 | | 0.9286 | 0.8667 | 0.8000 | 1.0000 |
| 27 | | 0.8000 | 0.9333 | 0.9333 | 0.8667 |
| 37.5 | | 0.6667 | 0.8667 | 0.8667 | 1.0000 |
| 54.7 | | 0.8667 | 0.9286 | 0.9333 | 0.8667 |
| 93.1 | | 0.7273 | 0.8000 | 0.9231 | 0.8667 |
| 169.6 | | 0.9333 | 0.9333 | 0.9333 | 0.9231 |

CETIS Analytical Report

Report Date: 16 Aug-17 10:11 (p 1 of 2)
 Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 04-1109-2037 | Endpoint: Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 10:10 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: |
| Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Non-Linear Regression Options

| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
|---|----------------------|--------------------|---------|---------|
| 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$ | Normal: $\omega = 1$ | Off: $\mu^* = \mu$ | None | None |

Regression Summary

| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|-------|--------|--------|--------|--------|----------|--------|----------|---------|-----------------------------|
| 19 | 62.13 | -117.4 | -113.9 | 0.0237 | Yes | 0.4519 | 2.621 | 0.8077 | Non-Significant Lack of Fit |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-----------|-----------|-----------|
| IC5 | 0.06048 | n/a | 45080 |
| IC10 | 13.47 | 1.156E-05 | 2271 |
| IC15 | 382.8 | n/a | 729200 |
| IC20 | 4758 | n/a | 2.548E+10 |
| IC25 | 38140 | n/a | n/a |
| IC40 | 5745000 | n/a | n/a |
| IC50 | 108000000 | n/a | n/a |

Regression Parameters

| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
|-----------|-----------|-----------|-----------|-----------|---------|----------|---------------------------|
| α | 1.103 | 0.07417 | 0.9514 | 1.255 | 14.87 | <1.0E-37 | Significant Parameter |
| γ | 0.1382 | 0.3192 | -0.5146 | 0.7911 | 0.433 | 0.6682 | Non-Significant Parameter |
| δ | 108000000 | 3.591E+09 | -7.24E+09 | 7.452E+09 | 0.03007 | 0.9762 | Non-Significant Parameter |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Model | 31.56 | 10.52 | 3 | 477.9 | <1.0E-37 | Significant |
| Lack of Fit | 0.05492 | 0.01098 | 5 | 0.4519 | 0.8077 | Non-Significant |
| Pure Error | 0.5833 | 0.02431 | 24 | | | |
| Residual | 0.6383 | 0.02201 | 29 | | | |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|---------------|----------------------------------|-----------|----------|---------|--------------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.342 | 2.938 | 0.0067 | Outlier Detected |
| Variances | Mod Levene Equality of Variance | 0.7355 | 2.423 | 0.6442 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9189 | 0.9338 | 0.0194 | Non-Normal Distribution |
| | Anderson-Darling A2 Normality Te | 0.6946 | 2.492 | 0.0697 | Normal Distribution |

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

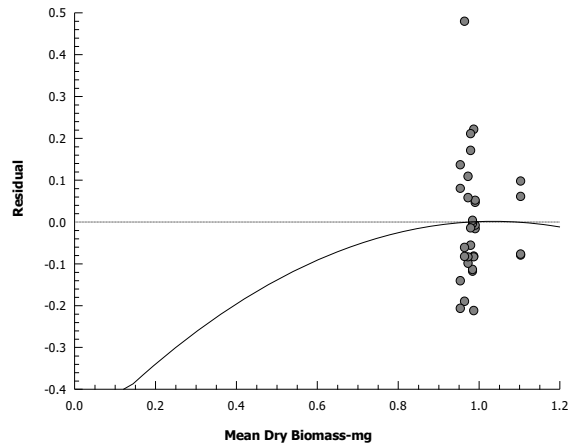
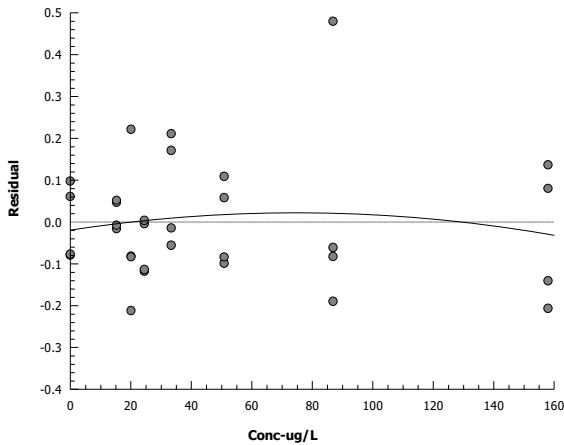
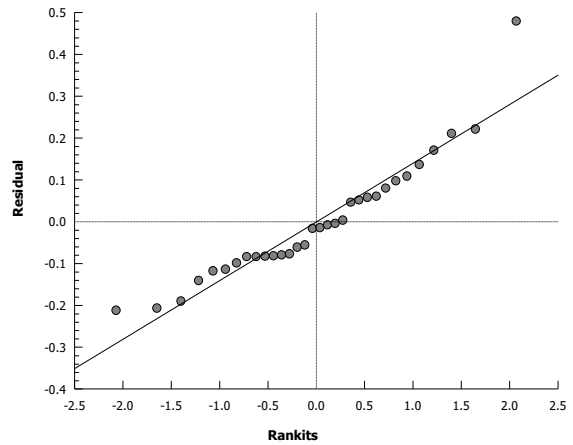
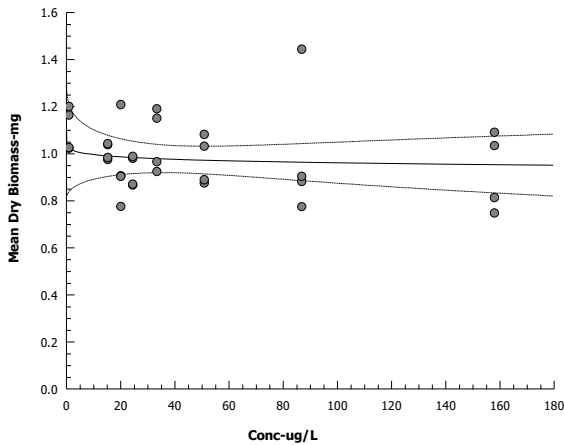
Analysis ID: 04-1109-2037 Endpoint: Mean Dry Biomass-mg CETIS Version: CETISv1.9.0
 Analyzed: 16 Aug-17 10:10 Analysis: Nonlinear Regression (NLR) Official Results: Yes

| Mean Dry Biomass-mg Summary | | | Calculated Variate | | | | | | |
|-----------------------------|------|-------|--------------------|--------|-------|---------|---------|--------|---------|
| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
| 0 | N | 4 | 1.103 | 1.023 | 1.201 | 0.04613 | 0.09226 | 8.36% | 0.00% |
| 15.3 | | 4 | 1.01 | 0.9747 | 1.043 | 0.01773 | 0.03546 | 3.51% | 8.52% |
| 20.1 | | 4 | 0.9482 | 0.7753 | 1.209 | 0.092 | 0.184 | 19.41% | 14.08% |
| 24.5 | | 4 | 0.9263 | 0.8667 | 0.988 | 0.03334 | 0.06669 | 7.20% | 16.05% |
| 33.4 | | 4 | 1.058 | 0.924 | 1.191 | 0.06629 | 0.1326 | 12.53% | 4.15% |
| 50.9 | | 4 | 0.9693 | 0.8747 | 1.082 | 0.05156 | 0.1031 | 10.64% | 12.16% |
| 86.9 | | 4 | 1.001 | 0.7747 | 1.444 | 0.1503 | 0.3007 | 30.04% | 9.29% |
| 158 | | 4 | 0.9213 | 0.7473 | 1.091 | 0.08332 | 0.1666 | 18.09% | 16.51% |

| Mean Dry Biomass-mg Detail | | | | | |
|----------------------------|------|--------|--------|--------|--------|
| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
| 0 | N | 1.164 | 1.023 | 1.026 | 1.201 |
| 15.3 | | 0.9747 | 1.037 | 1.043 | 0.9833 |
| 20.1 | | 1.209 | 0.9053 | 0.9033 | 0.7753 |
| 24.5 | | 0.8667 | 0.98 | 0.988 | 0.8707 |
| 33.4 | | 0.924 | 0.9653 | 1.151 | 1.191 |
| 50.9 | | 0.8747 | 1.082 | 0.8893 | 1.031 |
| 86.9 | | 0.882 | 0.7747 | 0.9033 | 1.444 |
| 158 | | 0.8133 | 0.7473 | 1.034 | 1.091 |

Graphics Model: 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$

Distribution: Normal [$\omega = 1$]



CETIS Analytical Report

Report Date: 16 Aug-17 10:11 (p 1 of 2)
 Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 17-1903-2022 | Endpoint: Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 10:11 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: |
| Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|-------|------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 158 | > 158 | n/a | | 24.8% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 15.3 | 0.8527 | 2.482 | 0.274 | 6 | CDF | 0.5498 | Non-Significant Effect |
| | | 20.1 | 1.409 | 2.482 | 0.274 | 6 | CDF | 0.3025 | Non-Significant Effect |
| | | 24.5 | 1.607 | 2.482 | 0.274 | 6 | CDF | 0.2304 | Non-Significant Effect |
| | | 33.4 | 0.4158 | 2.482 | 0.274 | 6 | CDF | 0.7413 | Non-Significant Effect |
| | | 50.9 | 1.217 | 2.482 | 0.274 | 6 | CDF | 0.3824 | Non-Significant Effect |
| | | 86.9 | 0.9298 | 2.482 | 0.274 | 6 | CDF | 0.5137 | Non-Significant Effect |
| | | 158 | 1.652 | 2.482 | 0.274 | 6 | CDF | 0.2156 | Non-Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.229 | 2.938 | 0.0124 | Outlier Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 0.11549 | 0.0164986 | 7 | 0.6788 | 0.6883 | Non-Significant Effect |
| Error | 0.583338 | 0.0243058 | 24 | | | |
| Total | 0.698829 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 13.55 | 18.48 | 0.0597 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9278 | 0.9081 | 0.0339 | Normal Distribution |

Mean Dry Biomass-mg Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|-------|---------|--------|---------|
| 0 | N | 4 | 1.103 | 0.9567 | 1.25 | | 1.023 | 1.201 | 0.04613 | 8.36% | 0.00% |
| 15.3 | | 4 | 1.01 | 0.9531 | 1.066 | | 0.9747 | 1.043 | 0.01773 | 3.51% | 8.52% |
| 20.1 | | 4 | 0.9482 | 0.6554 | 1.241 | | 0.7753 | 1.209 | 0.092 | 19.41% | 14.08% |
| 24.5 | | 4 | 0.9263 | 0.8202 | 1.032 | | 0.8667 | 0.988 | 0.03334 | 7.20% | 16.05% |
| 33.4 | | 4 | 1.058 | 0.8467 | 1.269 | | 0.924 | 1.191 | 0.06629 | 12.53% | 4.15% |
| 50.9 | | 4 | 0.9693 | 0.8053 | 1.133 | | 0.8747 | 1.082 | 0.05156 | 10.64% | 12.16% |
| 86.9 | | 4 | 1.001 | 0.5226 | 1.479 | | 0.7747 | 1.444 | 0.1503 | 30.04% | 9.29% |
| 158 | | 4 | 0.9213 | 0.6562 | 1.186 | | 0.7473 | 1.091 | 0.08332 | 18.09% | 16.51% |

CETIS Analytical Report

Report Date: 16 Aug-17 10:11 (p 2 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

Analysis ID: 17-1903-2022 Endpoint: Mean Dry Biomass-mg CETIS Version: CETISv1.9.0
Analyzed: 16 Aug-17 10:11 Analysis: Parametric-Control vs Treatments Official Results: Yes

Mean Dry Biomass-mg Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|--------|--------|--------|--------|
| 0 | N | 1.164 | 1.023 | 1.026 | 1.201 |
| 15.3 | | 0.9747 | 1.037 | 1.043 | 0.9833 |
| 20.1 | | 1.209 | 0.9053 | 0.9033 | 0.7753 |
| 24.5 | | 0.8667 | 0.98 | 0.988 | 0.8707 |
| 33.4 | | 0.924 | 0.9653 | 1.151 | 1.191 |
| 50.9 | | 0.8747 | 1.082 | 0.8893 | 1.031 |
| 86.9 | | 0.882 | 0.7747 | 0.9033 | 1.444 |
| 158 | | 0.8133 | 0.7473 | 1.034 | 1.091 |

CETIS Analytical Report

Report Date: 16 Aug-17 09:59 (p 1 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 17-0659-5951 | Endpoint: Hatch | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:59 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: |
| Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 390279 | 200 | Yes | Two-Point Interpolation |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.735 | 2.938 | 0.1164 | No Outliers Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|------|---------|---------|
| LC5 | >144 | n/a | n/a |
| LC10 | >144 | n/a | n/a |
| LC15 | >144 | n/a | n/a |
| LC20 | >144 | n/a | n/a |
| LC25 | >144 | n/a | n/a |
| LC40 | >144 | n/a | n/a |
| LC50 | >144 | n/a | n/a |

Hatch Summary

Calculated Variate(A/B)

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
|-----------|------|-------|--------|--------|--------|---------|---------|--------|---------|----|----|
| 0 | N | 4 | 0.9667 | 0.9333 | 1.0000 | 0.0192 | 0.0385 | 3.98% | 0.00% | 58 | 60 |
| 12.1 | | 4 | 0.9500 | 0.8667 | 1.0000 | 0.0319 | 0.0638 | 6.72% | 1.72% | 57 | 60 |
| 16.5 | | 4 | 0.9667 | 0.9333 | 1.0000 | 0.0192 | 0.0385 | 3.98% | 0.00% | 58 | 60 |
| 22.3 | | 4 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | -3.45% | 60 | 60 |
| 29.7 | | 4 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.00% | -3.45% | 60 | 60 |
| 46.6 | | 4 | 0.9833 | 0.9333 | 1.0000 | 0.0167 | 0.0333 | 3.39% | -1.72% | 59 | 60 |
| 85 | | 4 | 0.9000 | 0.7333 | 1.0000 | 0.0638 | 0.1277 | 14.18% | 6.90% | 54 | 60 |
| 144 | | 4 | 0.9667 | 0.8667 | 1.0000 | 0.0333 | 0.0667 | 6.90% | 0.00% | 58 | 60 |

Hatch Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|--------|--------|--------|--------|
| 0 | N | 1.0000 | 1.0000 | 0.9333 | 0.9333 |
| 12.1 | | 1.0000 | 0.8667 | 1.0000 | 0.9333 |
| 16.5 | | 0.9333 | 1.0000 | 1.0000 | 0.9333 |
| 22.3 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 29.7 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 46.6 | | 1.0000 | 0.9333 | 1.0000 | 1.0000 |
| 85 | | 0.7333 | 1.0000 | 0.8667 | 1.0000 |
| 144 | | 1.0000 | 1.0000 | 1.0000 | 0.8667 |

CETIS Analytical Report

Report Date: 16 Aug-17 09:59 (p 2 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

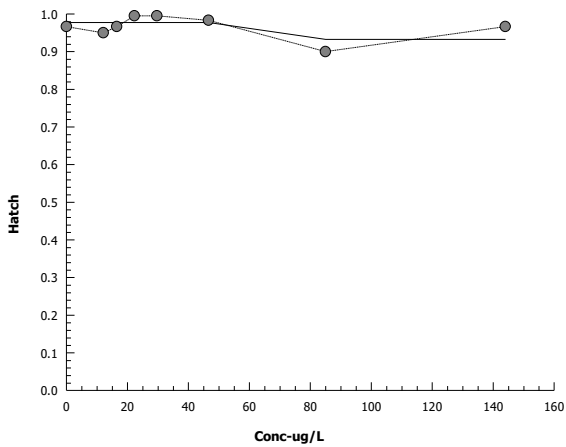
Analysis ID: 17-0659-5951 Endpoint: Hatch
Analyzed: 16 Aug-17 9:59 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
Official Results: Yes

Hatch Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | 15/15 | 15/15 | 14/15 | 14/15 |
| 12.1 | | 15/15 | 13/15 | 15/15 | 14/15 |
| 16.5 | | 14/15 | 15/15 | 15/15 | 14/15 |
| 22.3 | | 15/15 | 15/15 | 15/15 | 15/15 |
| 29.7 | | 15/15 | 15/15 | 15/15 | 15/15 |
| 46.6 | | 15/15 | 14/15 | 15/15 | 15/15 |
| 85 | | 11/15 | 15/15 | 13/15 | 15/15 |
| 144 | | 15/15 | 15/15 | 15/15 | 13/15 |

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 10:00 (p 1 of 2)
 Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 02-4821-4436 | Endpoint: Hatch | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:59 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: |
| Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|---------------------|---------|--------|------|-------|------|-------|------|----|-------|
| Angular (Corrected) | C > T | n/a | n/a | n/a | 144 | > 144 | n/a | | 10.6% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 12.1 | 0.3852 | 2.482 | 0.181 | 6 | CDF | 0.7531 | Non-Significant Effect |
| | | 16.5 | 0 | 2.482 | 0.181 | 6 | CDF | 0.8750 | Non-Significant Effect |
| | | 22.3 | -0.9008 | 2.482 | 0.181 | 6 | CDF | 0.9868 | Non-Significant Effect |
| | | 29.7 | -0.9008 | 2.482 | 0.181 | 6 | CDF | 0.9868 | Non-Significant Effect |
| | | 46.6 | -0.4504 | 2.482 | 0.181 | 6 | CDF | 0.9547 | Non-Significant Effect |
| | | 85 | 1.348 | 2.482 | 0.181 | 6 | CDF | 0.3270 | Non-Significant Effect |
| | | 144 | -0.06519 | 2.482 | 0.181 | 6 | CDF | 0.8905 | Non-Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.735 | 2.938 | 0.1164 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 0.0802069 | 0.0114581 | 7 | 1.072 | 0.4108 | Non-Significant Effect |
| Error | 0.256496 | 0.0106873 | 24 | | | |
| Total | 0.336703 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|--------------------------------------|-----------|----------|---------|---------------------|
| Variances | Levene Equality of Variance Test | 7.869 | 3.496 | 5.7E-05 | Unequal Variances |
| Variances | Mod Levene Equality of Variance Test | 3.101 | 3.496 | 0.0178 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9469 | 0.9081 | 0.1173 | Normal Distribution |

Hatch Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 0 | N | 4 | 0.9667 | 0.9054 | 1.0000 | | 0.9333 | 1.0000 | 0.0192 | 3.98% | 0.00% |
| 12.1 | | 4 | 0.9500 | 0.8484 | 1.0000 | | 0.8667 | 1.0000 | 0.0319 | 6.72% | 1.72% |
| 16.5 | | 4 | 0.9667 | 0.9054 | 1.0000 | | 0.9333 | 1.0000 | 0.0192 | 3.98% | 0.00% |
| 22.3 | | 4 | 1.0000 | 1.0000 | 1.0000 | | 1.0000 | 1.0000 | 0.0000 | 0.00% | -3.45% |
| 29.7 | | 4 | 1.0000 | 1.0000 | 1.0000 | | 1.0000 | 1.0000 | 0.0000 | 0.00% | -3.45% |
| 46.6 | | 4 | 0.9833 | 0.9303 | 1.0000 | | 0.9333 | 1.0000 | 0.0167 | 3.39% | -1.72% |
| 85 | | 4 | 0.9000 | 0.6969 | 1.0000 | | 0.7333 | 1.0000 | 0.0638 | 14.18% | 6.90% |
| 144 | | 4 | 0.9667 | 0.8606 | 1.0000 | | 0.8667 | 1.0000 | 0.0333 | 6.90% | 0.00% |

CETIS Analytical Report

Report Date: 16 Aug-17 10:00 (p 2 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

Analysis ID: 02-4821-4436 **Endpoint:** Hatch **CETIS Version:** CETISv1.9.0
Analyzed: 16 Aug-17 9:59 **Analysis:** Parametric-Control vs Treatments **Official Results:** Yes

Angular (Corrected) Transformed Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|-------|-------|---------|--------|---------|
| 0 | N | 4 | 1.375 | 1.254 | 1.496 | | 1.31 | 1.441 | 0.03802 | 5.53% | 0.00% |
| 12.1 | | 4 | 1.347 | 1.16 | 1.535 | | 1.197 | 1.441 | 0.05894 | 8.75% | 2.05% |
| 16.5 | | 4 | 1.375 | 1.254 | 1.496 | | 1.31 | 1.441 | 0.03802 | 5.53% | 0.00% |
| 22.3 | | 4 | 1.441 | 1.441 | 1.442 | | 1.441 | 1.441 | 0 | 0.00% | -4.79% |
| 29.7 | | 4 | 1.441 | 1.441 | 1.442 | | 1.441 | 1.441 | 0 | 0.00% | -4.79% |
| 46.6 | | 4 | 1.408 | 1.304 | 1.513 | | 1.31 | 1.441 | 0.03292 | 4.68% | -2.39% |
| 85 | | 4 | 1.277 | 0.9556 | 1.598 | | 1.028 | 1.441 | 0.101 | 15.81% | 7.16% |
| 144 | | 4 | 1.38 | 1.186 | 1.575 | | 1.197 | 1.441 | 0.06108 | 8.85% | -0.35% |

Hatch Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|--------|--------|--------|--------|
| 0 | N | 1.0000 | 1.0000 | 0.9333 | 0.9333 |
| 12.1 | | 1.0000 | 0.8667 | 1.0000 | 0.9333 |
| 16.5 | | 0.9333 | 1.0000 | 1.0000 | 0.9333 |
| 22.3 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 29.7 | | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 46.6 | | 1.0000 | 0.9333 | 1.0000 | 1.0000 |
| 85 | | 0.7333 | 1.0000 | 0.8667 | 1.0000 |
| 144 | | 1.0000 | 1.0000 | 1.0000 | 0.8667 |

Angular (Corrected) Transformed Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | | | | |
| 12.1 | | | | | |
| 16.5 | | | | | |
| 22.3 | | | | | |
| 29.7 | | | | | |
| 46.6 | | | | | |
| 85 | | | | | |
| 144 | | | | | |

CETIS Analytical Report

Report Date: 16 Aug-17 10:08 (p 1 of 2)
 Test Code: SP1617-029 FM2 | 18-3772-6964

| Fathead Minnow 32-d Larval Survival and Growth Test | | | Nautilus Environmental Calgary | | |
|---|------------------------------|------------------------------|--------------------------------|--------------------------------------|-----------------------|
| Analysis ID: 11-7618-8288 | Endpoint: Mean Length-mm | CETIS Version: CETISv1.9.0 | Analized: 16 Aug-17 10:07 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek | Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: | Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental | Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | | Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Non-Linear Regression Options | | | | |
|--|--------------------|------------------|---------|---------|
| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
| 3P Cumulative Log-Normal: $\mu=\alpha \cdot [1 - \Phi[\log[x/\delta]/\gamma]]$ | Normal: $\omega=1$ | Off: $\mu^*=\mu$ | None | None |

| Regression Summary | | | | | | | | | |
|--------------------|--------|--------|-------|--------|----------|--------|----------|---------|-----------------------------|
| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
| 7 | 27.3 | -47.74 | -44.2 | 0.2721 | Yes | 1.809 | 2.621 | 0.1492 | Non-Significant Lack of Fit |

| Point Estimates | | | |
|-----------------|-------|---------|---------|
| Level | ug/L | 95% LCL | 95% UCL |
| IC5 | 45.32 | 20.67 | 79.44 |
| IC10 | 150.4 | 62.96 | 287.2 |
| IC15 | 337.7 | 63.9 | 986.5 |
| IC20 | 642.5 | 47.6 | 2858 |
| IC25 | 1116 | 28.71 | 7592 |
| IC40 | 4480 | n/a | 170500 |
| IC50 | 10340 | n/a | n/a |

| Regression Parameters | | | | | | | |
|-----------------------|----------|-----------|---------|---------|--------|----------|---------------------------|
| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
| α | 9.661 | 0.2154 | 9.22 | 10.1 | 44.85 | <1.0E-37 | Significant Parameter |
| γ | 3.301 | 1.566 | 0.09885 | 6.504 | 2.108 | 0.0438 | Significant Parameter |
| δ | 10340 | 20730 | -32060 | 52740 | 0.4988 | 0.6217 | Non-Significant Parameter |

| ANOVA Table | | | | | | |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
| Model | 2728 | 909.2 | 3 | 4685 | <1.0E-37 | Significant |
| Lack of Fit | 1.54 | 0.3081 | 5 | 1.809 | 0.1492 | Non-Significant |
| Pure Error | 4.088 | 0.1703 | 24 | | | |
| Residual | 5.628 | 0.1941 | 29 | | | |

| Residual Analysis | | | | | |
|-------------------|----------------------------------|-----------|----------|---------|--------------------------|
| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
| Extreme Value | Grubbs Extreme Value Test | 3.691 | 2.938 | 7.6E-04 | Outlier Detected |
| Variances | Mod Levene Equality of Variance | 1.794 | 2.423 | 0.1350 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.8643 | 0.9338 | 8.6E-04 | Non-Normal Distribution |
| | Anderson-Darling A2 Normality Te | 1.304 | 2.492 | 0.0018 | Non-Normal Distribution |

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

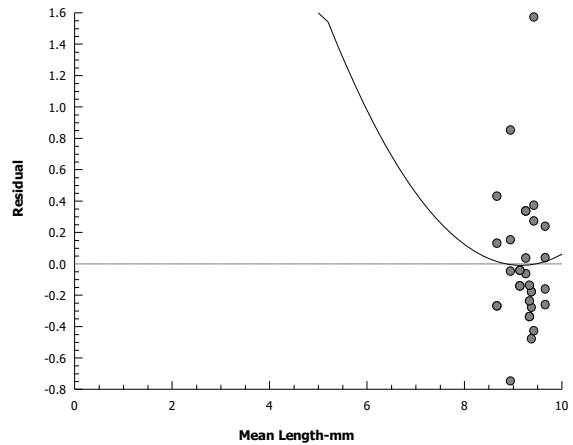
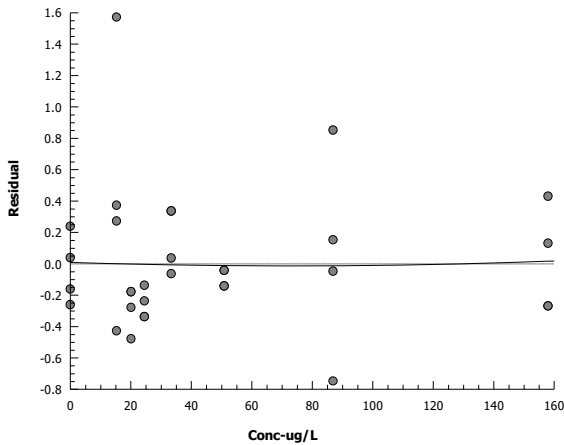
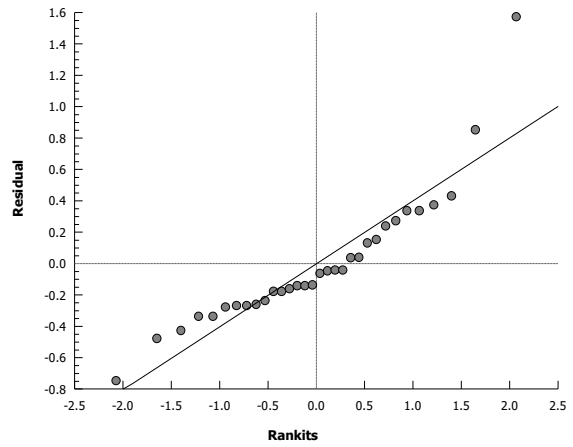
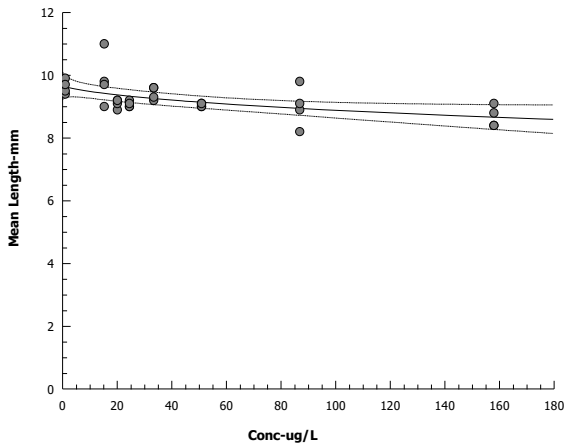
Analysis ID: 11-7618-8288 Endpoint: Mean Length-mm CETIS Version: CETISv1.9.0
 Analyzed: 16 Aug-17 10:07 Analysis: Nonlinear Regression (NLR) Official Results: Yes

| Mean Length-mm Summary | | | Calculated Variate | | | | | | |
|------------------------|------|-------|--------------------|-----|-----|---------|---------|-------|---------|
| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
| 0 | N | 4 | 9.625 | 9.4 | 9.9 | 0.1109 | 0.2217 | 2.30% | 0.00% |
| 15.3 | | 4 | 9.875 | 9 | 11 | 0.4151 | 0.8302 | 8.41% | -2.60% |
| 20.1 | | 4 | 9.1 | 8.9 | 9.2 | 0.07071 | 0.1414 | 1.55% | 5.45% |
| 24.5 | | 4 | 9.075 | 9 | 9.2 | 0.04787 | 0.09574 | 1.06% | 5.71% |
| 33.4 | | 4 | 9.425 | 9.2 | 9.6 | 0.1031 | 0.2062 | 2.19% | 2.08% |
| 50.9 | | 4 | 9.05 | 9 | 9.1 | 0.02886 | 0.05773 | 0.64% | 5.97% |
| 86.9 | | 4 | 9 | 8.2 | 9.8 | 0.3291 | 0.6583 | 7.31% | 6.49% |
| 158 | | 4 | 8.675 | 8.4 | 9.1 | 0.1702 | 0.3403 | 3.92% | 9.87% |

| Mean Length-mm Detail | | | | | |
|-----------------------|------|-------|-------|-------|-------|
| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
| 0 | N | 9.9 | 9.4 | 9.5 | 9.7 |
| 15.3 | | 11 | 9.8 | 9 | 9.7 |
| 20.1 | | 9.2 | 8.9 | 9.1 | 9.2 |
| 24.5 | | 9.2 | 9 | 9 | 9.1 |
| 33.4 | | 9.6 | 9.2 | 9.6 | 9.3 |
| 50.9 | | 9 | 9.1 | 9 | 9.1 |
| 86.9 | | 9.8 | 8.2 | 8.9 | 9.1 |
| 158 | | 8.8 | 8.4 | 8.4 | 9.1 |

Graphics Model: 3P Cumulative Log-Normal: $\mu = \alpha [1 - \Phi[\log(x/\delta)/\gamma]]$

Distribution: Normal [$\omega=1$]



CETIS Analytical Report

Report Date: 16 Aug-17 10:09 (p 1 of 2)
 Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 06-1813-2912 | Endpoint: Mean Length-mm | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 10:08 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: |
| Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|------|-------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 86.9 | 158 | 117.2 | | 7.52% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 15.3 | -0.8567 | 2.482 | 0.724 | 6 | CDF | 0.9850 | Non-Significant Effect |
| | | 20.1 | 1.799 | 2.482 | 0.724 | 6 | CDF | 0.1721 | Non-Significant Effect |
| | | 24.5 | 1.885 | 2.482 | 0.724 | 6 | CDF | 0.1498 | Non-Significant Effect |
| | | 33.4 | 0.6854 | 2.482 | 0.724 | 6 | CDF | 0.6270 | Non-Significant Effect |
| | | 50.9 | 1.97 | 2.482 | 0.724 | 6 | CDF | 0.1297 | Non-Significant Effect |
| | | 86.9 | 2.142 | 2.482 | 0.724 | 6 | CDF | 0.0959 | Non-Significant Effect |
| | | 158* | 3.255 | 2.482 | 0.724 | 6 | CDF | 0.0093 | Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.098 | 2.938 | 0.0239 | Outlier Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 4.17719 | 0.596741 | 7 | 3.504 | 0.0099 | Significant Effect |
| Error | 4.0875 | 0.170313 | 24 | | | |
| Total | 8.26469 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|-------------------------|
| Variances | Bartlett Equality of Variance Test | 25.82 | 18.48 | 5.4E-04 | Unequal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.8789 | 0.9081 | 0.0019 | Non-Normal Distribution |

Mean Length-mm Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|-----|-----|---------|-------|---------|
| 0 | N | 4 | 9.625 | 9.272 | 9.978 | | 9.4 | 9.9 | 0.1109 | 2.30% | 0.00% |
| 15.3 | | 4 | 9.875 | 8.554 | 11.2 | | 9 | 11 | 0.4151 | 8.41% | -2.60% |
| 20.1 | | 4 | 9.1 | 8.875 | 9.325 | | 8.9 | 9.2 | 0.07071 | 1.55% | 5.45% |
| 24.5 | | 4 | 9.075 | 8.923 | 9.227 | | 9 | 9.2 | 0.04787 | 1.06% | 5.71% |
| 33.4 | | 4 | 9.425 | 9.097 | 9.753 | | 9.2 | 9.6 | 0.1031 | 2.19% | 2.08% |
| 50.9 | | 4 | 9.05 | 8.958 | 9.142 | | 9 | 9.1 | 0.02886 | 0.64% | 5.97% |
| 86.9 | | 4 | 9 | 7.953 | 10.05 | | 8.2 | 9.8 | 0.3291 | 7.31% | 6.49% |
| 158 | | 4 | 8.675 | 8.133 | 9.217 | | 8.4 | 9.1 | 0.1702 | 3.92% | 9.87% |

CETIS Analytical Report

Report Date: 16 Aug-17 10:09 (p 2 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

Analysis ID: 06-1813-2912 Endpoint: Mean Length-mm CETIS Version: CETISv1.9.0
Analyzed: 16 Aug-17 10:08 Analysis: Parametric-Control vs Treatments Official Results: Yes

Mean Length-mm Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | 9.9 | 9.4 | 9.5 | 9.7 |
| 15.3 | | 11 | 9.8 | 9 | 9.7 |
| 20.1 | | 9.2 | 8.9 | 9.1 | 9.2 |
| 24.5 | | 9.2 | 9 | 9 | 9.1 |
| 33.4 | | 9.6 | 9.2 | 9.6 | 9.3 |
| 50.9 | | 9 | 9.1 | 9 | 9.1 |
| 86.9 | | 9.8 | 8.2 | 8.9 | 9.1 |
| 158 | | 8.8 | 8.4 | 8.4 | 9.1 |

CETIS Analytical Report

Report Date: 16 Aug-17 10:05 (p 1 of 2)
 Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 16-7017-8720 | Endpoint: Overall Survival | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 10:04 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: |
| Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 967869 | 200 | Yes | Two-Point Interpolation |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.986 | 2.938 | 0.0404 | Outlier Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| LC5 | 6.266 | n/a | n/a |
| LC10 | >158 | n/a | n/a |
| LC15 | >158 | n/a | n/a |
| LC20 | >158 | n/a | n/a |
| LC25 | >158 | n/a | n/a |
| LC40 | >158 | n/a | n/a |
| LC50 | >158 | n/a | n/a |

Overall Survival Summary

Calculated Variate(A/B)

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
|-----------|------|-------|--------|--------|--------|---------|---------|--------|---------|----|----|
| 0 | N | 4 | 0.9000 | 0.8667 | 0.9333 | 0.0193 | 0.0385 | 4.28% | 0.00% | 54 | 60 |
| 15.3 | | 4 | 0.7000 | 0.4000 | 1.0000 | 0.1232 | 0.2465 | 35.21% | 22.22% | 42 | 60 |
| 20.1 | | 4 | 0.8667 | 0.8000 | 0.9333 | 0.0272 | 0.0544 | 6.28% | 3.70% | 52 | 60 |
| 24.5 | | 4 | 0.8833 | 0.8000 | 0.9333 | 0.0319 | 0.0638 | 7.23% | 1.85% | 53 | 60 |
| 33.4 | | 4 | 0.8500 | 0.6667 | 1.0000 | 0.0687 | 0.1374 | 16.17% | 5.56% | 51 | 60 |
| 50.9 | | 4 | 0.8833 | 0.8667 | 0.9333 | 0.0167 | 0.0333 | 3.77% | 1.85% | 53 | 60 |
| 86.9 | | 4 | 0.7500 | 0.5333 | 0.8667 | 0.0739 | 0.1478 | 19.71% | 16.67% | 45 | 60 |
| 158 | | 4 | 0.9000 | 0.8000 | 0.9333 | 0.0333 | 0.0667 | 7.41% | 0.00% | 54 | 60 |

Overall Survival

| Detail Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|------------------|------|--------|--------|--------|--------|
| 0 | N | 0.8667 | 0.9333 | 0.8667 | 0.9333 |
| 15.3 | | 0.4000 | 0.7333 | 1.0000 | 0.6667 |
| 20.1 | | 0.8667 | 0.8667 | 0.8000 | 0.9333 |
| 24.5 | | 0.8000 | 0.9333 | 0.9333 | 0.8667 |
| 33.4 | | 0.6667 | 0.8667 | 0.8667 | 1.0000 |
| 50.9 | | 0.8667 | 0.8667 | 0.9333 | 0.8667 |
| 86.9 | | 0.5333 | 0.8000 | 0.8000 | 0.8667 |
| 158 | | 0.9333 | 0.9333 | 0.9333 | 0.8000 |

CETIS Analytical Report

Report Date: 16 Aug-17 10:05 (p 2 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

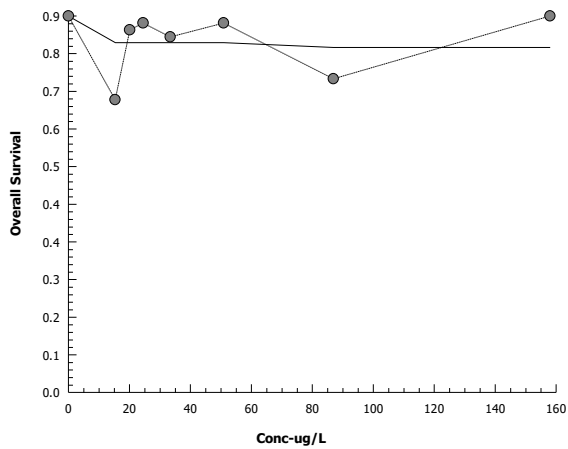
Analysis ID: 16-7017-8720 Endpoint: Overall Survival
Analyzed: 16 Aug-17 10:04 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
Official Results: Yes

Overall Survival Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | 13/15 | 14/15 | 13/15 | 14/15 |
| 15.3 | | 6/15 | 11/15 | 15/15 | 10/15 |
| 20.1 | | 13/15 | 13/15 | 12/15 | 14/15 |
| 24.5 | | 12/15 | 14/15 | 14/15 | 13/15 |
| 33.4 | | 10/15 | 13/15 | 13/15 | 15/15 |
| 50.9 | | 13/15 | 13/15 | 14/15 | 13/15 |
| 86.9 | | 8/15 | 12/15 | 12/15 | 13/15 |
| 158 | | 14/15 | 14/15 | 14/15 | 12/15 |

Graphics



CETIS Analytical Report

Report Date: 04 Oct-17 11:11 (p 1 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 15-3113-0393 | Endpoint: Overall Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 04 Oct-17 11:10 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: |
| Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|---------------------|---------|--------|------|-------|------|-------|------|----|-------|
| Angular (Corrected) | C > T | n/a | n/a | n/a | 158 | > 158 | n/a | | 23.7% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 15.3 | 2.028 | 2.482 | 0.277 | 6 | CDF | 0.1175 | Non-Significant Effect |
| | | 20.1 | 0.4543 | 2.482 | 0.277 | 6 | CDF | 0.7261 | Non-Significant Effect |
| | | 24.5 | 0.2016 | 2.482 | 0.277 | 6 | CDF | 0.8176 | Non-Significant Effect |
| | | 33.4 | 0.4995 | 2.482 | 0.277 | 6 | CDF | 0.7076 | Non-Significant Effect |
| | | 50.9 | 0.2527 | 2.482 | 0.277 | 6 | CDF | 0.8008 | Non-Significant Effect |
| | | 86.9 | 1.757 | 2.482 | 0.277 | 6 | CDF | 0.1838 | Non-Significant Effect |
| | | 158 | -0.05111 | 2.482 | 0.277 | 6 | CDF | 0.8873 | Non-Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.986 | 2.938 | 0.0404 | Outlier Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 0.221379 | 0.0316256 | 7 | 1.274 | 0.3045 | Non-Significant Effect |
| Error | 0.595915 | 0.0248298 | 24 | | | |
| Total | 0.817295 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 13.39 | 18.48 | 0.0631 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9322 | 0.9081 | 0.0452 | Normal Distribution |

Overall Survival Rate Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 0 | N | 4 | 0.9000 | 0.8388 | 0.9612 | | 0.8667 | 0.9333 | 0.0193 | 4.28% | 0.00% |
| 15.3 | | 4 | 0.7000 | 0.3078 | 1.0000 | | 0.4000 | 1.0000 | 0.1232 | 35.21% | 22.22% |
| 20.1 | | 4 | 0.8667 | 0.7801 | 0.9533 | | 0.8000 | 0.9333 | 0.0272 | 6.28% | 3.70% |
| 24.5 | | 4 | 0.8833 | 0.7818 | 0.9849 | | 0.8000 | 0.9333 | 0.0319 | 7.23% | 1.85% |
| 33.4 | | 4 | 0.8500 | 0.6313 | 1.0000 | | 0.6667 | 1.0000 | 0.0687 | 16.17% | 5.56% |
| 50.9 | | 4 | 0.8833 | 0.8303 | 0.9364 | | 0.8667 | 0.9333 | 0.0167 | 3.77% | 1.85% |
| 86.9 | | 4 | 0.7500 | 0.5148 | 0.9852 | | 0.5333 | 0.8667 | 0.0739 | 19.71% | 16.67% |
| 158 | | 4 | 0.9000 | 0.7939 | 1.0000 | | 0.8000 | 0.9333 | 0.0333 | 7.41% | 0.00% |

CETIS Analytical Report

Report Date: 04 Oct-17 11:11 (p 2 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

Analysis ID: 15-3113-0393 **Endpoint:** Overall Survival Rate **CETIS Version:** CETISv1.9.0
Analyzed: 04 Oct-17 11:10 **Analysis:** Parametric-Control vs Treatments **Official Results:** Yes

Angular (Corrected) Transformed Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|--------|-------|---------|--------|---------|
| 0 | N | 4 | 1.253 | 1.15 | 1.357 | | 1.197 | 1.31 | 0.03251 | 5.19% | 0.00% |
| 15.3 | | 4 | 1.027 | 0.5293 | 1.525 | | 0.6847 | 1.441 | 0.1565 | 30.47% | 18.03% |
| 20.1 | | 4 | 1.203 | 1.071 | 1.335 | | 1.107 | 1.31 | 0.04146 | 6.90% | 4.04% |
| 24.5 | | 4 | 1.231 | 1.075 | 1.387 | | 1.107 | 1.31 | 0.04904 | 7.97% | 1.79% |
| 33.4 | | 4 | 1.198 | 0.8819 | 1.513 | | 0.9553 | 1.441 | 0.09921 | 16.57% | 4.44% |
| 50.9 | | 4 | 1.225 | 1.136 | 1.315 | | 1.197 | 1.31 | 0.02816 | 4.60% | 2.25% |
| 86.9 | | 4 | 1.058 | 0.7954 | 1.32 | | 0.8188 | 1.197 | 0.08236 | 15.58% | 15.62% |
| 158 | | 4 | 1.259 | 1.098 | 1.42 | | 1.107 | 1.31 | 0.05062 | 8.04% | -0.45% |

Overall Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|--------|--------|--------|--------|
| 0 | N | 0.8667 | 0.9333 | 0.8667 | 0.9333 |
| 15.3 | | 0.4000 | 0.7333 | 1.0000 | 0.6667 |
| 20.1 | | 0.8667 | 0.8667 | 0.8000 | 0.9333 |
| 24.5 | | 0.8000 | 0.9333 | 0.9333 | 0.8667 |
| 33.4 | | 0.6667 | 0.8667 | 0.8667 | 1.0000 |
| 50.9 | | 0.8667 | 0.8667 | 0.9333 | 0.8667 |
| 86.9 | | 0.5333 | 0.8000 | 0.8000 | 0.8667 |
| 158 | | 0.9333 | 0.9333 | 0.9333 | 0.8000 |

Angular (Corrected) Transformed Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | | | | |
| 15.3 | | | | | |
| 20.1 | | | | | |
| 24.5 | | | | | |
| 33.4 | | | | | |
| 50.9 | | | | | |
| 86.9 | | | | | |
| 158 | | | | | |

CETIS Analytical Report

Report Date: 16 Aug-17 10:02 (p 1 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 03-1952-4791 | Endpoint: Post Hatch Survival | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 10:01 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: |
| Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|---------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 1995805 | 200 | Yes | Two-Point Interpolation |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.835 | 2.938 | 0.0777 | No Outliers Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| LC5 | 5.452 | n/a | n/a |
| LC10 | >158 | n/a | n/a |
| LC15 | >158 | n/a | n/a |
| LC20 | >158 | n/a | n/a |
| LC25 | >158 | n/a | n/a |
| LC40 | >158 | n/a | n/a |
| LC50 | >158 | n/a | n/a |

Post Hatch Survival Summary

Calculated Variate(A/B)

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
|-----------|------|-------|--------|--------|--------|---------|---------|--------|---------|----|----|
| 0 | N | 4 | 0.9321 | 0.8667 | 1.0000 | 0.0272 | 0.0545 | 5.85% | 0.00% | 54 | 58 |
| 15.3 | | 4 | 0.7401 | 0.4000 | 1.0000 | 0.1275 | 0.2550 | 34.46% | 20.60% | 42 | 57 |
| 20.1 | | 4 | 0.8988 | 0.8000 | 1.0000 | 0.0427 | 0.0855 | 9.51% | 3.58% | 52 | 58 |
| 24.5 | | 4 | 0.8833 | 0.8000 | 0.9333 | 0.0319 | 0.0638 | 7.23% | 5.24% | 53 | 60 |
| 33.4 | | 4 | 0.8500 | 0.6667 | 1.0000 | 0.0687 | 0.1374 | 16.17% | 8.81% | 51 | 60 |
| 50.9 | | 4 | 0.8988 | 0.8667 | 0.9333 | 0.0186 | 0.0372 | 4.14% | 3.58% | 53 | 59 |
| 86.9 | | 4 | 0.8293 | 0.7273 | 0.9231 | 0.0423 | 0.0846 | 10.20% | 11.04% | 45 | 54 |
| 158 | | 4 | 0.9308 | 0.9231 | 0.9333 | 0.0026 | 0.0051 | 0.55% | 0.15% | 54 | 58 |

Post Hatch Survival

| Detail Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|------------------|------|--------|--------|--------|--------|
| 0 | N | 0.8667 | 0.9333 | 0.9286 | 1.0000 |
| 15.3 | | 0.4000 | 0.8462 | 1.0000 | 0.7143 |
| 20.1 | | 0.9286 | 0.8667 | 0.8000 | 1.0000 |
| 24.5 | | 0.8000 | 0.9333 | 0.9333 | 0.8667 |
| 33.4 | | 0.6667 | 0.8667 | 0.8667 | 1.0000 |
| 50.9 | | 0.8667 | 0.9286 | 0.9333 | 0.8667 |
| 86.9 | | 0.7273 | 0.8000 | 0.9231 | 0.8667 |
| 158 | | 0.9333 | 0.9333 | 0.9333 | 0.9231 |

CETIS Analytical Report

Report Date: 16 Aug-17 10:02 (p 2 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

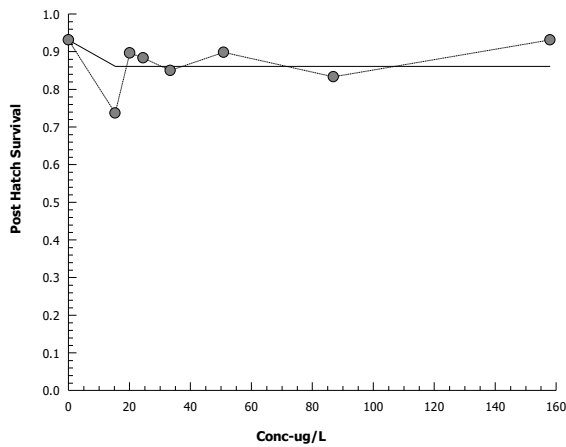
Analysis ID: 03-1952-4791 Endpoint: Post Hatch Survival
Analyzed: 16 Aug-17 10:01 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
Official Results: Yes

Post Hatch Survival Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | 13/15 | 14/15 | 13/14 | 14/14 |
| 15.3 | | 6/15 | 11/13 | 15/15 | 10/14 |
| 20.1 | | 13/14 | 13/15 | 12/15 | 14/14 |
| 24.5 | | 12/15 | 14/15 | 14/15 | 13/15 |
| 33.4 | | 10/15 | 13/15 | 13/15 | 15/15 |
| 50.9 | | 13/15 | 13/14 | 14/15 | 13/15 |
| 86.9 | | 8/11 | 12/15 | 12/13 | 13/15 |
| 158 | | 14/15 | 14/15 | 14/15 | 12/13 |

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 10:02 (p 1 of 2)
 Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 06-3044-8082 | Endpoint: Post Hatch Survival | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 10:02 | Analysis: Parametric-Control vs Ord.Treatments | Official Results: Yes |
| Batch ID: 20-1684-1453 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: Not Applicable | Diluent: |
| Ending Date: 26 Jun-17 | Species: Pimephales promelas | Brine: |
| Duration: 32d 0h | Source: Aquatox, AR | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|---------------------|---------|--------|------|-------|------|-------|------|----|-------|
| Angular (Corrected) | C > T | n/a | n/a | n/a | 158 | > 158 | n/a | | 14.2% |

Williams Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 15.3 | 2.13 | 1.711 | 0.189 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 20.1 | 1.294 | 1.791 | 0.198 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 24.5 | 1.104 | 1.818 | 0.201 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 33.4 | 1.084 | 1.83 | 0.203 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 50.9 | 0.9752 | 1.838 | 0.203 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 86.9 | 1.42 | 1.843 | 0.204 | 6 | CDF | >0.05 | Non-Significant Effect |
| | | 158 | 0.9074 | 1.846 | 0.204 | 6 | CDF | >0.05 | Non-Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.835 | 2.938 | 0.0777 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 0.175675 | 0.0250964 | 7 | 1.024 | 0.4398 | Non-Significant Effect |
| Error | 0.587932 | 0.0244972 | 24 | | | |
| Total | 0.763607 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 21.72 | 18.48 | 0.0028 | Unequal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9564 | 0.9081 | 0.2179 | Normal Distribution |

Post Hatch Survival Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 0 | N | 4 | 0.9321 | 0.8454 | 1.0000 | | 0.8667 | 1.0000 | 0.0272 | 5.85% | 0.00% |
| 15.3 | | 4 | 0.7401 | 0.3343 | 1.0000 | | 0.4000 | 1.0000 | 0.1275 | 34.46% | 20.60% |
| 20.1 | | 4 | 0.8988 | 0.7628 | 1.0000 | | 0.8000 | 1.0000 | 0.0427 | 9.51% | 3.58% |
| 24.5 | | 4 | 0.8833 | 0.7818 | 0.9849 | | 0.8000 | 0.9333 | 0.0319 | 7.23% | 5.24% |
| 33.4 | | 4 | 0.8500 | 0.6313 | 1.0000 | | 0.6667 | 1.0000 | 0.0687 | 16.17% | 8.81% |
| 50.9 | | 4 | 0.8988 | 0.8397 | 0.9579 | | 0.8667 | 0.9333 | 0.0186 | 4.14% | 3.58% |
| 86.9 | | 4 | 0.8293 | 0.6947 | 0.9638 | | 0.7273 | 0.9231 | 0.0423 | 10.20% | 11.04% |
| 158 | | 4 | 0.9308 | 0.9226 | 0.9389 | | 0.9231 | 0.9333 | 0.0026 | 0.55% | 0.15% |

CETIS Analytical Report

Report Date: 16 Aug-17 10:02 (p 2 of 2)
Test Code: SP1617-029 FM2 | 18-3772-6964

Fathead Minnow 32-d Larval Survival and Growth Test

Nautilus Environmental Calgary

Analysis ID: 06-3044-8082 **Endpoint:** Post Hatch Survival **CETIS Version:** CETISv1.9.0
Analyzed: 16 Aug-17 10:02 **Analysis:** Parametric-Control vs Ord.Treatments **Official Results:** Yes

Angular (Corrected) Transformed Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|--------|-------|---------|--------|---------|
| 0 | N | 4 | 1.311 | 1.155 | 1.467 | | 1.197 | 1.437 | 0.0491 | 7.49% | 0.00% |
| 15.3 | | 4 | 1.075 | 0.5722 | 1.578 | | 0.6847 | 1.441 | 0.1581 | 29.40% | 17.98% |
| 20.1 | | 4 | 1.26 | 1.035 | 1.486 | | 1.107 | 1.437 | 0.07083 | 11.24% | 3.86% |
| 24.5 | | 4 | 1.231 | 1.075 | 1.387 | | 1.107 | 1.31 | 0.04904 | 7.97% | 6.11% |
| 33.4 | | 4 | 1.198 | 0.8819 | 1.513 | | 0.9553 | 1.441 | 0.09921 | 16.57% | 8.64% |
| 50.9 | | 4 | 1.251 | 1.152 | 1.35 | | 1.197 | 1.31 | 0.03122 | 4.99% | 4.57% |
| 86.9 | | 4 | 1.154 | 0.9699 | 1.338 | | 1.021 | 1.29 | 0.05779 | 10.02% | 11.98% |
| 158 | | 4 | 1.305 | 1.289 | 1.32 | | 1.29 | 1.31 | 0.00497 | 0.76% | 0.48% |

Post Hatch Survival Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|--------|--------|--------|--------|
| 0 | N | 0.8667 | 0.9333 | 0.9286 | 1.0000 |
| 15.3 | | 0.4000 | 0.8462 | 1.0000 | 0.7143 |
| 20.1 | | 0.9286 | 0.8667 | 0.8000 | 1.0000 |
| 24.5 | | 0.8000 | 0.9333 | 0.9333 | 0.8667 |
| 33.4 | | 0.6667 | 0.8667 | 0.8667 | 1.0000 |
| 50.9 | | 0.8667 | 0.9286 | 0.9333 | 0.8667 |
| 86.9 | | 0.7273 | 0.8000 | 0.9231 | 0.8667 |
| 158 | | 0.9333 | 0.9333 | 0.9333 | 0.9231 |

Angular (Corrected) Transformed Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | | | | |
| 15.3 | | | | | |
| 20.1 | | | | | |
| 24.5 | | | | | |
| 33.4 | | | | | |
| 50.9 | | | | | |
| 86.9 | | | | | |
| 158 | | | | | |

APPENDIX D – *Hyalella azteca* Toxicity Test Data

Hyalella Bench Sheet

Method 42-d HA Client MIN100 Sample **SP1617029**

Test Log

| Date | Day | Time | Technicians | Temp (°C)* | Chem Cart Used | Fed | Feeding Rate (per replicate) | | Y&T Expiry Date | Bench Sheet Review | |
|------------|-----|------|-------------|------------|----------------|-----|------------------------------|----------|-----------------|--------------------|--------|
| | | | | | | | YAT | Tetramin | | First | Second |
| 2017/05/25 | 0 | 1000 | NM/JN | 22 | 3 | ✓ | 1 mL | 0.25 mg | 06/11/25 | JN | JW |
| 2017/05/26 | 1 | 1000 | NM | 23 | 3 | ✓ | 1 mL | 0.25 mg | 06/11/25 | JN | JW |
| 2017/05/27 | 2 | 1300 | NM | 23 | 3 | ✓ | 1 mL | 0.25 mg | 06/12/25 | JN | LC |
| 2017/05/28 | 3 | 1210 | NM | 23 | 3 | ✓ | 1 mL | 0.25 mg | 06/12/25 | NM | SS |
| 2017/05/29 | 4 | 1130 | NM | 23 | 3 | ✓ | 1 mL | 0.25 mg | 06/12/25 | JW | SS |
| 2017/05/30 | 5 | 0930 | NM | 23 | 3 | ✓ | 1 mL | 0.25 mg | 06/12/25 | SS | EP |
| 2017/05/31 | 6 | 1550 | NM/EP | 23 | 3 | ✓ | 1 mL | 0.25 mg | 06/25 | EP | JW |
| 2017/06/01 | 7 | 1200 | EP | 23 | 3 | ✓ | 1 mL | 0.5 mg | 06/25 | JW | LC |
| 2017/06/02 | 8 | 1345 | EP | 23 | 3 | ✓ | 1 mL | 0.5 mg | 06/31 | EP | EP |
| 2017/06/03 | 9 | 0930 | SS | 23 | 3 | ✓ | 1 mL | 0.5 mg | 06/31 | LC | EP |
| 2017/06/04 | 10 | 1400 | NM | 23 | 3 | ✓ | 1 mL | 0.5 mg | 06/31 | JW | NM |
| 2017/06/05 | 11 | 1200 | NM | 23 | 3 | ✓ | 1 mL | 0.5 mg | 06/31 | JW | EP |
| 2017/06/06 | 12 | 1300 | EP | 23 | 3 | ✓ | 1 mL | 0.5 mg | 06/31 | JW | EP |
| 2017/06/07 | 13 | 1100 | SS | 23 | 3 | ✓ | 1 mL | 0.5 mg | 06/31 | LC | JW |
| 2017/06/08 | 14 | 1400 | NM/HS | 24 | 3 | ✓ | 1 mL | 1.0 mg | 06/31 | HS | SS |
| 2017/06/09 | 15 | 1230 | EP | 24 | 3 | ✓ | 1 mL | 1.0 mg | 06/31 | LC | SS |
| 2017/06/10 | 16 | 1400 | HS | 24 | 3 | ✓ | 1 mL | 1.0 mg | 06/31 | LC | HS |
| 2017/06/11 | 17 | 1500 | NM | 23 | 3 | ✓ | 1 mL | 1.0 mg | 06/31 | SS | SS |
| 2017/06/12 | 18 | 1130 | HS | 23 | 3 | ✓ | 1 mL | 1.0 mg | 06/31 | HS | SS |
| 2017/06/13 | 19 | 1430 | NM | 23 | 3 | ✓ | 1 mL | 1.0 mg | 06/31 | NM | HS |
| 2017/06/14 | 20 | 1400 | NM | 23 | 3 | ✓ | 1 mL | 1.0 mg | 06/31 | JW | HS |
| 2017/06/15 | 21 | 1100 | JW | 23 | 3 | ✓ | 1 mL | 1.5 mg | 06/31 | JW | EP |
| 2017/06/16 | 22 | 1345 | EP | 23 | 3 | ✓ | 1 mL | 1.5 mg | 06/31 | JW | EP |
| 2017/06/17 | 23 | 1300 | JW | 23 | 3 | ✓ | 1 mL | 1.5 mg | 06/31 | JW | LC |
| 2017/06/18 | 24 | 1600 | NM | 23 | 3 | ✓ | 1 mL | 1.5 mg | 06/31 | NM | SS |
| 2017/06/19 | 25 | 1550 | NM | 23 | 3 | ✓ | 1 mL | 1.5 mg | 06/31 | JW | NM |
| 2017/06/20 | 26 | 1545 | SS | 23 | 3 | ✓ | 1 mL | 1.5 mg | 06/31 | JW | EP |
| 2017/06/21 | 27 | 1310 | SS | 23 | 3 | ✓ | 1 mL | 1.5 mg | 06/31 | JW | HS |
| 2017/06/22 | 28 | 1115 | NM | 23 | 3 | ✓ | 1 mL | 2.0 mg | 06/31 | HS | EP |
| 2017/06/23 | 29 | 1570 | EP | 23 | 3 | ✓ | 1 mL | 2.0 mg | 06/31 | HS | EP |
| 2017/06/24 | 30 | 1045 | EP | 23 | 3 | ✓ | 1 mL | 2.0 mg | 06/31 | LC | EP |
| 2017/06/25 | 31 | 1350 | HS | 23 | 3 | ✓ | 1 mL | 2.0 mg | 06/31 | HS | EP |
| 2017/06/26 | 32 | 1130 | EP | 23 | 3 | ✓ | 1 mL | 2.0 mg | 06/31 | JW | LC |
| 2017/06/27 | 33 | 0930 | JW | 23 | 3 | ✓ | 1 mL | 2.0 mg | 07/14 | JW | LC |
| 2017/06/28 | 34 | 1030 | SS | 23 | 3 | ✓ | 1 mL | 2.0 mg | 07/14 | HS | EP |
| 2017/06/29 | 35 | 1100 | HS/EP | 23 | 3 | ✓ | 1 mL | 2.5 mg | 07/14 | HS | EP |
| 2017/06/30 | 36 | 1230 | EP | 23 | 3 | ✓ | 1 mL | 2.5 mg | 07/14 | LC | EP |
| 2017/07/01 | 37 | 1200 | HS | 23 | 3 | ✓ | 1 mL | 2.5 mg | 07/14 | HS | SS |
| 2017/07/02 | 38 | 1300 | NM | 23 | 3 | ✓ | 1 mL | 2.5 mg | 07/14 | JW | NM |
| 2017/07/03 | 39 | 1300 | JW | 23 | 3 | ✓ | 1 mL | 2.5 mg | 07/14 | JW | LC |
| 2017/07/04 | 40 | 1300 | F | 23 | 3 | ✓ | 1 mL | 2.5 mg | 07/14 | JW | LC |
| 2017/07/05 | 41 | 0930 | NM | 24 | 3 | ✓ | 1 mL | 2.5 mg | 07/14 | HS | EP |
| 2017/07/06 | 42 | 0800 | HS/LC | 24 | 3 | ✓ | 1 mL | 2.5 mg | 07/14 | HS | LC |

*23 ± 1°C (23 ± 3°C instantaneous)

Bolded days are to be scored for survival and/or reproduction

Comments:

- Feed +.95 mL per Jar from ^{NM} 06/11 + 06/25 yct. (Taw from undiluted bottle)
0.97 mL
- Feeding calculated as the same for 06/31 batch 2017/06/01 sp

Hyaella Bench Sheet

Method 42-d HA

Client MINICO Sample SP1617-029

Biology (# of surviving organisms, young produced - day 35)

| dose (ug/L) replicate | Lab | Site | 5 | 10 | 20 | 40 | 80 | 160 | Lab | Site | 5 | 10 | 20 | 40 | 80 | 160 |
|--------------------------|-------------------------------|------|----|----|----|----|----|-----|-------------------------------|------|----|----|----|----|----|-----|
| | CTL | CTL | | | | | | | CTL | CTL | | | | | | |
| | ***day 35 - adult survival*** | | | | | | | | ***day 35 - young produced*** | | | | | | | |
| a | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 13 | 10 | 26 | 3 | 7 | 9 | 0 | 3 |
| b | 8 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 7 | 7 | 8 | 5 | 7 | 10 | 5 | 0 |
| c | 9 | 10 | 8 | 10 | 9 | 7 | 10 | 8 | 6 | 7 | 7 | 4 | 8 | 10 | 4 | 0 |
| d | 10 | 10 | 9 | 10 | 7 | 9 | 10 | 8 | 6 | 12 | 11 | 3 | 9 | 9 | 0 | 0 |
| e | 9 | 10 | 9 | 10 | 8 | 10 | 10 | 8 | 4 | 4 | 17 | 7 | 2 | 10 | 3 | 0 |
| f | 9 | 10 | 8 | 9 | 9 | 9 | 10 | 8 | 3 | 0 | 8 | 0 | 7 | 9 | 3 | 0 |
| g | 10 | 8 | 9 | 9 | 8 | 10 | 10 | 9 | 4 | 4 | 4 | 5 | 7 | 10 | 2 | 10 |
| h | 10 | 9 | 10 | 8 | 8 | 10 | 10 | 10 | 5 | 7 | 0 | 3 | 7 | 10 | 0 | 0 |

4
0
0
0
0
0
0
0

Day 35 - Remove young from the replicates and place the adults back into their appropriate replicate

Biology (# of surviving organisms, young produced - day 42)

| replicate | ***day 42 - adult survival*** | | | | | | | | **day 42 - number of males** | | | | | | | |
|-----------|-------------------------------|----|----|----|----|----|----|----|------------------------------|---|---|---|---|---|---|---|
| | a | 8 | 9 | 7 | 8 | 9 | 9 | 9 | 8 | 4 | 3 | 3 | 4 | 3 | 5 | 3 |
| b | 7 | 8 | 10 | 10 | 10 | 9 | 10 | 6 | 5 | 5 | 3 | 6 | 3 | 4 | 3 | 2 |
| c | 9 | 7 | 7 | 9 | 7 | 8 | 8 | 8 | 4 | 4 | 2 | 3 | 2 | 4 | 7 | 1 |
| d | 9 | 10 | 9 | 10 | 7 | 9 | 8 | 6 | 6 | 3 | 4 | 4 | 2 | 2 | 3 | 6 |
| e | 8 | 10 | 9 | 7 | 8 | 10 | 9 | 7 | 4 | 4 | 4 | 2 | 3 | 2 | 3 | 3 |
| f | 9 | 8 | 8 | 7 | 7 | 9 | 9 | 7 | 5 | 4 | 4 | 3 | 4 | 5 | 4 | 1 |
| g | 10 | 8 | 9 | 9 | 8 | 10 | 10 | 9 | 4 | 4 | 4 | 4 | 5 | 3 | 2 | 3 |
| h | 10 | 9 | 9 | 6 | 8 | 10 | 10 | 10 | 4 | 2 | 7 | 3 | 5 | 4 | 4 | 3 |
| | ***day 42 - young produced*** | | | | | | | | | | | | | | | |
| a | 105 | 21 | 67 | 16 | 55 | 7 | 82 | 3 | | | | | | | | |
| b | 36 | 14 | 68 | 7 | 33 | 17 | 51 | 0 | | | | | | | | |
| c | 47 | 17 | 27 | 22 | 18 | 35 | 0 | 0 | | | | | | | | |
| d | 41 | 78 | 48 | 24 | 22 | 20 | 11 | 0 | | | | | | | | |
| e | 33 | 21 | 36 | 15 | 25 | 35 | 0 | 0 | | | | | | | | |
| f | 42 | 24 | 24 | 0 | 21 | 18 | 0 | 8 | | | | | | | | |
| g | 62 | 26 | 46 | 18 | 20 | 19 | 12 | 0 | | | | | | | | |
| h | 43 | 22 | 11 | 10 | 23 | 13 | 6 | 0 | | | | | | | | |

Day 42 - Place all adult HA into pre-weighed weigh boats to determine growth

Comments:

Hyaella Bench Sheet

Method 42-d HA

Client MINCO Sample # SP1617-029

Culture Information:

Organism Batch: 20170523 HA
Source: CHESAPEAKE CULTURES
Age: 4-5 Day old

Culture Acclimation Mortality (%): ~~11~~ 0%

Lab Control Water Preparation Date(s):
2017/05/23 HS
2017/05/30 NM

Comments:

Hyalella Bench Sheet

Method 42-d HA

Client MINICO Sample SP1617-029
Biology (# of surviving organisms)

| dose (ug/L) | Lab CTL | Site CTL | 5 | 10 | 20 | 40 | 80 | 160 |
|-------------|---------|----------|----|----|----|----|----|-----|
| replicate | day 0 | | | | | | | |
| a | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| b | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| c | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| d | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| e | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| f | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| g | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| h | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| i | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| j | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| k | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| l | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |

| Lab CTL | Site CTL | 5 | 10 | 20 | 40 | 80 | 160 |
|---------|----------|----|----|----|----|----|-----|
| day 21 | | | | | | | |
| 10 | 9 | 9 | 10 | 9 | 9 | 10 | 9 |
| 9 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 9 | 10 | 10 | 9 | 7 | 10 | 9 | 9 |
| 10* | 10 | 10 | 10 | 7 | 9 | 10 | 9 |
| 10 | 10 | 9 | 10 | 9 | 10 | 10 | 8 |
| 9 | 10 | 8 | 9 | 10 | 10 | 10 | 8 |
| 10 | 10 | 9 | 9 | 10 | 10 | 10 | 9 |
| 10 | 9 | 10 | 8 | 9 | 10 | 10 | 10 |
| 8 | 10 | 10 | 10 | 9 | 10 | 10 | 9 |
| 10 | 10 | 10 | 9 | 10 | 10 | 10 | 9 |
| 10 | 10 | 9 | 9 | 10 | 9 | 10 | 10 |
| 9 | 10 | 10 | 9 | 9 | 10 | 9 | 8 |

| replicate | 5 | 10 | 20 | 40 | 80 | 160 |
|-----------|----|----|----|----|----|-----|
| day 7 | | | | | | |
| a | 10 | 10 | 10 | 10 | 10 | 10 |
| b | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| c | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| d | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| e | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| f | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| g | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| h | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| i | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| j | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| k | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| l | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |

| Lab CTL | Site CTL | 5 | 10 | 20 | 40 | 80 | 160 |
|---------|----------|----|----|----|----|----|-----|
| day 28 | | | | | | | |
| 9 | 9 | 9 | 9 | 9 | 9 | 10 | 8 |
| 9 | 10 | 10 | 10 | 10 | 10 | 10 | 9 |
| 9 | 10 | 10 | 9 | 7 | 10 | 9 | 9 |
| 10 | 10 | 10 | 10 | 7 | 9 | 10 | 9 |
| 10 | 10 | 9 | 10 | 9 | 10 | 10 | 8 |
| 9 | 10 | 8 | 9 | 10 | 10 | 10 | 8 |
| 10 | 8 | 9 | 9 | 8 | 10 | 10 | 8 |
| 10 | 9 | 10 | 8 | 8 | 10 | 10 | 10 |
| 8 | 10 | 10 | 10 | 10 | 10 | 10 | 8 |
| 10 | 10 | 8 | 9 | 10 | 10 | 9 | 8 |
| 10 | 10 | 9 | 9 | 10 | 9 | 10 | 10 |
| 9 | 8 | 10 | 8 | 9 | 9 | 9 | 7 |

| replicate | 5 | 10 | 20 | 40 | 80 | 160 |
|-----------|----|----|----|----|----|-----|
| day 14 | | | | | | |
| a | 10 | 10 | 10 | 10 | 10 | 10 |
| b | 10 | 10 | 10 | 10 | 10 | 10 |
| c | 10 | 10 | 10 | 10 | 10 | 10 |
| d | 10 | 10 | 10 | 10 | 10 | 10 |
| e | 10 | 10 | 10 | 10 | 10 | 10 |
| f | 10 | 10 | 10 | 10 | 10 | 10 |
| g | 10 | 10 | 10 | 10 | 10 | 10 |
| h | 10 | 10 | 10 | 10 | 10 | 10 |
| i | 9 | 10 | 10 | 10 | 10 | 10 |
| j | 10 | 10 | 10 | 10 | 10 | 10 |
| k | 10 | 10 | 10 | 10 | 10 | 10 |
| l | 10 | 10 | 10 | 10 | 10 | 10 |

Day 28 - Place HA from replicates l, j, k, l into pre-weighed weigh dishes to determine growth

Comments:

Organism Weights Bench Sheet

Client MIN100 Sample SP1617-029 Organism HAZ - 28d

Initial Weight (mg) (dried pan)

Date: 2017/06/20 Initials: DM Balance*: Nutcher #1

| | | | | | | | |
|-------|------------|----------|-----------|-----------|-----------|-----------|------------|
| Conc. | <u>CTL</u> | <u>5</u> | <u>10</u> | <u>20</u> | <u>40</u> | <u>80</u> | <u>160</u> |
|-------|------------|----------|-----------|-----------|-----------|-----------|------------|

| | | | | | | | | |
|-------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Replicate | | | | | | | | |
| I <u>DM</u> | <u>416.70</u> | <u>411.61</u> | <u>421.12</u> | <u>414.41</u> | <u>415.07</u> | <u>421.57</u> | <u>418.30</u> | <u>408.33</u> |
| J <u>DM</u> | <u>412.43</u> | <u>409.81</u> | <u>406.00</u> | <u>411.96</u> | <u>410.69</u> | <u>420.25</u> | <u>425.75</u> | <u>415.23</u> |
| K <u>DM</u> | <u>411.64</u> | <u>410.25</u> | <u>409.92</u> | <u>412.81</u> | <u>413.68</u> | <u>417.35</u> | <u>416.78</u> | <u>416.20</u> |
| L <u>DM</u> | <u>423.83</u> | <u>411.47</u> | <u>409.9</u> | <u>421.17</u> | <u>413.59</u> | <u>412.76</u> | <u>416.02</u> | <u>423.72</u> |
| e | | | <u>418.18</u> | | | | | |

Final Weight (mg) (dried pan+organisms)

Date: 2017/07/19 Initials: EP Balance*: #1

| | | | | | | | | |
|-------|------------|-----------------|----------|-----------|-----------|-----------|-----------|------------|
| Conc. | <u>CTL</u> | <u>Site CTL</u> | <u>5</u> | <u>10</u> | <u>20</u> | <u>40</u> | <u>80</u> | <u>160</u> |
|-------|------------|-----------------|----------|-----------|-----------|-----------|-----------|------------|

| | | | | | | | | |
|-------------|------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Replicate | | | | | | | | |
| a | <u>422.45 EP</u> | <u>419.36</u> | <u>428.71</u> | <u>423.18</u> | <u>422.28</u> | <u>428.11</u> | <u>424.21</u> | <u>411.89</u> |
| b <u>EP</u> | <u>416.47</u> | <u>417.42</u> | <u>413.05</u> | <u>419.95</u> | <u>417.84</u> | <u>425.77</u> | <u>431.55</u> | <u>417.89</u> |
| c <u>EP</u> | <u>416.66</u> | <u>416.88</u> | <u>415.91</u> | <u>420.52</u> | <u>421.59</u> | <u>424.91</u> | <u>422.98</u> | <u>419.69</u> |
| d | <u>431.20</u> | <u>416.98</u> | <u>424.71</u> | <u>427.99</u> | <u>422.29</u> | <u>420.01</u> | <u>423.20</u> | <u>426.80</u> |
| e | | | | | | | | |

Test Validity Met: **Yes/No/NA**

Results are Logical**: **Yes/No**

**no negative numbers, consistent values across replicates

*Same balance must be used for initial and final weights

*For FM/HA/CT must use scale with 0.01 mg accuracy

| | |
|-------------------------------------|---|
| Balance Calibration Check: | |
| Initial | Site Final |
| first pan weighed: <u>CTL I</u> | first pan+org weighed: <u>CTL I</u> |
| weight of first pan: <u>416.70</u> | weight of first pan + org: <u>419.36</u> |
| re-weigh of first pan after | re-weigh of first pan + org |
| all weights measured: <u>416.72</u> | after all weights measured: <u>419.39</u> |
| % difference <5%: <u>Yes</u> /No | % difference <5%: <u>Yes</u> /No |

Calculation: % difference = [(initial weight-reweight)/((initial weight+reweight)/2)]x100

If "no" is circled for any parameter, notify Lab Supervisor/QA Group to determine appropriate action

Organism Weights Bench Sheet

Client MIN100 Sample S1617-029 Organism 44

Initial Weight (mg) (dried pan)

Date: 2017/07/05 Initials: HS Balance*: Mettler #1

| Conc. | LAB CTL | SITE CTL | 5 | 10 | 20 | 40 | 80 | 160 | ug |
|-------|---------|----------|---|----|----|----|----|-----|----|
|-------|---------|----------|---|----|----|----|----|-----|----|

| Replicate | | | | | | | | | |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--|
| a | 409.00 | 411.30 | 414.27 | 413.89 | 422.19 | 414.39 | 415.83 | 408.57 | |
| b | 420.04 | 418.98 | 418.33 | 414.62 | 414.13 | 411.91 | 407.37 | 414.09 | |
| c | 415.77 | 412.08 | 410.34 | 417.81 | 419.26 | 412.71 | 410.46 | 414.55 | |
| d | 410.87 | 416.51 | 414.02 | 415.19 | 414.09 | 414.37 | 419.84 | 414.20 | |
| e | 414.42 | 417.98 | 414.13 | 418.34 | 408.91 | 418.48 | 403.05 | 414.84 | |

Final Weight (mg) (dried pan+organisms)

Date: 2017/07/27 Initials: BS Balance*: Mettler #1

| Conc. | LAB CTL | SITE CTL | 5 | 10 | 20 | 40 | 80 | 160 | mg/L |
|-------|---------|----------|---|----|----|----|----|-----|------|
|-------|---------|----------|---|----|----|----|----|-----|------|

| Replicate | | | | | | | | | |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--|
| a | 417.94 | 422.09 | 422.58 | 422.45 | 432.04 | 423.77 | 423.14 | 415.33 | |
| b | 427.11 | 427.27 | 428.91 | 424.42 | 429.87 | 420.85 | 416.40 | 416.88 | |
| c | 424.05 | 419.36 | 417.24 | 427.02 | 428.37 | 420.85 | 419.47 | 419.53 | |
| d | 420.13 | 426.70 | 423.51 | 426.31 | 422.74 | 423.52 | 426.13 | 419.26 | |
| e | 423.41 | 428.93 | 424.55 | 427.32 | 417.05 | 429.22 | 407.12 | 418.49 | |

Test Validity Met: Yes/No/NA

Results are Logical**: Yes/No

**no negative numbers, consistent values across replicates

*Same balance must be used for initial and final weights

*For FM/HA/CT must use scale with 0.01 mg accuracy

| Balance Calibration Check: | | Initial | Final |
|-----------------------------|--|---|---|
| first pan weighed: | | 160 A | first pan+org weighed: 20E |
| weight of first pan: | | 408.57 | weight of first pan + org: 417.05 |
| re-weigh of first pan after | | | re-weigh of first pan + org |
| all weights measured : | | 408.60 | after all weights measured: 417.03 |
| % difference <5%: | | <input checked="" type="radio"/> Yes/No | % difference <5%: <input checked="" type="radio"/> Yes/No |

Calculation: % difference = $(\text{initial weight} - \text{reweight}) / ((\text{initial weight} + \text{reweight}) / 2) \times 100$

If "no" is circled for any parameter, notify Lab Supervisor/QA Group to determine appropriate action

Organism Weights Bench Sheet

Client MINTO Sample SP1617-02c1 Organism HA

Initial Weight (mg) (dried pan)

| Conc. | LAB CTL | SITE CTL | Date: | | Initials: | | Balance*: | | |
|-------|---------|----------|-------|----|-----------|----|-----------|-----|------|
| | | | 5 | 10 | 20 | 40 | 80 | 160 | ug/L |

| Replicate | | | | | | | | | |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--|
| a | 408.64 | 424.04 | 413.33 | 415.70 | 408.47 | 417.19 | 409.13 | 410.86 | |
| b | 411.58 | 415.83 | 407.35 | 421.79 | 406.51 | 413.07 | 413.53 | 415.38 | |
| c | 413.98 | 414.91 | 405.66 | 417.71 | 413.55 | 412.51 | 409.04 | 410.42 | |
| d | | | | | | | | | |
| e | | | | | | | | | |
| HS | | | | | | | | | |

Final Weight (mg) (dried pan+organisms)

| Conc. | Lab CTL | Site CTL | Date: 2017/02/27 | | Initials: BS | | Balance*: Mettler 41 | | |
|-------|---------|----------|------------------|----|--------------|----|----------------------|-----|------|
| | | | 5 | 10 | 20 | 40 | 80 | 160 | ug/L |

| Replicate | | | | | | | | | |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--|
| a | 417.47 | 430.84 | 422.33 | 423.76 | 416.16 | 426.07 | 417.17 | 414.35 | |
| b | 421.29 | 424.50 | 418.10 | 431.78 | 415.07 | 423.99 | 421.00 | 420.99 | |
| c | 423.03 | 425.29 | 416.56 | 425.33 | 421.96 | 422.68 | 417.00 | 417.06 | |
| d | | | 415.71 | | | | | | |
| e | | | | | | | | | |
| HS | | | | | | | | | |

Test Validity Met: Yes/No/NA

Results are Logical**: Yes/No

**no negative numbers, consistent values across replicates

*Same balance must be used for initial and final weights

*For FM/HA/CT must use scale with 0.01 mg accuracy

Balance Calibration Check:

| Initial | Final |
|--|--|
| first pan weighed: <input type="text"/> | first pan+org weighed: <input type="text"/> |
| weight of first pan: <input type="text"/> | weight of first pan + org: <input type="text"/> |
| re-weigh of first pan after | re-weigh of first pan + org |
| all weights measured: <input type="text"/> | after all weights measured: <input type="text"/> |
| % difference <5%: Yes/No | % difference <5%: Yes/No |

Calculation: % difference = [(initial weight-reweight)/((initial weight+reweight)/2)]x100

If "no" is circled for any parameter, notify Lab Supervisor/QA Group to determine appropriate action

CETIS Analytical Report

Report Date: 02 Aug-17 11:16 (p 1 of 2)
 Test Code: SP1617-029 HA | 16-7437-8210

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 11-3267-1705 | Endpoint: 28-d Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 02 Aug-17 11:15 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Non-Linear Regression Options

| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
|---|----------------------|--------------------|---------|---------|
| 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$ | Normal: $\omega = 1$ | Off: $\mu^* = \mu$ | None | None |

Regression Summary

| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|-------|--------|--------|------|--------|----------|--------|----------|---------|-----------------------------|
| 5 | 81.72 | -156.6 | -153 | 0.7268 | Yes | 1.538 | 2.621 | 0.2156 | Non-Significant Lack of Fit |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| IC5 | 68.23 | n/a | 88.7 |
| IC10 | 84.24 | 31.84 | 105.2 |
| IC15 | 95.98 | 62.74 | 117 |
| IC20 | 105.9 | 78.97 | 126.4 |
| IC25 | 114.8 | 91.85 | 134.5 |
| IC40 | 139.6 | 122.4 | 157.5 |
| IC50 | 156.6 | 138.6 | 176.9 |

Regression Parameters

| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
|-----------|----------|-----------|---------|---------|--------|----------|--------------------------|
| α | 0.7207 | 0.01795 | 0.684 | 0.7574 | 40.16 | <1.0E-37 | Significant Parameter |
| γ | 3.545 | 0.9311 | 1.641 | 5.449 | 3.807 | 6.7E-04 | Significant Parameter |
| δ | 156.6 | 9.558 | 137 | 176.1 | 16.38 | <1.0E-37 | Significant Parameter |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Model | 14.31 | 4.77 | 3 | 737.5 | <1.0E-37 | Significant |
| Lack of Fit | 0.04551 | 0.009102 | 5 | 1.538 | 0.2156 | Non-Significant |
| Pure Error | 0.142 | 0.005919 | 24 | | | |
| Residual | 0.1876 | 0.006467 | 29 | | | |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|---------------|------------------------------------|-----------|----------|---------|--------------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.178 | 2.938 | 0.7768 | No Outliers Detected |
| Variances | Bartlett Equality of Variance Test | 2.425 | 14.07 | 0.9326 | Equal Variances |
| | Mod Levene Equality of Variance | 0.5283 | 2.423 | 0.8044 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9839 | 0.9338 | 0.9020 | Normal Distribution |
| | Anderson-Darling A2 Normality Te | 0.1958 | 2.492 | 0.9385 | Normal Distribution |

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

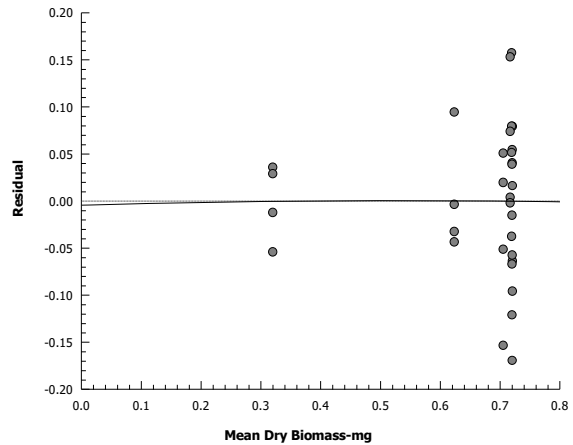
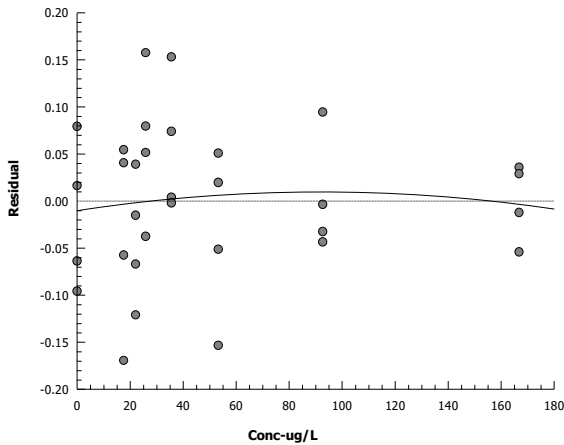
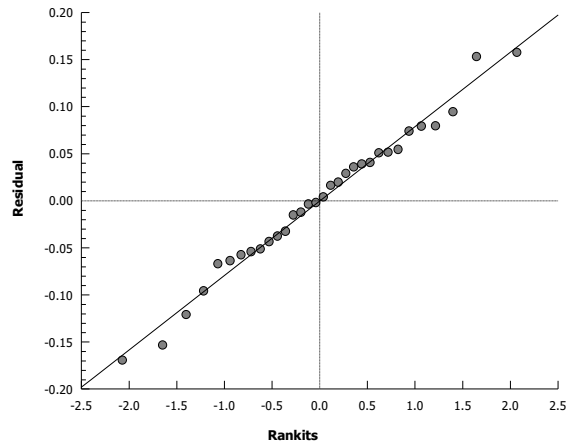
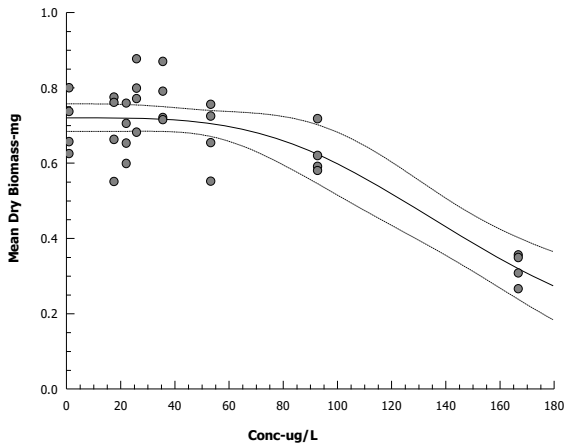
Analysis ID: 11-3267-1705 Endpoint: 28-d Mean Dry Biomass-mg CETIS Version: CETISv1.9.0
 Analyzed: 02 Aug-17 11:15 Analysis: Nonlinear Regression (NLR) Official Results: Yes

| 28-d Mean Dry Biomass-mg Summary | | | Calculated Variate | | | | | | |
|----------------------------------|------|-------|--------------------|-------|-------|---------|---------|--------|---------|
| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
| 0 | N | 4 | 0.7048 | 0.625 | 0.8 | 0.03953 | 0.07906 | 11.22% | 0.00% |
| 17.6 | | 4 | 0.6875 | 0.551 | 0.775 | 0.05187 | 0.1037 | 15.09% | 2.45% |
| 22.1 | | 4 | 0.679 | 0.599 | 0.759 | 0.03434 | 0.06868 | 10.12% | 3.65% |
| 25.9 | | 4 | 0.7823 | 0.682 | 0.877 | 0.04024 | 0.08049 | 10.29% | -11.00% |
| 35.6 | | 4 | 0.7743 | 0.715 | 0.87 | 0.03628 | 0.07256 | 9.37% | -9.86% |
| 53.3 | | 4 | 0.6717 | 0.552 | 0.756 | 0.04527 | 0.09053 | 13.48% | 4.68% |
| 92.7 | | 4 | 0.6273 | 0.58 | 0.718 | 0.0314 | 0.06281 | 10.01% | 11.00% |
| 166.8 | | 4 | 0.3198 | 0.266 | 0.356 | 0.02081 | 0.04162 | 13.02% | 54.63% |

| 28-d Mean Dry Biomass-mg Detail | | | | | |
|---------------------------------|------|-------|-------|-------|-------|
| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
| 0 | N | 0.625 | 0.657 | 0.8 | 0.737 |
| 17.6 | | 0.775 | 0.761 | 0.663 | 0.551 |
| 22.1 | | 0.759 | 0.705 | 0.599 | 0.653 |
| 25.9 | | 0.877 | 0.799 | 0.771 | 0.682 |
| 35.6 | | 0.721 | 0.715 | 0.791 | 0.87 |
| 53.3 | | 0.654 | 0.552 | 0.756 | 0.725 |
| 92.7 | | 0.591 | 0.58 | 0.62 | 0.718 |
| 166.8 | | 0.356 | 0.266 | 0.349 | 0.308 |

Graphics Model: 3P Log-Logistic: $\mu=\alpha/[1+(x/\delta)^\gamma]$

Distribution: Normal [$\omega=1$]



CETIS Analytical Report

Report Date: 02 Aug-17 11:12 (p 1 of 2)
 Test Code: SP1617-029 HA | 16-7437-8210

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 05-6466-1748 | Endpoint: 28-d Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 02 Aug-17 11:11 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|-------|-------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 92.7 | 166.8 | 124.3 | | 19.2% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 17.6 | 0.3171 | 2.482 | 0.135 | 6 | CDF | 0.7783 | Non-Significant Effect |
| | | 22.1 | 0.4734 | 2.482 | 0.135 | 6 | CDF | 0.7184 | Non-Significant Effect |
| | | 25.9 | -1.425 | 2.482 | 0.135 | 6 | CDF | 0.9975 | Non-Significant Effect |
| | | 35.6 | -1.278 | 2.482 | 0.135 | 6 | CDF | 0.9959 | Non-Significant Effect |
| | | 53.3 | 0.6066 | 2.482 | 0.135 | 6 | CDF | 0.6620 | Non-Significant Effect |
| | | 92.7 | 1.425 | 2.482 | 0.135 | 6 | CDF | 0.2964 | Non-Significant Effect |
| | | 166.8* | 7.077 | 2.482 | 0.135 | 6 | CDF | 1.6E-06 | Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.017 | 2.938 | 1.0000 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 0.591833 | 0.0845476 | 7 | 14.29 | 3.6E-07 | Significant Effect |
| Error | 0.142045 | 0.0059186 | 24 | | | |
| Total | 0.733879 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 2.425 | 18.48 | 0.9326 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9514 | 0.9081 | 0.1582 | Normal Distribution |

28-d Mean Dry Biomass-mg Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|-------|-------|---------|--------|---------|
| 0 | N | 4 | 0.7048 | 0.5789 | 0.8306 | | 0.625 | 0.8 | 0.03953 | 11.22% | 0.00% |
| 17.6 | | 4 | 0.6875 | 0.5224 | 0.8526 | | 0.551 | 0.775 | 0.05187 | 15.09% | 2.45% |
| 22.1 | | 4 | 0.679 | 0.5697 | 0.7883 | | 0.599 | 0.759 | 0.03434 | 10.12% | 3.65% |
| 25.9 | | 4 | 0.7823 | 0.6542 | 0.9103 | | 0.682 | 0.877 | 0.04024 | 10.29% | -11.00% |
| 35.6 | | 4 | 0.7743 | 0.6588 | 0.8897 | | 0.715 | 0.87 | 0.03628 | 9.37% | -9.86% |
| 53.3 | | 4 | 0.6717 | 0.5277 | 0.8158 | | 0.552 | 0.756 | 0.04527 | 13.48% | 4.68% |
| 92.7 | | 4 | 0.6273 | 0.5273 | 0.7272 | | 0.58 | 0.718 | 0.0314 | 10.01% | 11.00% |
| 166.8 | | 4 | 0.3198 | 0.2535 | 0.386 | | 0.266 | 0.356 | 0.02081 | 13.02% | 54.63% |

CETIS Analytical Report

Report Date: 02 Aug-17 11:12 (p 2 of 2)
Test Code: SP1617-029 HA | 16-7437-8210

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 05-6466-1748 Endpoint: 28-d Mean Dry Biomass-mg CETIS Version: CETISv1.9.0
Analyzed: 02 Aug-17 11:11 Analysis: Parametric-Control vs Treatments Official Results: Yes

28-d Mean Dry Biomass-mg Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | 0.625 | 0.657 | 0.8 | 0.737 |
| 17.6 | | 0.775 | 0.761 | 0.663 | 0.551 |
| 22.1 | | 0.759 | 0.705 | 0.599 | 0.653 |
| 25.9 | | 0.877 | 0.799 | 0.771 | 0.682 |
| 35.6 | | 0.721 | 0.715 | 0.791 | 0.87 |
| 53.3 | | 0.654 | 0.552 | 0.756 | 0.725 |
| 92.7 | | 0.591 | 0.58 | 0.62 | 0.718 |
| 166.8 | | 0.356 | 0.266 | 0.349 | 0.308 |

CETIS Analytical Report

Report Date: 26 Jul-17 12:20 (p 1 of 2)
Test Code: SP1617-029 HA28 | 00-0208-7308

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 11-9553-0133 | Endpoint: 28-d Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 26 Jul-17 12:20 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 113382 | 200 | Yes | Two-Point Interpolation |

Test Acceptability Criteria

TAC Limits

| Attribute | Test Stat | Lower | Upper | Overlap | Decision |
|--------------|-----------|-------|-------|---------|-------------------------------|
| Control Resp | 0.9417 | 0.8 | >> | Yes | Passes Acceptability Criteria |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.205 | 3.37 | 1.0000 | No Outliers Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|--------|---------|---------|
| LC5 | 122.6 | 92.97 | n/a |
| LC10 | >166.8 | n/a | n/a |
| LC15 | >166.8 | n/a | n/a |
| LC20 | >166.8 | n/a | n/a |
| LC25 | >166.8 | n/a | n/a |
| LC40 | >166.8 | n/a | n/a |
| LC50 | >166.8 | n/a | n/a |

28-d Survival Rate Summary

Calculated Variate(A/B)

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
|-----------|------|-------|--------|--------|--------|---------|---------|--------|---------|-----|-----|
| 0 | N | 12 | 0.9417 | 0.8000 | 1.0000 | 0.0193 | 0.0669 | 7.10% | 0.00% | 113 | 120 |
| 17.6 | | 12 | 0.9417 | 0.8000 | 1.0000 | 0.0229 | 0.0793 | 8.42% | 0.00% | 113 | 120 |
| 22.1 | | 12 | 0.9333 | 0.8000 | 1.0000 | 0.0225 | 0.0779 | 8.34% | 0.88% | 112 | 120 |
| 25.9 | | 12 | 0.9167 | 0.8000 | 1.0000 | 0.0207 | 0.0718 | 7.83% | 2.65% | 110 | 120 |
| 35.6 | | 12 | 0.8833 | 0.7000 | 1.0000 | 0.0322 | 0.1115 | 12.62% | 6.19% | 106 | 120 |
| 53.3 | | 12 | 0.9667 | 0.9000 | 1.0000 | 0.0142 | 0.0492 | 5.09% | -2.65% | 116 | 120 |
| 92.7 | | 12 | 0.9750 | 0.9000 | 1.0000 | 0.0131 | 0.0452 | 4.64% | -3.54% | 117 | 120 |
| 166.8 | | 12 | 0.8500 | 0.7000 | 1.0000 | 0.0261 | 0.0905 | 10.64% | 9.73% | 102 | 120 |

CETIS Analytical Report

Report Date: 26 Jul-17 12:20 (p 2 of 2)
 Test Code: SP1617-029 HA28 | 00-0208-7308

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 11-9553-0133
 Analyzed: 26 Jul-17 12:20

Endpoint: 28-d Survival Rate
 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
 Official Results: Yes

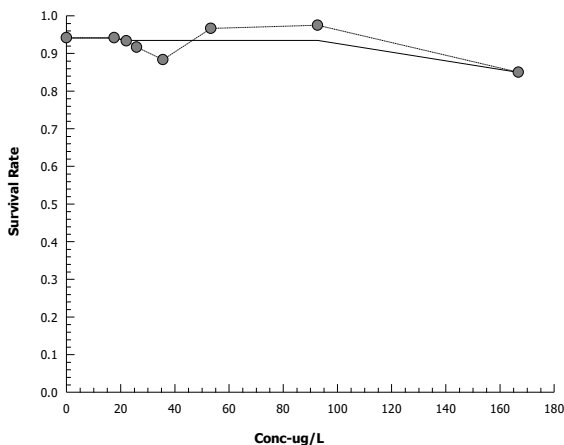
28-d Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 0.9000 | 0.9000 | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 0.8000 | 1.0000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 17.6 | | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.8000 | 0.9000 | 1.0000 | 1.0000 |
| | | 0.9000 | 0.8000 | | | | | | | | |
| 22.1 | | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 0.9000 | 0.8000 | 0.9000 | 1.0000 | 1.0000 | 0.8000 |
| | | 0.9000 | 1.0000 | | | | | | | | |
| 25.9 | | 0.9000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 0.9000 | 0.8000 | 1.0000 | 0.9000 |
| | | 0.9000 | 0.8000 | | | | | | | | |
| 35.6 | | 0.9000 | 1.0000 | 0.7000 | 0.7000 | 0.9000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 | 1.0000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 53.3 | | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | | 0.9000 | 0.9000 | | | | | | | | |
| 92.7 | | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 166.8 | | 0.8000 | 0.9000 | 0.9000 | 0.9000 | 0.8000 | 0.8000 | 0.8000 | 1.0000 | 0.8000 | 0.8000 |
| | | 1.0000 | 0.7000 | | | | | | | | |

28-d Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | N | 9/10 | 9/10 | 9/10 | 10/10 | 10/10 | 9/10 | 10/10 | 10/10 | 8/10 | 10/10 |
| | | 10/10 | 9/10 | | | | | | | | |
| 17.6 | | 9/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 8/10 | 9/10 | 10/10 | 10/10 |
| | | 9/10 | 8/10 | | | | | | | | |
| 22.1 | | 9/10 | 10/10 | 10/10 | 10/10 | 9/10 | 8/10 | 9/10 | 10/10 | 10/10 | 8/10 |
| | | 9/10 | 10/10 | | | | | | | | |
| 25.9 | | 9/10 | 10/10 | 9/10 | 10/10 | 10/10 | 9/10 | 9/10 | 8/10 | 10/10 | 9/10 |
| | | 9/10 | 8/10 | | | | | | | | |
| 35.6 | | 9/10 | 10/10 | 7/10 | 7/10 | 9/10 | 10/10 | 8/10 | 8/10 | 9/10 | 10/10 |
| | | 10/10 | 9/10 | | | | | | | | |
| 53.3 | | 9/10 | 10/10 | 10/10 | 9/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 |
| | | 9/10 | 9/10 | | | | | | | | |
| 92.7 | | 10/10 | 10/10 | 9/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 9/10 |
| | | 10/10 | 9/10 | | | | | | | | |
| 166.8 | | 8/10 | 9/10 | 9/10 | 9/10 | 8/10 | 8/10 | 8/10 | 10/10 | 8/10 | 8/10 |
| | | 10/10 | 7/10 | | | | | | | | |

Graphics



CETIS Analytical Report

Report Date: 26 Jul-17 12:19 (p 1 of 2)
Test Code: SP1617-029 HA28 | 00-0208-7308

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|--|-------------------------------------|
| Analysis ID: 01-2178-3731 | Endpoint: 28-d Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 26 Jul-17 12:19 | Analysis: Nonparametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|---------------------|---------|--------|------|-------|-------|---------|------|----|------|
| Angular (Corrected) | C > T | n/a | n/a | n/a | 166.8 | > 166.8 | n/a | | 7.3% |

Steel Many-One Rank Sum Test

| Control | vs | Conc-ug/L | Test Stat | Critical | Ties | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|------|----|--------|---------|------------------------|
| Negative Control | | 17.6 | 152.5 | 109 | 3 | 22 | Asymp | 0.9077 | Non-Significant Effect |
| | | 22.1 | 147 | 109 | 3 | 22 | Asymp | 0.8261 | Non-Significant Effect |
| | | 25.9 | 136 | 109 | 3 | 22 | Asymp | 0.5671 | Non-Significant Effect |
| | | 35.6 | 129 | 109 | 3 | 22 | Asymp | 0.3761 | Non-Significant Effect |
| | | 53.3 | 164 | 109 | 2 | 22 | Asymp | 0.9840 | Non-Significant Effect |
| | | 92.7 | 169.5 | 109 | 2 | 22 | Asymp | 0.9944 | Non-Significant Effect |
| | | 166.8 | 109.5 | 109 | 3 | 22 | Asymp | 0.0503 | Non-Significant Effect |

Test Acceptability Criteria

| Attribute | Test Stat | TAC Limits | | Overlap | Decision |
|--------------|-----------|------------|-------|---------|-------------------------------|
| | | Lower | Upper | | |
| Control Resp | 0.9417 | 0.8 | >> | Yes | Passes Acceptability Criteria |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.205 | 3.37 | 1.0000 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 0.324851 | 0.0464073 | 7 | 3.465 | 0.0025 | Significant Effect |
| Error | 1.17853 | 0.0133924 | 88 | | | |
| Total | 1.50338 | | 95 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|-------------------------|
| Variances | Bartlett Equality of Variance Test | 8.91 | 18.48 | 0.2592 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9635 | 0.9642 | 0.0089 | Non-Normal Distribution |

28-d Survival Rate Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 0 | N | 12 | 0.9417 | 0.8992 | 0.9841 | | 0.8000 | 1.0000 | 0.0193 | 7.10% | 0.00% |
| 17.6 | | 12 | 0.9417 | 0.8913 | 0.9920 | | 0.8000 | 1.0000 | 0.0229 | 8.42% | 0.00% |
| 22.1 | | 12 | 0.9333 | 0.8839 | 0.9828 | | 0.8000 | 1.0000 | 0.0225 | 8.34% | 0.88% |
| 25.9 | | 12 | 0.9167 | 0.8711 | 0.9623 | | 0.8000 | 1.0000 | 0.0207 | 7.83% | 2.65% |
| 35.6 | | 12 | 0.8833 | 0.8125 | 0.9542 | | 0.7000 | 1.0000 | 0.0322 | 12.62% | 6.19% |
| 53.3 | | 12 | 0.9667 | 0.9354 | 0.9980 | | 0.9000 | 1.0000 | 0.0142 | 5.09% | -2.65% |
| 92.7 | | 12 | 0.9750 | 0.9463 | 1.0000 | | 0.9000 | 1.0000 | 0.0131 | 4.64% | -3.54% |
| 166.8 | | 12 | 0.8500 | 0.7925 | 0.9075 | | 0.7000 | 1.0000 | 0.0261 | 10.64% | 9.73% |

CETIS Analytical Report

Report Date: 26 Jul-17 12:19 (p 2 of 2)
Test Code: SP1617-029 HA28 | 00-0208-7308

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 01-2178-3731 **Endpoint:** 28-d Survival Rate **CETIS Version:** CETISv1.9.0
Analyzed: 26 Jul-17 12:19 **Analysis:** Nonparametric-Control vs Treatments **Official Results:** Yes

Angular (Corrected) Transformed Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|--------|-------|---------|--------|---------|
| 0 | N | 12 | 1.319 | 1.252 | 1.385 | | 1.107 | 1.412 | 0.03031 | 7.96% | 0.00% |
| 17.6 | | 12 | 1.32 | 1.243 | 1.398 | | 1.107 | 1.412 | 0.03535 | 9.27% | -0.13% |
| 22.1 | | 12 | 1.307 | 1.23 | 1.383 | | 1.107 | 1.412 | 0.03476 | 9.21% | 0.90% |
| 25.9 | | 12 | 1.28 | 1.209 | 1.35 | | 1.107 | 1.412 | 0.03201 | 8.66% | 2.96% |
| 35.6 | | 12 | 1.237 | 1.136 | 1.338 | | 0.9912 | 1.412 | 0.04587 | 12.85% | 6.22% |
| 53.3 | | 12 | 1.358 | 1.307 | 1.409 | | 1.249 | 1.412 | 0.02316 | 5.91% | -2.96% |
| 92.7 | | 12 | 1.371 | 1.324 | 1.418 | | 1.249 | 1.412 | 0.02128 | 5.38% | -3.99% |
| 166.8 | | 12 | 1.184 | 1.1 | 1.267 | | 0.9912 | 1.412 | 0.03787 | 11.08% | 10.23% |

28-d Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 0.9000 | 0.9000 | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 0.8000 | 1.0000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 17.6 | | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.8000 | 0.9000 | 1.0000 | 1.0000 |
| | | 0.9000 | 0.8000 | | | | | | | | |
| 22.1 | | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 0.9000 | 0.8000 | 0.9000 | 1.0000 | 1.0000 | 0.8000 |
| | | 0.9000 | 1.0000 | | | | | | | | |
| 25.9 | | 0.9000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 0.9000 | 0.8000 | 1.0000 | 0.9000 |
| | | 0.9000 | 0.8000 | | | | | | | | |
| 35.6 | | 0.9000 | 1.0000 | 0.7000 | 0.7000 | 0.9000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 | 1.0000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 53.3 | | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | | 0.9000 | 0.9000 | | | | | | | | |
| 92.7 | | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 166.8 | | 0.8000 | 0.9000 | 0.9000 | 0.9000 | 0.8000 | 0.8000 | 0.8000 | 1.0000 | 0.8000 | 0.8000 |
| | | 1.0000 | 0.7000 | | | | | | | | |

CETIS Analytical Report

Report Date: 09 Aug-17 14:27 (p 1 of 2)
 Test Code: SP1617-029 HA | 13-1522-0967

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-----------------------------------|
| Analysis ID: 00-3806-6440 | Endpoint: 42-d Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 09 Aug-17 14:26 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 09-4919-8630 | Code: SP1617-029 | Client: |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Non-Linear Regression Options

| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
|---|--------------------|------------------|---------|---------|
| 3P Cumulative Log-Normal: $\mu=\alpha[1-\Phi[\log[x/\delta]/\gamma]]$ | Normal: $\omega=1$ | Off: $\mu^*=\mu$ | None | None |

Regression Summary

| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|-------|--------|--------|--------|--------|----------|--------|----------|---------|-----------------------------|
| 13 | 133.4 | -260.4 | -254.4 | 0.5622 | Yes | 0.8177 | 2.38 | 0.5422 | Non-Significant Lack of Fit |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| IC5 | 61.57 | n/a | 80.5 |
| IC10 | 77.51 | 47.99 | 97.58 |
| IC15 | 90.54 | 66.73 | 110.6 |
| IC20 | 102.4 | 81.61 | 121.8 |
| IC25 | 113.9 | 95.03 | 132.5 |
| IC40 | 148.7 | 129.5 | 169.5 |
| IC50 | 174.6 | 148.3 | 205.6 |

Regression Parameters

| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
|-----------|----------|-----------|---------|---------|--------|----------|--------------------------|
| α | 0.9185 | 0.0207 | 0.8771 | 0.9599 | 44.38 | <1.0E-37 | Significant Parameter |
| γ | 0.6337 | 0.1494 | 0.335 | 0.9325 | 4.242 | 7.7E-05 | Significant Parameter |
| δ | 174.6 | 14.13 | 146.4 | 202.9 | 12.36 | <1.0E-37 | Significant Parameter |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Model | 46.54 | 15.51 | 3 | 971.7 | <1.0E-37 | Significant |
| Lack of Fit | 0.06627 | 0.01325 | 5 | 0.8177 | 0.5422 | Non-Significant |
| Pure Error | 0.9077 | 0.01621 | 56 | | | |
| Residual | 0.974 | 0.01597 | 61 | | | |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|---------------|------------------------------------|-----------|----------|---------|--------------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.924 | 3.224 | 0.1614 | No Outliers Detected |
| Variances | Bartlett Equality of Variance Test | 6.045 | 14.07 | 0.5345 | Equal Variances |
| | Mod Levene Equality of Variance | 1.128 | 2.178 | 0.3591 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9755 | 0.9626 | 0.2332 | Normal Distribution |
| | Anderson-Darling A2 Normality Te | 0.2967 | 2.492 | 0.6220 | Normal Distribution |

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 00-3806-6440 Endpoint: Mean Dry Biomass-mg CETIS Version: CETISv1.9.0
 Analyzed: 09 Aug-17 14:26 Analysis: Nonlinear Regression (NLR) Official Results: Yes

42-d Mean Dry Biomass-mg Summary

Calculated Variate

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
|-----------|------|-------|--------|-------|-------|---------|---------|--------|---------|
| 0 | N | 8 | 0.8766 | 0.707 | 0.971 | 0.02807 | 0.0794 | 9.06% | 0.00% |
| 17.5 | | 8 | 0.9169 | 0.68 | 1.095 | 0.05749 | 0.1626 | 17.74% | -4.59% |
| 22.3 | | 8 | 0.9438 | 0.69 | 1.075 | 0.04681 | 0.1324 | 14.03% | -7.66% |
| 26.4 | | 8 | 0.9167 | 0.762 | 1.112 | 0.0399 | 0.1129 | 12.31% | -4.58% |
| 37.1 | | 8 | 0.8894 | 0.769 | 1.074 | 0.03483 | 0.0985 | 11.08% | -1.45% |
| 54 | | 8 | 0.954 | 0.814 | 1.092 | 0.03452 | 0.09765 | 10.24% | -8.83% |
| 92.7 | | 8 | 0.74 | 0.409 | 0.903 | 0.05697 | 0.1611 | 21.77% | 15.59% |
| 169 | | 8 | 0.4872 | 0.279 | 0.676 | 0.05179 | 0.1465 | 30.06% | 44.42% |

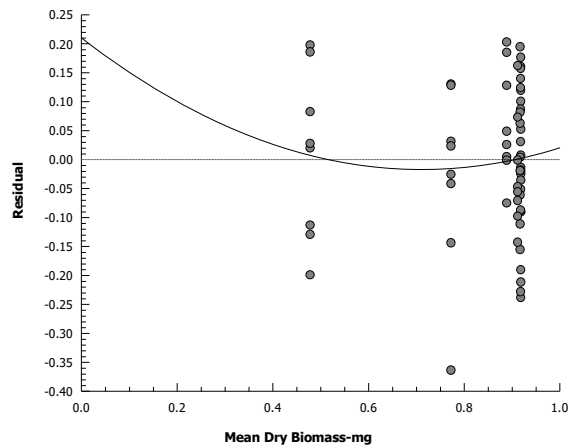
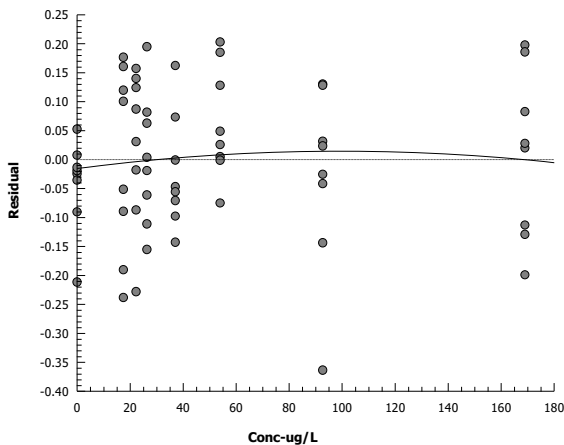
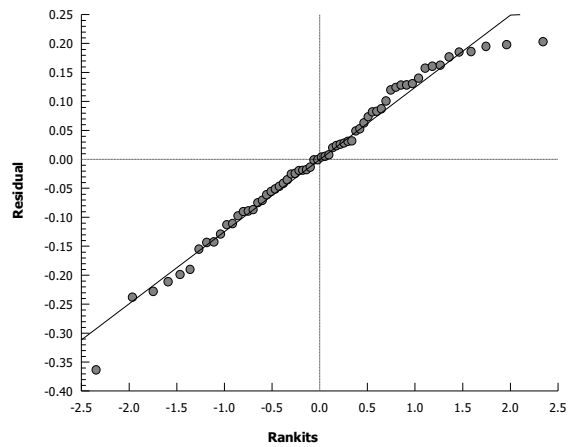
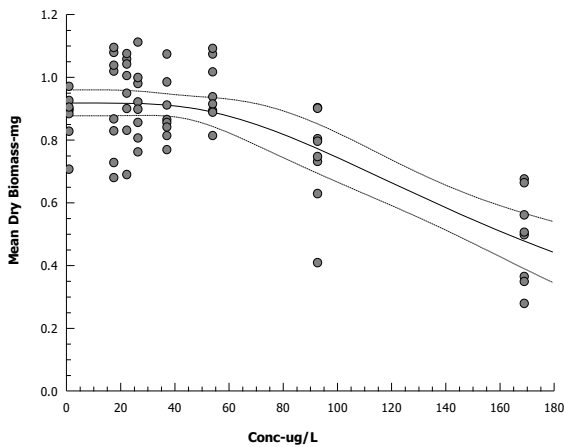
42-d Mean Dry Biomass-mg Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | N | 0.894 | 0.707 | 0.828 | 0.926 | 0.899 | 0.883 | 0.971 | 0.905 |
| 17.5 | | 1.079 | 0.829 | 0.728 | 1.019 | 1.095 | 0.68 | 0.867 | 1.038 |
| 22.3 | | 0.831 | 1.058 | 0.69 | 0.949 | 1.042 | 0.9 | 1.075 | 1.005 |
| 26.4 | | 0.856 | 0.98 | 0.921 | 1.112 | 0.898 | 0.806 | 0.999 | 0.762 |
| 37.1 | | 0.985 | 1.074 | 0.911 | 0.865 | 0.814 | 0.769 | 0.856 | 0.841 |
| 54 | | 0.938 | 0.894 | 0.814 | 0.915 | 1.074 | 0.888 | 1.092 | 1.017 |
| 92.7 | | 0.731 | 0.903 | 0.901 | 0.629 | 0.409 | 0.804 | 0.747 | 0.796 |
| 169 | | 0.676 | 0.279 | 0.498 | 0.506 | 0.365 | 0.349 | 0.561 | 0.664 |

Graphics

Model: 3P Cumulative Log-Normal: $\mu = \alpha [1 - \Phi[\log(x/\delta)/\gamma]]$

Distribution: Normal [$\omega=1$]



CETIS Analytical Report

Report Date: 09 Aug-17 14:21 (p 1 of 2)
 Test Code: SP1617-029 HA | 13-1522-0967

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-----------------------------------|
| Analysis ID: 20-7907-5112 | Endpoint: 42-d Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 09 Aug-17 14:19 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 09-4919-8630 | Code: SP1617-029 | Client: |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|------|-------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 92.7 | 169 | 125.2 | | 17.4% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 17.5 | -0.6323 | 2.399 | 0.153 | 14 | CDF | 0.9725 | Non-Significant Effect |
| | | 22.3 | -1.054 | 2.399 | 0.153 | 14 | CDF | 0.9924 | Non-Significant Effect |
| | | 26.4 | -0.6303 | 2.399 | 0.153 | 14 | CDF | 0.9723 | Non-Significant Effect |
| | | 37.1 | -0.2003 | 2.399 | 0.153 | 14 | CDF | 0.9184 | Non-Significant Effect |
| | | 54 | -1.215 | 2.399 | 0.153 | 14 | CDF | 0.9956 | Non-Significant Effect |
| | | 92.7 | 2.146 | 2.399 | 0.153 | 14 | CDF | 0.0854 | Non-Significant Effect |
| | | 169* | 6.117 | 2.399 | 0.153 | 14 | CDF | 9.5E-07 | Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.758 | 3.224 | 0.2919 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|----------|--------------------|
| Between | 1.39016 | 0.198594 | 7 | 12.25 | <1.0E-37 | Significant Effect |
| Error | 0.907723 | 0.0162093 | 56 | | | |
| Total | 2.29788 | | 63 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 6.045 | 18.48 | 0.5345 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9761 | 0.9488 | 0.2486 | Normal Distribution |

42-d Mean Dry Biomass-mg Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|-------|-------|---------|--------|---------|
| 0 | N | 8 | 0.8766 | 0.8102 | 0.943 | | 0.707 | 0.971 | 0.02807 | 9.06% | 0.00% |
| 17.5 | | 8 | 0.9169 | 0.7809 | 1.053 | | 0.68 | 1.095 | 0.05749 | 17.74% | -4.59% |
| 22.3 | | 8 | 0.9438 | 0.8331 | 1.054 | | 0.69 | 1.075 | 0.04681 | 14.03% | -7.66% |
| 26.4 | | 8 | 0.9167 | 0.8224 | 1.011 | | 0.762 | 1.112 | 0.0399 | 12.31% | -4.58% |
| 37.1 | | 8 | 0.8894 | 0.807 | 0.9717 | | 0.769 | 1.074 | 0.03483 | 11.08% | -1.45% |
| 54 | | 8 | 0.954 | 0.8724 | 1.036 | | 0.814 | 1.092 | 0.03452 | 10.24% | -8.83% |
| 92.7 | | 8 | 0.74 | 0.6053 | 0.8747 | | 0.409 | 0.903 | 0.05697 | 21.77% | 15.59% |
| 169 | | 8 | 0.4872 | 0.3648 | 0.6097 | | 0.279 | 0.676 | 0.05179 | 30.06% | 44.42% |

CETIS Analytical Report

Report Date: 09 Aug-17 14:21 (p 2 of 2)
Test Code: SP1617-029 HA | 13-1522-0967

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 20-7907-5112 Endpoint: 42-d Mean Dry Biomass-mg CETIS Version: CETISv1.9.0
Analyzed: 09 Aug-17 14:19 Analysis: Parametric-Control vs Treatments Official Results: Yes

42-d Mean Dry Biomass-mg Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | N | 0.894 | 0.707 | 0.828 | 0.926 | 0.899 | 0.883 | 0.971 | 0.905 |
| 17.5 | | 1.079 | 0.829 | 0.728 | 1.019 | 1.095 | 0.68 | 0.867 | 1.038 |
| 22.3 | | 0.831 | 1.058 | 0.69 | 0.949 | 1.042 | 0.9 | 1.075 | 1.005 |
| 26.4 | | 0.856 | 0.98 | 0.921 | 1.112 | 0.898 | 0.806 | 0.999 | 0.762 |
| 37.1 | | 0.985 | 1.074 | 0.911 | 0.865 | 0.814 | 0.769 | 0.856 | 0.841 |
| 54 | | 0.938 | 0.894 | 0.814 | 0.915 | 1.074 | 0.888 | 1.092 | 1.017 |
| 92.7 | | 0.731 | 0.903 | 0.901 | 0.629 | 0.409 | 0.804 | 0.747 | 0.796 |
| 169 | | 0.676 | 0.279 | 0.498 | 0.506 | 0.365 | 0.349 | 0.561 | 0.664 |

CETIS Analytical Report

Report Date: 26 Jul-17 12:26 (p 1 of 2)
 Test Code: SP1617-029 HA42 | 19-7989-2732

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 07-7483-6365 | Endpoint: 42-d Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 26 Jul-17 12:25 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|---------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 1552901 | 200 | Yes | Two-Point Interpolation |

Test Acceptability Criteria

| Attribute | Test Stat | TAC Limits | | Overlap | Decision |
|--------------|-----------|------------|-------|---------|-------------------------------|
| | | Lower | Upper | | |
| Control Resp | 0.8625 | 0.8 | >> | Yes | Passes Acceptability Criteria |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.357 | 3.224 | 1.0000 | No Outliers Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| LC5 | 119.2 | 12.82 | n/a |
| LC10 | 153.2 | 108 | n/a |
| LC15 | >169 | n/a | n/a |
| LC20 | >169 | n/a | n/a |
| LC25 | >169 | n/a | n/a |
| LC40 | >169 | n/a | n/a |
| LC50 | >169 | n/a | n/a |

42-d Survival Rate Summary

| Conc-ug/L | Code | Count | Calculated Variate(A/B) | | | | | | | | |
|-----------|------|-------|-------------------------|--------|--------|---------|---------|--------|---------|----|----|
| | | | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
| 0 | N | 8 | 0.8625 | 0.7000 | 1.0000 | 0.0324 | 0.0916 | 10.62% | 0.00% | 69 | 80 |
| 17.5 | | 8 | 0.8625 | 0.7000 | 1.0000 | 0.0375 | 0.1061 | 12.30% | 0.00% | 69 | 80 |
| 22.3 | | 8 | 0.8500 | 0.7000 | 1.0000 | 0.0378 | 0.1069 | 12.58% | 1.45% | 68 | 80 |
| 26.4 | | 8 | 0.8500 | 0.6000 | 1.0000 | 0.0500 | 0.1414 | 16.64% | 1.45% | 68 | 80 |
| 37.1 | | 8 | 0.8000 | 0.7000 | 1.0000 | 0.0378 | 0.1069 | 13.36% | 7.25% | 64 | 80 |
| 54 | | 8 | 0.9250 | 0.8000 | 1.0000 | 0.0250 | 0.0707 | 7.64% | -7.25% | 74 | 80 |
| 92.7 | | 8 | 0.9125 | 0.8000 | 1.0000 | 0.0295 | 0.0835 | 9.15% | -5.80% | 73 | 80 |
| 169 | | 8 | 0.7625 | 0.6000 | 1.0000 | 0.0498 | 0.1408 | 18.46% | 11.59% | 61 | 80 |

42-d Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 0.8000 | 0.7000 | 0.9000 | 0.9000 | 0.9000 | 0.9000 | 1.0000 | 0.8000 |
| 17.5 | | 0.9000 | 0.8000 | 0.7000 | 1.0000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 |
| 22.3 | | 0.7000 | 1.0000 | 0.7000 | 0.9000 | 0.9000 | 0.8000 | 0.9000 | 0.9000 |
| 26.4 | | 0.8000 | 1.0000 | 0.9000 | 1.0000 | 0.9000 | 0.7000 | 0.9000 | 0.6000 |
| 37.1 | | 0.9000 | 1.0000 | 0.7000 | 0.7000 | 0.8000 | 0.7000 | 0.8000 | 0.8000 |
| 54 | | 0.9000 | 0.9000 | 0.8000 | 0.9000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 |
| 92.7 | | 0.9000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 | 0.9000 | 1.0000 | 1.0000 |
| 169 | | 0.8000 | 0.6000 | 0.8000 | 0.6000 | 0.7000 | 0.7000 | 0.9000 | 1.0000 |

CETIS Analytical Report

Report Date: 26 Jul-17 12:26 (p 2 of 2)
 Test Code: SP1617-029 HA42 | 19-7989-2732

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 07-7483-6365
 Analyzed: 26 Jul-17 12:25

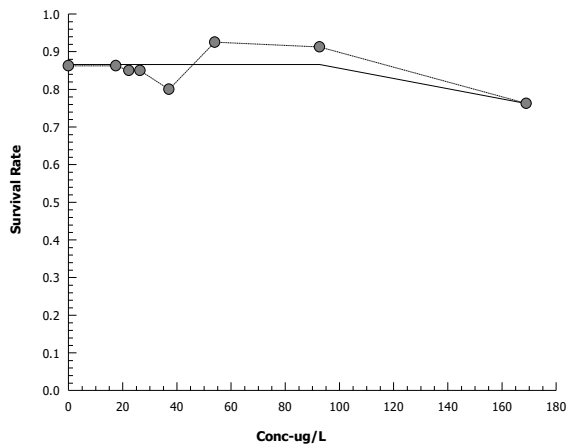
Endpoint: 42-d Survival Rate
 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
 Official Results: Yes

42-d Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | N | 8/10 | 7/10 | 9/10 | 9/10 | 9/10 | 9/10 | 10/10 | 8/10 |
| 17.5 | | 9/10 | 8/10 | 7/10 | 10/10 | 10/10 | 8/10 | 8/10 | 9/10 |
| 22.3 | | 7/10 | 10/10 | 7/10 | 9/10 | 9/10 | 8/10 | 9/10 | 9/10 |
| 26.4 | | 8/10 | 10/10 | 9/10 | 10/10 | 9/10 | 7/10 | 9/10 | 6/10 |
| 37.1 | | 9/10 | 10/10 | 7/10 | 7/10 | 8/10 | 7/10 | 8/10 | 8/10 |
| 54 | | 9/10 | 9/10 | 8/10 | 9/10 | 10/10 | 9/10 | 10/10 | 10/10 |
| 92.7 | | 9/10 | 10/10 | 8/10 | 8/10 | 9/10 | 9/10 | 10/10 | 10/10 |
| 169 | | 8/10 | 6/10 | 8/10 | 6/10 | 7/10 | 7/10 | 9/10 | 10/10 |

Graphics



CETIS Analytical Report

Report Date: 26 Jul-17 12:25 (p 1 of 2)
 Test Code: SP1617-029 HA42 | 19-7989-2732

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 07-3382-3748 | Endpoint: 42-d Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 26 Jul-17 12:25 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|---------------------|---------|--------|------|-------|------|-------|------|----|-------|
| Angular (Corrected) | C > T | n/a | n/a | n/a | 169 | > 169 | n/a | | 15.6% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|------|----|--------|---------|------------------------|
| Negative Control | | 17.5 | -0.03513 | 2.399 | 0.18 | 14 | CDF | 0.8836 | Non-Significant Effect |
| | | 22.3 | 0.1934 | 2.399 | 0.18 | 14 | CDF | 0.8199 | Non-Significant Effect |
| | | 26.4 | 0.09687 | 2.399 | 0.18 | 14 | CDF | 0.8491 | Non-Significant Effect |
| | | 37.1 | 1.096 | 2.399 | 0.18 | 14 | CDF | 0.4326 | Non-Significant Effect |
| | | 54 | -1.21 | 2.399 | 0.18 | 14 | CDF | 0.9955 | Non-Significant Effect |
| | | 92.7 | -0.9734 | 2.399 | 0.18 | 14 | CDF | 0.9901 | Non-Significant Effect |
| | | 169 | 1.64 | 2.399 | 0.18 | 14 | CDF | 0.2113 | Non-Significant Effect |

Test Acceptability Criteria

| Attribute | Test Stat | TAC Limits | | Overlap | Decision |
|--------------|-----------|------------|-------|---------|-------------------------------|
| | | Lower | Upper | | |
| Control Resp | 0.8625 | 0.8 | >> | Yes | Passes Acceptability Criteria |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.357 | 3.224 | 1.0000 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 0.281983 | 0.0402833 | 7 | 1.792 | 0.1071 | Non-Significant Effect |
| Error | 1.25916 | 0.022485 | 56 | | | |
| Total | 1.54115 | | 63 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 3.015 | 18.48 | 0.8836 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.98 | 0.9488 | 0.3839 | Normal Distribution |

42-d Survival Rate Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 0 | N | 8 | 0.8625 | 0.7859 | 0.9391 | | 0.7000 | 1.0000 | 0.0324 | 10.62% | 0.00% |
| 17.5 | | 8 | 0.8625 | 0.7738 | 0.9512 | | 0.7000 | 1.0000 | 0.0375 | 12.30% | 0.00% |
| 22.3 | | 8 | 0.8500 | 0.7606 | 0.9394 | | 0.7000 | 1.0000 | 0.0378 | 12.58% | 1.45% |
| 26.4 | | 8 | 0.8500 | 0.7318 | 0.9682 | | 0.6000 | 1.0000 | 0.0500 | 16.64% | 1.45% |
| 37.1 | | 8 | 0.8000 | 0.7106 | 0.8894 | | 0.7000 | 1.0000 | 0.0378 | 13.36% | 7.25% |
| 54 | | 8 | 0.9250 | 0.8659 | 0.9841 | | 0.8000 | 1.0000 | 0.0250 | 7.64% | -7.25% |
| 92.7 | | 8 | 0.9125 | 0.8427 | 0.9823 | | 0.8000 | 1.0000 | 0.0295 | 9.15% | -5.80% |
| 169 | | 8 | 0.7625 | 0.6448 | 0.8802 | | 0.6000 | 1.0000 | 0.0498 | 18.46% | 11.59% |

CETIS Analytical Report

Report Date: 26 Jul-17 12:25 (p 2 of 2)
Test Code: SP1617-029 HA42 | 19-7989-2732

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 07-3382-3748 **Endpoint:** 42-d Survival Rate **CETIS Version:** CETISv1.9.0
Analyzed: 26 Jul-17 12:25 **Analysis:** Parametric-Control vs Treatments **Official Results:** Yes

Angular (Corrected) Transformed Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|--------|-------|---------|--------|---------|
| 0 | N | 8 | 1.202 | 1.094 | 1.309 | | 0.9912 | 1.412 | 0.0454 | 10.68% | 0.00% |
| 17.5 | | 8 | 1.204 | 1.076 | 1.332 | | 0.9912 | 1.412 | 0.05412 | 12.71% | -0.22% |
| 22.3 | | 8 | 1.187 | 1.065 | 1.309 | | 0.9912 | 1.412 | 0.0516 | 12.29% | 1.21% |
| 26.4 | | 8 | 1.194 | 1.037 | 1.352 | | 0.8861 | 1.412 | 0.0665 | 15.75% | 0.60% |
| 37.1 | | 8 | 1.119 | 0.9962 | 1.243 | | 0.9912 | 1.412 | 0.05214 | 13.17% | 6.84% |
| 54 | | 8 | 1.292 | 1.2 | 1.384 | | 1.107 | 1.412 | 0.0389 | 8.51% | -7.55% |
| 92.7 | | 8 | 1.275 | 1.168 | 1.382 | | 1.107 | 1.412 | 0.04525 | 10.04% | -6.07% |
| 169 | | 8 | 1.079 | 0.9268 | 1.231 | | 0.8861 | 1.412 | 0.06426 | 16.85% | 10.23% |

42-d Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 0.8000 | 0.7000 | 0.9000 | 0.9000 | 0.9000 | 0.9000 | 1.0000 | 0.8000 |
| 17.5 | | 0.9000 | 0.8000 | 0.7000 | 1.0000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 |
| 22.3 | | 0.7000 | 1.0000 | 0.7000 | 0.9000 | 0.9000 | 0.8000 | 0.9000 | 0.9000 |
| 26.4 | | 0.8000 | 1.0000 | 0.9000 | 1.0000 | 0.9000 | 0.7000 | 0.9000 | 0.6000 |
| 37.1 | | 0.9000 | 1.0000 | 0.7000 | 0.7000 | 0.8000 | 0.7000 | 0.8000 | 0.8000 |
| 54 | | 0.9000 | 0.9000 | 0.8000 | 0.9000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 |
| 92.7 | | 0.9000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 | 0.9000 | 1.0000 | 1.0000 |
| 169 | | 0.8000 | 0.6000 | 0.8000 | 0.6000 | 0.7000 | 0.7000 | 0.9000 | 1.0000 |

CETIS Analytical Report

Report Date: 26 Jul-17 12:33 (p 1 of 2)
 Test Code: SP1617-029 HA42 | 08-6375-1836

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 04-1428-7151 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 26 Jul-17 12:32 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Non-Linear Regression Options

| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
|---|----------------------|--------------------|---------|---------|
| 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$ | Normal: $\omega = 1$ | Off: $\mu^* = \mu$ | None | None |

Regression Summary

| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|-------|--------|-------|-------|--------|----------|--------|----------|---------|-----------------------------|
| 9 | -102.2 | 210.8 | 216.8 | 0.4490 | Yes | 1.883 | 2.383 | 0.1121 | Non-Significant Lack of Fit |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|--------|---------|---------|
| IC5 | 0.6054 | n/a | 4.927 |
| IC10 | 1.374 | n/a | 7.475 |
| IC15 | 2.281 | n/a | 10.45 |
| IC20 | 3.342 | n/a | 13.63 |
| IC25 | 4.582 | n/a | 16.86 |
| IC40 | 9.797 | 2.952 | 25.84 |
| IC50 | 15.28 | 7.479 | 31.22 |

Regression Parameters

| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
|-----------|----------|-----------|---------|---------|--------|----------|--------------------------|
| α | 17.69 | 1.818 | 14.05 | 21.33 | 9.728 | <1.0E-37 | Significant Parameter |
| γ | 0.912 | 0.3606 | 0.1906 | 1.633 | 2.529 | 0.0141 | Significant Parameter |
| δ | 15.28 | 6.17 | 2.939 | 27.62 | 2.477 | 0.0161 | Significant Parameter |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Model | 4312 | 1437 | 3 | 54.28 | <1.0E-37 | Significant |
| Lack of Fit | 232.3 | 46.45 | 5 | 1.883 | 0.1121 | Non-Significant |
| Pure Error | 1357 | 24.66 | 55 | | | |
| Residual | 1589 | 26.48 | 60 | | | |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|---------------|----------------------------------|-----------|----------|----------|--------------------------|
| Extreme Value | Grubbs Extreme Value Test | 5 | 3.218 | 2.1E-07 | Outlier Detected |
| Variances | Mod Levene Equality of Variance | 2.036 | 2.185 | 0.0671 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.8139 | 0.9621 | 1.8E-07 | Non-Normal Distribution |
| | Anderson-Darling A2 Normality Te | 3.117 | 2.492 | <1.0E-37 | Non-Normal Distribution |

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 04-1428-7151
 Analyzed: 26 Jul-17 12:32

Endpoint: Reproduction
 Analysis: Nonlinear Regression (NLR)

CETIS Version: CETISv1.9.0
 Official Results: Yes

Reproduction Summary

Calculated Variate

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
|-----------|------|-------|--------|-----|-----|---------|---------|---------|---------|
| 0 | N | 8 | 17.75 | 7 | 43 | 4.358 | 12.33 | 69.44% | 0.00% |
| 17.5 | | 8 | 6.75 | 4 | 13 | 1.031 | 2.915 | 43.19% | 61.97% |
| 22.3 | | 8 | 10.38 | 6 | 18 | 1.322 | 3.739 | 36.04% | 41.55% |
| 26.4 | | 8 | 3.5 | 0 | 5 | 0.5669 | 1.604 | 45.82% | 80.28% |
| 37.1 | | 8 | 7.75 | 5 | 11 | 0.7962 | 2.252 | 29.06% | 56.34% |
| 54 | | 8 | 4.375 | 3 | 10 | 0.8224 | 2.326 | 53.17% | 75.35% |
| 92.7 | | 8 | 2.875 | 0 | 8 | 0.875 | 2.475 | 86.08% | 83.80% |
| 169 | | 7 | 0.2857 | 0 | 1 | 0.1844 | 0.488 | 170.78% | 98.39% |

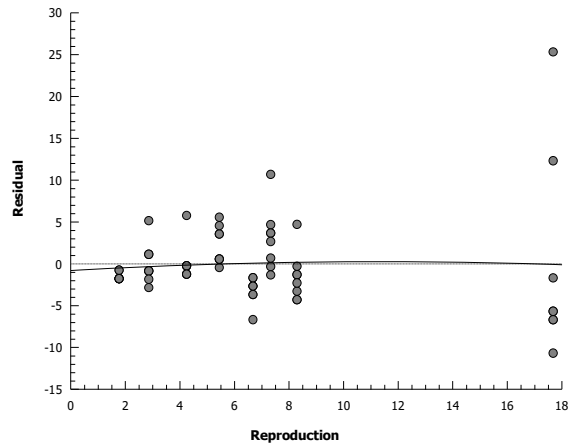
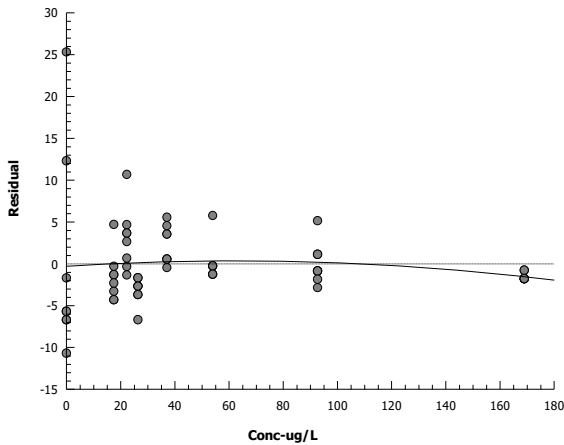
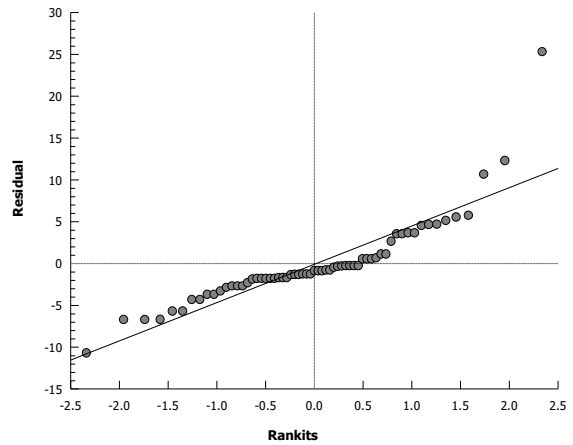
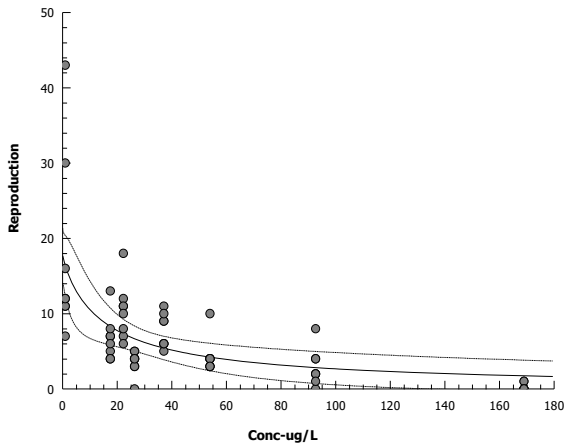
Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | N | 30 | 43 | 11 | 16 | 7 | 12 | 11 | 12 |
| 17.5 | | 5 | 7 | 7 | 13 | 4 | 6 | 8 | 4 |
| 22.3 | | 18 | 11 | 7 | 12 | 11 | 8 | 10 | 6 |
| 26.4 | | 5 | 3 | 4 | 4 | 3 | 0 | 5 | 4 |
| 37.1 | | 11 | 6 | 5 | 6 | 6 | 9 | 9 | 10 |
| 54 | | 3 | 4 | 10 | 3 | 4 | 4 | 4 | 3 |
| 92.7 | | 4 | 8 | 4 | 2 | 0 | 2 | 2 | 1 |
| 169 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |

Graphics

Model: 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$

Distribution: Normal [$\omega = 1$]



CETIS Analytical Report

Report Date: 26 Jul-17 12:36 (p 1 of 2)
Test Code: SP1617-029 HA42 | 08-6375-1836

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|--|-------------------------------------|
| Analysis ID: 10-4003-9940 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 26 Jul-17 12:35 | Analysis: Nonparametric-Multiple Comparison | Official Results: Yes |
| Batch ID: 06-3155-2206 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|------|-------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 22.3 | 26.4 | 24.26 | | 36.6% |

Wilcoxon/Bonferroni Adj Test

| Control | vs | Control II | Test Stat | Critical | Ties | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|------------|-----------|----------|------|----|--------|---------|------------------------|
| Negative Control | | 17.5* | 43 | NA | 1 | 14 | Exact | 0.0250 | Significant Effect |
| | | 22.3 | 52.5 | NA | 3 | 14 | Exact | 0.3742 | Non-Significant Effect |
| | | 26.4* | 36 | NA | 0 | 14 | Exact | 5.4E-04 | Significant Effect |
| | | 37.1* | 41 | NA | 1 | 14 | Exact | 0.0082 | Significant Effect |
| | | 54* | 37 | NA | 0 | 14 | Exact | 0.0011 | Significant Effect |
| | | 92.7* | 37 | NA | 0 | 14 | Exact | 0.0011 | Significant Effect |
| | | 169* | 28 | NA | 0 | 13 | Exact | 0.0011 | Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 5.398 | 3.218 | 2.3E-07 | Outlier Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 1623.16 | 231.88 | 7 | 9.401 | 1.3E-07 | Significant Effect |
| Error | 1356.55 | 24.6646 | 55 | | | |
| Total | 2979.71 | | 62 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|----------|-------------------------|
| Variances | Bartlett Equality of Variance Test | 69.99 | 18.48 | <1.0E-37 | Unequal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.7527 | 0.9481 | 5.9E-09 | Non-Normal Distribution |

Reproduction Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|-----|-----|---------|---------|---------|
| 0 | N | 8 | 17.75 | 7.445 | 28.05 | | 7 | 43 | 4.358 | 69.44% | 0.00% |
| 17.5 | | 8 | 6.75 | 4.313 | 9.187 | | 4 | 13 | 1.031 | 43.19% | 61.97% |
| 22.3 | | 8 | 10.38 | 7.249 | 13.5 | | 6 | 18 | 1.322 | 36.04% | 41.55% |
| 26.4 | | 8 | 3.5 | 2.159 | 4.841 | | 0 | 5 | 0.5669 | 45.82% | 80.28% |
| 37.1 | | 8 | 7.75 | 5.867 | 9.633 | | 5 | 11 | 0.7962 | 29.06% | 56.34% |
| 54 | | 8 | 4.375 | 2.43 | 6.32 | | 3 | 10 | 0.8224 | 53.17% | 75.35% |
| 92.7 | | 8 | 2.875 | 0.806 | 4.944 | | 0 | 8 | 0.875 | 86.08% | 83.80% |
| 169 | | 7 | 0.2857 | -0.1656 | 0.737 | | 0 | 1 | 0.1844 | 170.78% | 98.39% |

CETIS Analytical Report

Report Date: 26 Jul-17 12:36 (p 2 of 2)
Test Code: SP1617-029 HA42 | 08-6375-1836

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 10-4003-9940 Endpoint: Reproduction CETIS Version: CETISv1.9.0
Analyzed: 26 Jul-17 12:35 Analysis: Nonparametric-Multiple Comparison Official Results: Yes

Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | N | 30 | 43 | 11 | 16 | 7 | 12 | 11 | 12 |
| 17.5 | | 5 | 7 | 7 | 13 | 4 | 6 | 8 | 4 |
| 22.3 | | 18 | 11 | 7 | 12 | 11 | 8 | 10 | 6 |
| 26.4 | | 5 | 3 | 4 | 4 | 3 | 0 | 5 | 4 |
| 37.1 | | 11 | 6 | 5 | 6 | 6 | 9 | 9 | 10 |
| 54 | | 3 | 4 | 10 | 3 | 4 | 4 | 4 | 3 |
| 92.7 | | 4 | 8 | 4 | 2 | 0 | 2 | 2 | 1 |
| 169 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | |

CETIS Analytical Report

Report Date: 08 Aug-17 14:30 (p 1 of 2)
 Test Code: SP1617-029 HA r | 09-4407-0965

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 18-4602-2782 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 08 Aug-17 14:29 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Non-Linear Regression Options

| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
|---|----------------------|--------------------|---------|---------|
| 3P Log-Gompertz: $\mu = \alpha \cdot \exp[\log[0.5] \cdot [x/\delta]^\gamma]$ | Normal: $\omega = 1$ | Off: $\mu^* = \mu$ | None | None |

Regression Summary

| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|-------|--------|-------|-------|--------|----------|--------|----------|---------|--------------------------|
| 6 | -60.96 | 128.4 | 133.9 | 0.3720 | Yes | 8.29 | 2.565 | 0.0000 | Significant Lack of Fit |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| IC5 | 13 | n/a | 45.24 |
| IC10 | 20.55 | n/a | 40.1 |
| IC15 | 27.07 | 7.517 | 42.18 |
| IC20 | 33.11 | 14.95 | 48.95 |
| IC25 | 38.92 | 19.37 | 57.06 |
| IC40 | 56.08 | 34.08 | 80.17 |
| IC50 | 68.09 | 45.46 | 95.49 |

Regression Parameters

| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
|-----------|----------|-----------|---------|---------|--------|---------|---------------------------|
| α | 8.131 | 1.85 | 4.419 | 11.84 | 4.395 | 5.5E-05 | Significant Parameter |
| γ | 1.572 | 0.9903 | -0.415 | 3.559 | 1.588 | 0.1184 | Non-Significant Parameter |
| δ | 68.09 | 22.77 | 22.39 | 113.8 | 2.99 | 0.0043 | Significant Parameter |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Model | 1821 | 607.2 | 3 | 63.72 | <1.0E-37 | Significant |
| Lack of Fit | 202.5 | 50.61 | 4 | 8.29 | 3.6E-05 | Significant |
| Pure Error | 293.1 | 6.105 | 48 | | | |
| Residual | 495.5 | 9.529 | 52 | | | |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|---------------|----------------------------------|-----------|----------|---------|--------------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.561 | 3.166 | 0.0083 | Outlier Detected |
| Variances | Mod Levene Equality of Variance | 1.364 | 2.299 | 0.2487 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9235 | 0.9575 | 0.0018 | Non-Normal Distribution |
| | Anderson-Darling A2 Normality Te | 1.674 | 2.492 | 1.8E-07 | Non-Normal Distribution |

Reproduction Summary

| Conc-ug/L | Code | Count | Calculated Variate | | | | | | |
|-----------|------|-------|--------------------|-----|-----|---------|---------|---------|---------|
| | | | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
| 17.5 | N | 8 | 6.75 | 4 | 13 | 1.031 | 2.915 | 43.19% | 0.00% |
| 22.3 | | 8 | 10.38 | 6 | 18 | 1.322 | 3.739 | 36.04% | -53.70% |
| 26.4 | | 8 | 3.5 | 0 | 5 | 0.5669 | 1.604 | 45.82% | 48.15% |
| 37.1 | | 8 | 7.75 | 5 | 11 | 0.7962 | 2.252 | 29.06% | -14.81% |
| 54 | | 8 | 4.375 | 3 | 10 | 0.8224 | 2.326 | 53.17% | 35.19% |
| 92.7 | | 8 | 2.875 | 0 | 8 | 0.875 | 2.475 | 86.08% | 57.41% |
| 169 | | 7 | 0.2857 | 0 | 1 | 0.1844 | 0.488 | 170.78% | 95.77% |

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 18-4602-2782 Endpoint: Reproduction
 Analyzed: 08 Aug-17 14:29 Analysis: Nonlinear Regression (NLR)

CETIS Version: CETISv1.9.0
 Official Results: Yes

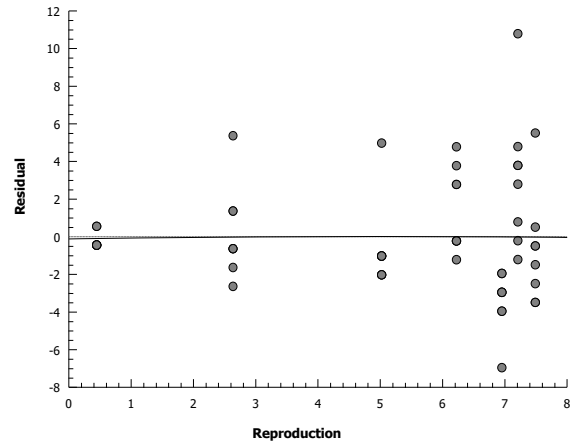
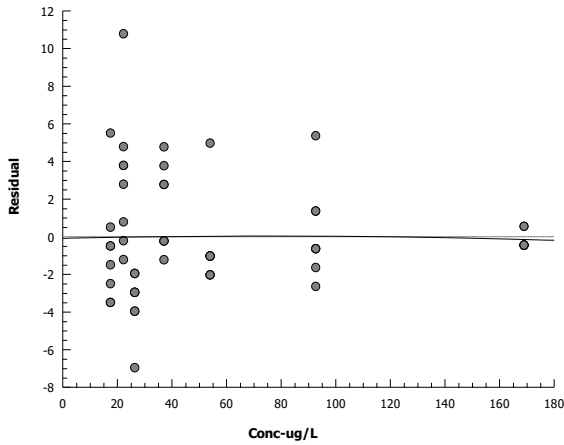
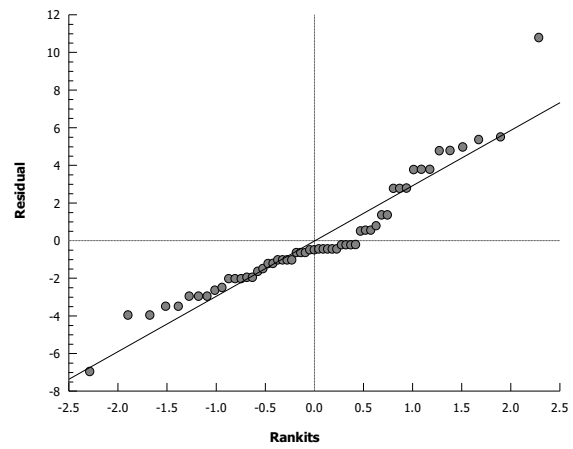
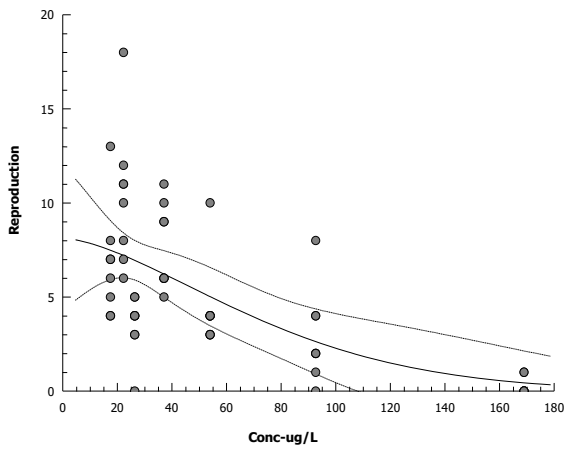
Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 17.5 | N | 5 | 7 | 7 | 13 | 4 | 6 | 8 | 4 |
| 22.3 | | 18 | 11 | 7 | 12 | 11 | 8 | 10 | 6 |
| 26.4 | | 5 | 3 | 4 | 4 | 3 | 0 | 5 | 4 |
| 37.1 | | 11 | 6 | 5 | 6 | 6 | 9 | 9 | 10 |
| 54 | | 3 | 4 | 10 | 3 | 4 | 4 | 4 | 3 |
| 92.7 | | 4 | 8 | 4 | 2 | 0 | 2 | 2 | 1 |
| 169 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | |

Graphics

Model: 3P Log-Gompertz: $\mu = \alpha \cdot \exp[\log(0.5) \cdot (x/\delta)^\gamma]$

Distribution: Normal [$\omega=1$]



CETIS Analytical Report

Report Date: 08 Aug-17 14:25 (p 1 of 2)
Test Code: SP1617-029 HA r | 09-4407-0965

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|--|-------------------------------------|
| Analysis ID: 04-6301-4282 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 08 Aug-17 14:24 | Analysis: Nonparametric-Multiple Comparison | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Total Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|------|-------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 54 | 92.7 | 70.75 | | 47.0% |

Wilcoxon/Bonferroni Adj Test

| Control | vs | Conc-ug/L | Test Stat | Critical | Ties | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|------|----|--------|---------|------------------------|
| Negative Control | | 22.3 | 87 | NA | 3 | 14 | Exact | 1.0000 | Non-Significant Effect |
| | | 26.4* | 44 | NA | 2 | 14 | Exact | 0.0312 | Significant Effect |
| | | 37.1 | 77 | NA | 2 | 14 | Exact | 1.0000 | Non-Significant Effect |
| | | 54 | 47 | NA | 1 | 14 | Exact | 0.0639 | Non-Significant Effect |
| | | 92.7* | 44.5 | NA | 2 | 14 | Exact | 0.0340 | Significant Effect |
| | | 169* | 28 | NA | 0 | 13 | Exact | 9.3E-04 | Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.273 | 3.166 | 0.0317 | Outlier Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|----------|--------------------|
| Between | 526.328 | 87.7214 | 6 | 14.37 | <1.0E-37 | Significant Effect |
| Error | 293.054 | 6.10528 | 48 | | | |
| Total | 819.382 | | 54 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|-------------------------|
| Variances | Bartlett Equality of Variance Test | 18.49 | 16.81 | 0.0051 | Unequal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9119 | 0.9417 | 6.6E-04 | Non-Normal Distribution |

Reproduction Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|-----|-----|---------|---------|---------|
| 17.5 | N | 8 | 6.75 | 4.313 | 9.187 | 6.5 | 4 | 13 | 1.031 | 43.19% | 0.00% |
| 22.3 | | 8 | 10.38 | 7.249 | 13.5 | 10.5 | 6 | 18 | 1.322 | 36.04% | -53.70% |
| 26.4 | | 8 | 3.5 | 2.159 | 4.841 | 4 | 0 | 5 | 0.5669 | 45.82% | 48.15% |
| 37.1 | | 8 | 7.75 | 5.867 | 9.633 | 7.5 | 5 | 11 | 0.7962 | 29.06% | -14.81% |
| 54 | | 8 | 4.375 | 2.43 | 6.32 | 4 | 3 | 10 | 0.8224 | 53.17% | 35.19% |
| 92.7 | | 8 | 2.875 | 0.806 | 4.944 | 2 | 0 | 8 | 0.875 | 86.08% | 57.41% |
| 169 | | 7 | 0.2857 | -0.1656 | 0.737 | 0 | 0 | 1 | 0.1844 | 170.78% | 95.77% |

Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 17.5 | N | 5 | 7 | 7 | 13 | 4 | 6 | 8 | 4 |
| 22.3 | | 18 | 11 | 7 | 12 | 11 | 8 | 10 | 6 |
| 26.4 | | 5 | 3 | 4 | 4 | 3 | 0 | 5 | 4 |
| 37.1 | | 11 | 6 | 5 | 6 | 6 | 9 | 9 | 10 |
| 54 | | 3 | 4 | 10 | 3 | 4 | 4 | 4 | 3 |
| 92.7 | | 4 | 8 | 4 | 2 | 0 | 2 | 2 | 1 |
| 169 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | |

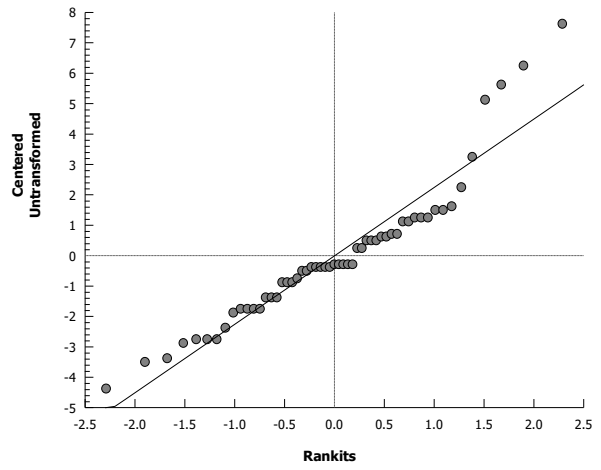
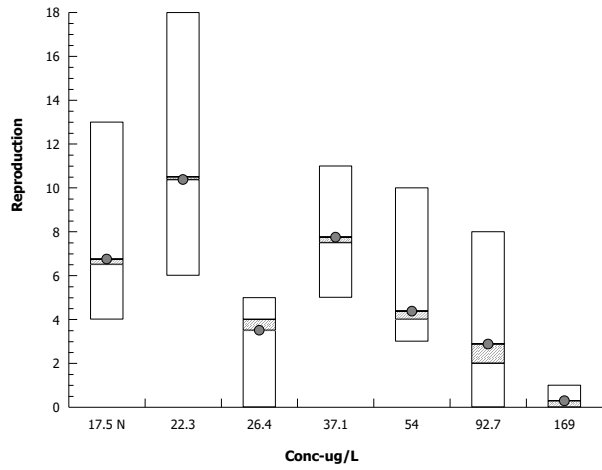
Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 04-6301-4282 Endpoint: Reproduction
Analyzed: 08 Aug-17 14:24 Analysis: Nonparametric-Multiple Comparison

CETIS Version: CETISv1.9.0
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 12:26 (p 1 of 2)
 Test Code: SP1617-029 HA 2 | 03-1094-5659

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 06-5099-7677 | Endpoint: 28-d Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 12:26 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 03-1012-0093 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|--------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 973576 | 200 | Yes | Two-Point Interpolation |

Test Acceptability Criteria

| Attribute | Test Stat | TAC Limits | | Overlap | Decision |
|--------------|-----------|------------|-------|---------|-------------------------------|
| | | Lower | Upper | | |
| Control Resp | 0.9417 | 0.8 | >> | Yes | Passes Acceptability Criteria |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.205 | 3.37 | 1.0000 | No Outliers Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| LC5 | 112.6 | 85.14 | 143.8 |
| LC10 | >154 | n/a | n/a |
| LC15 | >154 | n/a | n/a |
| LC20 | >154 | n/a | n/a |
| LC25 | >154 | n/a | n/a |
| LC40 | >154 | n/a | n/a |
| LC50 | >154 | n/a | n/a |

28-d Survival Rate Summary

| Conc-ug/L | Code | Count | Calculated Variate(A/B) | | | | | | | | |
|-----------|------|-------|-------------------------|--------|--------|---------|---------|--------|---------|-----|-----|
| | | | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
| 0 | N | 12 | 0.9417 | 0.8000 | 1.0000 | 0.0193 | 0.0669 | 7.10% | 0.00% | 113 | 120 |
| 14.7 | | 12 | 0.9417 | 0.8000 | 1.0000 | 0.0229 | 0.0793 | 8.42% | 0.00% | 113 | 120 |
| 19.1 | | 12 | 0.9333 | 0.8000 | 1.0000 | 0.0225 | 0.0779 | 8.34% | 0.88% | 112 | 120 |
| 23.7 | | 12 | 0.9167 | 0.8000 | 1.0000 | 0.0207 | 0.0718 | 7.83% | 2.65% | 110 | 120 |
| 32.4 | | 12 | 0.8833 | 0.7000 | 1.0000 | 0.0322 | 0.1115 | 12.62% | 6.19% | 106 | 120 |
| 49.7 | | 12 | 0.9667 | 0.9000 | 1.0000 | 0.0142 | 0.0492 | 5.09% | -2.65% | 116 | 120 |
| 84.7 | | 12 | 0.9750 | 0.9000 | 1.0000 | 0.0131 | 0.0452 | 4.64% | -3.54% | 117 | 120 |
| 154 | | 12 | 0.8500 | 0.7000 | 1.0000 | 0.0261 | 0.0905 | 10.64% | 9.73% | 102 | 120 |

CETIS Analytical Report

Report Date: 16 Aug-17 12:26 (p 2 of 2)
Test Code: SP1617-029 HA 2 | 03-1094-5659

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 06-5099-7677 **Endpoint:** 28-d Survival Rate **CETIS Version:** CETISv1.9.0
Analyzed: 16 Aug-17 12:26 **Analysis:** Linear Interpolation (ICPIN) **Official Results:** Yes

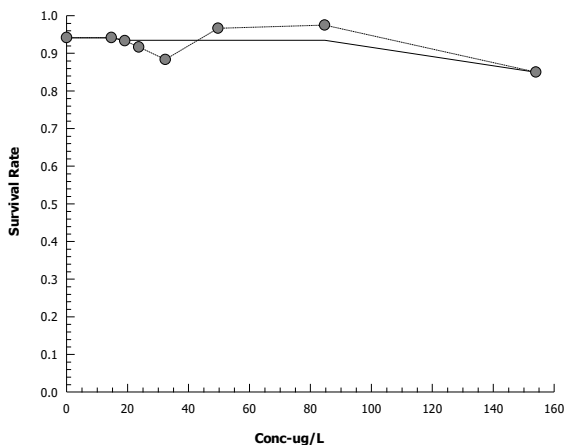
28-d Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 0.9000 | 0.9000 | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 0.8000 | 1.0000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 14.7 | | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.8000 | 0.9000 | 1.0000 | 1.0000 |
| | | 0.9000 | 0.8000 | | | | | | | | |
| 19.1 | | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 0.9000 | 0.8000 | 0.9000 | 1.0000 | 1.0000 | 0.8000 |
| | | 0.9000 | 1.0000 | | | | | | | | |
| 23.7 | | 0.9000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 0.9000 | 0.8000 | 1.0000 | 0.9000 |
| | | 0.9000 | 0.8000 | | | | | | | | |
| 32.4 | | 0.9000 | 1.0000 | 0.7000 | 0.7000 | 0.9000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 | 1.0000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 49.7 | | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | | 0.9000 | 0.9000 | | | | | | | | |
| 84.7 | | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 154 | | 0.8000 | 0.9000 | 0.9000 | 0.9000 | 0.8000 | 0.8000 | 0.8000 | 1.0000 | 0.8000 | 0.8000 |
| | | 1.0000 | 0.7000 | | | | | | | | |

28-d Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | N | 9/10 | 9/10 | 9/10 | 10/10 | 10/10 | 9/10 | 10/10 | 10/10 | 8/10 | 10/10 |
| | | 10/10 | 9/10 | | | | | | | | |
| 14.7 | | 9/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 8/10 | 9/10 | 10/10 | 10/10 |
| | | 9/10 | 8/10 | | | | | | | | |
| 19.1 | | 9/10 | 10/10 | 10/10 | 10/10 | 9/10 | 8/10 | 9/10 | 10/10 | 10/10 | 8/10 |
| | | 9/10 | 10/10 | | | | | | | | |
| 23.7 | | 9/10 | 10/10 | 9/10 | 10/10 | 10/10 | 9/10 | 9/10 | 8/10 | 10/10 | 9/10 |
| | | 9/10 | 8/10 | | | | | | | | |
| 32.4 | | 9/10 | 10/10 | 7/10 | 7/10 | 9/10 | 10/10 | 8/10 | 8/10 | 9/10 | 10/10 |
| | | 10/10 | 9/10 | | | | | | | | |
| 49.7 | | 9/10 | 10/10 | 10/10 | 9/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 |
| | | 9/10 | 9/10 | | | | | | | | |
| 84.7 | | 10/10 | 10/10 | 9/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 9/10 |
| | | 10/10 | 9/10 | | | | | | | | |
| 154 | | 8/10 | 9/10 | 9/10 | 9/10 | 8/10 | 8/10 | 8/10 | 10/10 | 8/10 | 8/10 |
| | | 10/10 | 7/10 | | | | | | | | |

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 12:29 (p 1 of 3)
Test Code: SP1617-029 HA 2 | 03-1094-5659

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|--|-------------------------------------|
| Analysis ID: 03-3130-6276 | Endpoint: 28- d Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 12:28 | Analysis: Nonparametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 03-1012-0093 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|---------------------|---------|--------|------|-------|------|-------|------|----|------|
| Angular (Corrected) | C > T | n/a | n/a | n/a | 154 | > 154 | n/a | | 7.3% |

Steel Many-One Rank Sum Test

| Control | vs | Conc-ug/L | Test Stat | Critical | Ties | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|------|----|--------|---------|------------------------|
| Negative Control | | 14.7 | 152.5 | 109 | 3 | 22 | Asymp | 0.9077 | Non-Significant Effect |
| | | 19.1 | 147 | 109 | 3 | 22 | Asymp | 0.8261 | Non-Significant Effect |
| | | 23.7 | 136 | 109 | 3 | 22 | Asymp | 0.5671 | Non-Significant Effect |
| | | 32.4 | 129 | 109 | 3 | 22 | Asymp | 0.3761 | Non-Significant Effect |
| | | 49.7 | 164 | 109 | 2 | 22 | Asymp | 0.9840 | Non-Significant Effect |
| | | 84.7 | 169.5 | 109 | 2 | 22 | Asymp | 0.9944 | Non-Significant Effect |
| | | 154 | 109.5 | 109 | 3 | 22 | Asymp | 0.0503 | Non-Significant Effect |

Test Acceptability Criteria

| Attribute | Test Stat | TAC Limits | | Overlap | Decision |
|--------------|-----------|------------|-------|---------|-------------------------------|
| | | Lower | Upper | | |
| Control Resp | 0.9417 | 0.8 | >> | Yes | Passes Acceptability Criteria |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.205 | 3.37 | 1.0000 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 0.324851 | 0.0464073 | 7 | 3.465 | 0.0025 | Significant Effect |
| Error | 1.17853 | 0.0133924 | 88 | | | |
| Total | 1.50338 | | 95 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|-------------------------|
| Variances | Bartlett Equality of Variance Test | 8.91 | 18.48 | 0.2592 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9635 | 0.9642 | 0.0089 | Non-Normal Distribution |

Survival Rate Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 0 | N | 12 | 0.9417 | 0.8992 | 0.9841 | 0.9500 | 0.8000 | 1.0000 | 0.0193 | 7.10% | 0.00% |
| 14.7 | | 12 | 0.9417 | 0.8913 | 0.9920 | 1.0000 | 0.8000 | 1.0000 | 0.0229 | 8.42% | 0.00% |
| 19.1 | | 12 | 0.9333 | 0.8839 | 0.9828 | 0.9500 | 0.8000 | 1.0000 | 0.0225 | 8.34% | 0.88% |
| 23.7 | | 12 | 0.9167 | 0.8711 | 0.9623 | 0.9000 | 0.8000 | 1.0000 | 0.0207 | 7.83% | 2.65% |
| 32.4 | | 12 | 0.8833 | 0.8125 | 0.9542 | 0.9000 | 0.7000 | 1.0000 | 0.0322 | 12.62% | 6.19% |
| 49.7 | | 12 | 0.9667 | 0.9354 | 0.9980 | 1.0000 | 0.9000 | 1.0000 | 0.0142 | 5.09% | -2.65% |
| 84.7 | | 12 | 0.9750 | 0.9463 | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 0.0131 | 4.64% | -3.54% |
| 154 | | 12 | 0.8500 | 0.7925 | 0.9075 | 0.8000 | 0.7000 | 1.0000 | 0.0261 | 10.64% | 9.73% |

CETIS Analytical Report

Report Date: 16 Aug-17 12:29 (p 2 of 3)
Test Code: SP1617-029 HA 2 | 03-1094-5659

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 03-3130-6276 **Endpoint:** 28-d Survival Rate **CETIS Version:** CETISv1.9.0
Analyzed: 16 Aug-17 12:28 **Analysis:** Nonparametric-Control vs Treatments **Official Results:** Yes

Angular (Corrected) Transformed Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|--------|-------|---------|--------|---------|
| 0 | N | 12 | 1.319 | 1.252 | 1.385 | 1.331 | 1.107 | 1.412 | 0.03031 | 7.96% | 0.00% |
| 14.7 | | 12 | 1.32 | 1.243 | 1.398 | 1.412 | 1.107 | 1.412 | 0.03535 | 9.27% | -0.13% |
| 19.1 | | 12 | 1.307 | 1.23 | 1.383 | 1.331 | 1.107 | 1.412 | 0.03476 | 9.21% | 0.90% |
| 23.7 | | 12 | 1.28 | 1.209 | 1.35 | 1.249 | 1.107 | 1.412 | 0.03201 | 8.66% | 2.96% |
| 32.4 | | 12 | 1.237 | 1.136 | 1.338 | 1.249 | 0.9912 | 1.412 | 0.04587 | 12.85% | 6.22% |
| 49.7 | | 12 | 1.358 | 1.307 | 1.409 | 1.412 | 1.249 | 1.412 | 0.02316 | 5.91% | -2.96% |
| 84.7 | | 12 | 1.371 | 1.324 | 1.418 | 1.412 | 1.249 | 1.412 | 0.02128 | 5.38% | -3.99% |
| 154 | | 12 | 1.184 | 1.1 | 1.267 | 1.107 | 0.9912 | 1.412 | 0.03787 | 11.08% | 10.23% |

28-d Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 0.9000 | 0.9000 | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 0.8000 | 1.0000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 14.7 | | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.8000 | 0.9000 | 1.0000 | 1.0000 |
| | | 0.9000 | 0.8000 | | | | | | | | |
| 19.1 | | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 0.9000 | 0.8000 | 0.9000 | 1.0000 | 1.0000 | 0.8000 |
| | | 0.9000 | 1.0000 | | | | | | | | |
| 23.7 | | 0.9000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 0.9000 | 0.8000 | 1.0000 | 0.9000 |
| | | 0.9000 | 0.8000 | | | | | | | | |
| 32.4 | | 0.9000 | 1.0000 | 0.7000 | 0.7000 | 0.9000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 | 1.0000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 49.7 | | 0.9000 | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | | 0.9000 | 0.9000 | | | | | | | | |
| 84.7 | | 1.0000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9000 |
| | | 1.0000 | 0.9000 | | | | | | | | |
| 154 | | 0.8000 | 0.9000 | 0.9000 | 0.9000 | 0.8000 | 0.8000 | 0.8000 | 1.0000 | 0.8000 | 0.8000 |
| | | 1.0000 | 0.7000 | | | | | | | | |

Angular (Corrected) Transformed Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|--------|--------|-------|-------|-------|-------|-------|--------|
| 0 | N | 1.249 | 1.249 | 1.249 | 1.412 | 1.412 | 1.249 | 1.412 | 1.412 | 1.107 | 1.412 |
| 14.7 | | 1.249 | 1.412 | 1.412 | 1.412 | 1.412 | 1.412 | 1.107 | 1.249 | 1.412 | 1.412 |
| 19.1 | | 1.249 | 1.412 | 1.412 | 1.412 | 1.249 | 1.107 | 1.249 | 1.412 | 1.412 | 1.107 |
| 23.7 | | 1.249 | 1.412 | 1.249 | 1.412 | 1.412 | 1.249 | 1.249 | 1.107 | 1.412 | 1.249 |
| 32.4 | | 1.249 | 1.412 | 0.9912 | 0.9912 | 1.249 | 1.412 | 1.107 | 1.107 | 1.249 | 1.412 |
| 49.7 | | 1.249 | 1.412 | 1.412 | 1.249 | 1.412 | 1.412 | 1.412 | 1.412 | 1.412 | 1.412 |
| 84.7 | | 1.412 | 1.412 | 1.249 | 1.412 | 1.412 | 1.412 | 1.412 | 1.412 | 1.412 | 1.249 |
| 154 | | 1.107 | 1.249 | 1.249 | 1.249 | 1.107 | 1.107 | 1.107 | 1.412 | 1.107 | 1.107 |

CETIS Analytical Report

Report Date: 16 Aug-17 12:29 (p 3 of 3)
 Test Code: SP1617-029 HA 2 | 03-1094-5659

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

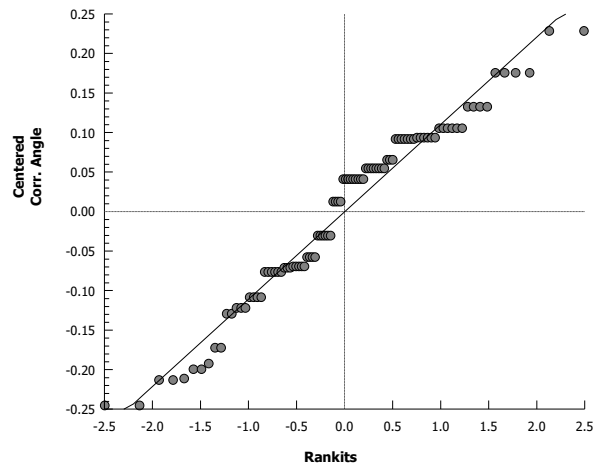
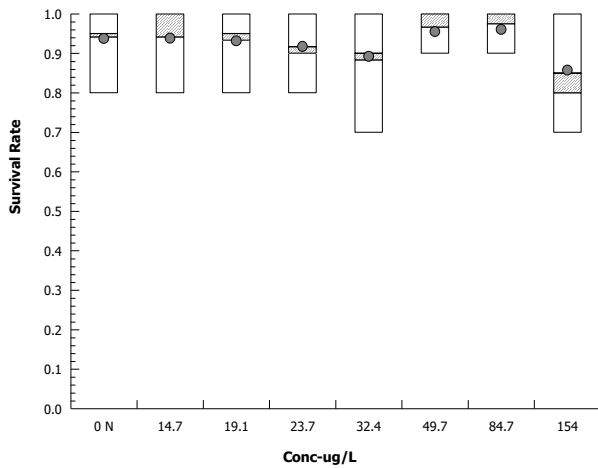
Nautilus Environmental Calgary

Analysis ID: 03-3130-6276 Endpoint: 28-d Survival Rate CETIS Version: CETISv1.9.0
 Analyzed: 16 Aug-17 12:28 Analysis: Nonparametric-Control vs Treatments Official Results: Yes

28-d Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 | Rep 9 | Rep 10 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 0 | N | 9/10 | 9/10 | 9/10 | 10/10 | 10/10 | 9/10 | 10/10 | 10/10 | 8/10 | 10/10 |
| | | 10/10 | 9/10 | | | | | | | | |
| 14.7 | | 9/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 8/10 | 9/10 | 10/10 | 10/10 |
| | | 9/10 | 8/10 | | | | | | | | |
| 19.1 | | 9/10 | 10/10 | 10/10 | 10/10 | 9/10 | 8/10 | 9/10 | 10/10 | 10/10 | 8/10 |
| | | 9/10 | 10/10 | | | | | | | | |
| 23.7 | | 9/10 | 10/10 | 9/10 | 10/10 | 10/10 | 9/10 | 9/10 | 8/10 | 10/10 | 9/10 |
| | | 9/10 | 8/10 | | | | | | | | |
| 32.4 | | 9/10 | 10/10 | 7/10 | 7/10 | 9/10 | 10/10 | 8/10 | 8/10 | 9/10 | 10/10 |
| | | 10/10 | 9/10 | | | | | | | | |
| 49.7 | | 9/10 | 10/10 | 10/10 | 9/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 |
| | | 9/10 | 9/10 | | | | | | | | |
| 84.7 | | 10/10 | 10/10 | 9/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 10/10 | 9/10 |
| | | 10/10 | 9/10 | | | | | | | | |
| 154 | | 8/10 | 9/10 | 9/10 | 9/10 | 8/10 | 8/10 | 8/10 | 10/10 | 8/10 | 8/10 |
| | | 10/10 | 7/10 | | | | | | | | |

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 09:46 (p 1 of 2)
 Test Code: SP1617-029 HA 2 | 03-1094-5659

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 21-3430-3370 | Endpoint: 28-d Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:46 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes |
| Batch ID: 03-1012-0093 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Non-Linear Regression Options

| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
|---|----------------------|--------------------|---------|---------|
| 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$ | Normal: $\omega = 1$ | Off: $\mu^* = \mu$ | None | None |

Regression Summary

| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|-------|--------|--------|--------|--------|----------|--------|----------|---------|-----------------------------|
| 5 | 81.75 | -156.6 | -153.1 | 0.7272 | Yes | 1.529 | 2.621 | 0.2183 | Non-Significant Lack of Fit |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| IC5 | 62.01 | n/a | 80.83 |
| IC10 | 76.84 | 30.6 | 96.19 |
| IC15 | 87.74 | 57.38 | 107.1 |
| IC20 | 96.97 | 72.21 | 115.9 |
| IC25 | 105.3 | 84.08 | 123.6 |
| IC40 | 128.5 | 112.4 | 145.2 |
| IC50 | 144.3 | 127.5 | 163.4 |

Regression Parameters

| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
|-----------|----------|-----------|---------|---------|--------|----------|--------------------------|
| α | 0.721 | 0.01801 | 0.6842 | 0.7579 | 40.03 | <1.0E-37 | Significant Parameter |
| γ | 3.485 | 0.9086 | 1.627 | 5.344 | 3.836 | 6.2E-04 | Significant Parameter |
| δ | 144.3 | 8.955 | 126 | 162.6 | 16.12 | <1.0E-37 | Significant Parameter |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Model | 14.31 | 4.77 | 3 | 738.6 | <1.0E-37 | Significant |
| Lack of Fit | 0.04524 | 0.009049 | 5 | 1.529 | 0.2183 | Non-Significant |
| Pure Error | 0.142 | 0.005919 | 24 | | | |
| Residual | 0.1873 | 0.006458 | 29 | | | |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|---------------|------------------------------------|-----------|----------|---------|--------------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.184 | 2.938 | 0.7633 | No Outliers Detected |
| Variances | Bartlett Equality of Variance Test | 2.425 | 14.07 | 0.9326 | Equal Variances |
| | Mod Levene Equality of Variance | 0.5283 | 2.423 | 0.8044 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9842 | 0.9338 | 0.9084 | Normal Distribution |
| | Anderson-Darling A2 Normality Te | 0.1942 | 2.492 | 0.9424 | Normal Distribution |

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 21-3430-3370 Endpoint: 28-d Mean Dry Biomass-mg CETIS Version: CETISv1.9.0
 Analyzed: 16 Aug-17 9:46 Analysis: Nonlinear Regression (NLR) Official Results: Yes

28-d Mean Dry Biomass-mg Summary

Calculated Variate

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
|-----------|------|-------|--------|-------|-------|---------|---------|--------|---------|
| 0 | N | 4 | 0.7048 | 0.625 | 0.8 | 0.03953 | 0.07906 | 11.22% | 0.00% |
| 14.7 | | 4 | 0.6875 | 0.551 | 0.775 | 0.05187 | 0.1037 | 15.09% | 2.45% |
| 19.1 | | 4 | 0.679 | 0.599 | 0.759 | 0.03434 | 0.06868 | 10.12% | 3.65% |
| 23.7 | | 4 | 0.7823 | 0.682 | 0.877 | 0.04024 | 0.08049 | 10.29% | -11.00% |
| 32.4 | | 4 | 0.7743 | 0.715 | 0.87 | 0.03628 | 0.07256 | 9.37% | -9.86% |
| 49.7 | | 4 | 0.6717 | 0.552 | 0.756 | 0.04527 | 0.09053 | 13.48% | 4.68% |
| 84.7 | | 4 | 0.6273 | 0.58 | 0.718 | 0.0314 | 0.06281 | 10.01% | 11.00% |
| 154 | | 4 | 0.3198 | 0.266 | 0.356 | 0.02081 | 0.04162 | 13.02% | 54.63% |

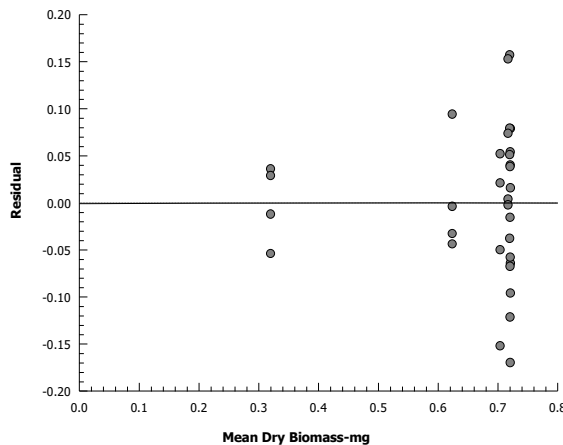
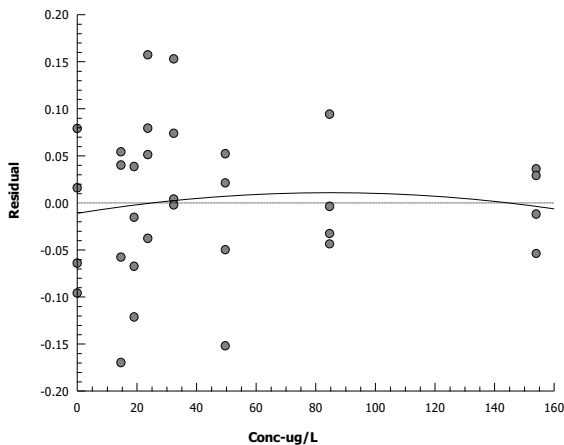
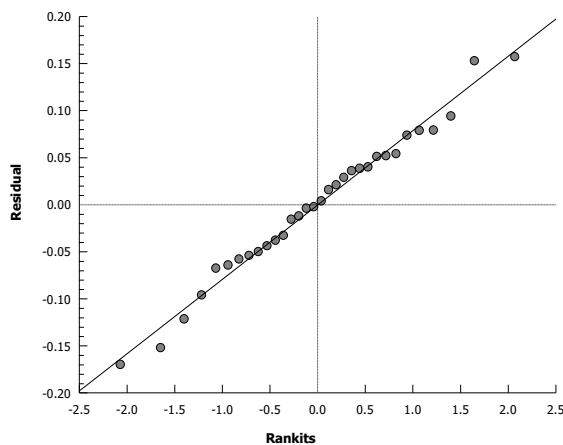
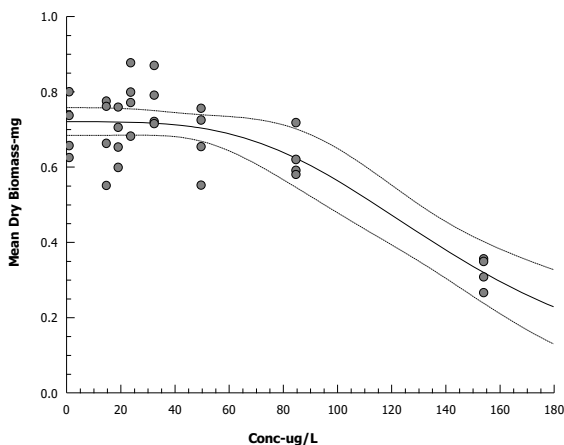
28-d Mean Dry Biomass-mg Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | 0.625 | 0.657 | 0.8 | 0.737 |
| 14.7 | | 0.775 | 0.761 | 0.663 | 0.551 |
| 19.1 | | 0.759 | 0.705 | 0.599 | 0.653 |
| 23.7 | | 0.877 | 0.799 | 0.771 | 0.682 |
| 32.4 | | 0.721 | 0.715 | 0.791 | 0.87 |
| 49.7 | | 0.654 | 0.552 | 0.756 | 0.725 |
| 84.7 | | 0.591 | 0.58 | 0.62 | 0.718 |
| 154 | | 0.356 | 0.266 | 0.349 | 0.308 |

Graphics

Model: 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$

Distribution: Normal [$\omega = 1$]



CETIS Analytical Report

Report Date: 16 Aug-17 09:47 (p 1 of 2)
 Test Code: SP1617-029 HA 2 | 03-1094-5659

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 16-9804-4853 | Endpoint: 28-d Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:47 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 03-1012-0093 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|------|-------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 84.7 | 154 | 114.2 | | 19.2% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 14.7 | 0.3171 | 2.482 | 0.135 | 6 | CDF | 0.7783 | Non-Significant Effect |
| | | 19.1 | 0.4734 | 2.482 | 0.135 | 6 | CDF | 0.7184 | Non-Significant Effect |
| | | 23.7 | -1.425 | 2.482 | 0.135 | 6 | CDF | 0.9975 | Non-Significant Effect |
| | | 32.4 | -1.278 | 2.482 | 0.135 | 6 | CDF | 0.9959 | Non-Significant Effect |
| | | 49.7 | 0.6066 | 2.482 | 0.135 | 6 | CDF | 0.6620 | Non-Significant Effect |
| | | 84.7 | 1.425 | 2.482 | 0.135 | 6 | CDF | 0.2964 | Non-Significant Effect |
| | | 154* | 7.077 | 2.482 | 0.135 | 6 | CDF | 1.6E-06 | Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.017 | 2.938 | 1.0000 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 0.591833 | 0.0845476 | 7 | 14.29 | 3.6E-07 | Significant Effect |
| Error | 0.142045 | 0.0059186 | 24 | | | |
| Total | 0.733879 | | 31 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 2.425 | 18.48 | 0.9326 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9514 | 0.9081 | 0.1582 | Normal Distribution |

28-d Mean Dry Biomass-mg Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|-------|-------|---------|--------|---------|
| 0 | N | 4 | 0.7048 | 0.5789 | 0.8306 | 0.697 | 0.625 | 0.8 | 0.03953 | 11.22% | 0.00% |
| 14.7 | | 4 | 0.6875 | 0.5224 | 0.8526 | 0.712 | 0.551 | 0.775 | 0.05187 | 15.09% | 2.45% |
| 19.1 | | 4 | 0.679 | 0.5697 | 0.7883 | 0.679 | 0.599 | 0.759 | 0.03434 | 10.12% | 3.65% |
| 23.7 | | 4 | 0.7823 | 0.6542 | 0.9103 | 0.785 | 0.682 | 0.877 | 0.04024 | 10.29% | -11.00% |
| 32.4 | | 4 | 0.7743 | 0.6588 | 0.8897 | 0.756 | 0.715 | 0.87 | 0.03628 | 9.37% | -9.86% |
| 49.7 | | 4 | 0.6717 | 0.5277 | 0.8158 | 0.6895 | 0.552 | 0.756 | 0.04527 | 13.48% | 4.68% |
| 84.7 | | 4 | 0.6273 | 0.5273 | 0.7272 | 0.6055 | 0.58 | 0.718 | 0.0314 | 10.01% | 11.00% |
| 154 | | 4 | 0.3198 | 0.2535 | 0.386 | 0.3285 | 0.266 | 0.356 | 0.02081 | 13.02% | 54.63% |

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

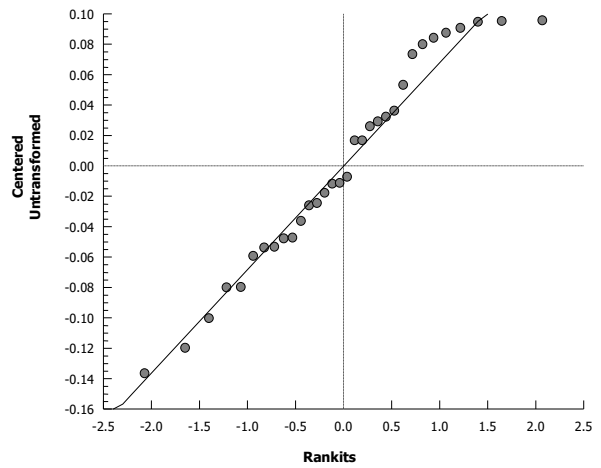
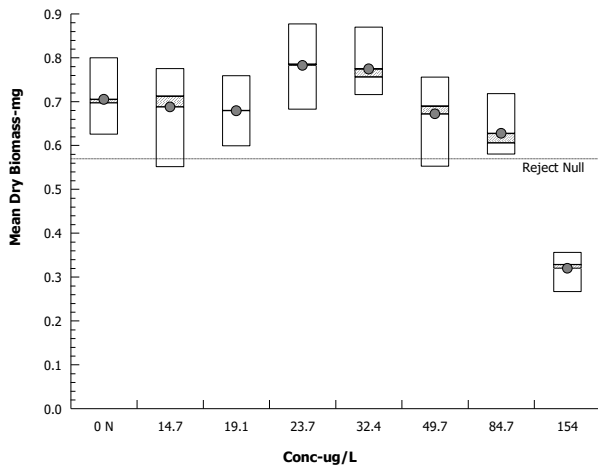
Analysis ID: 16-9804-4853 **Endpoint:** 28-d Mean Dry Biomass-mg
Analyzed: 16 Aug-17 9:47 **Analysis:** Parametric-Control vs Treatments

CETIS Version: CETISv1.9.0
Official Results: Yes

28-d Mean Dry Biomass-mg Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 |
|-----------|------|-------|-------|-------|-------|
| 0 | N | 0.625 | 0.657 | 0.8 | 0.737 |
| 14.7 | | 0.775 | 0.761 | 0.663 | 0.551 |
| 19.1 | | 0.759 | 0.705 | 0.599 | 0.653 |
| 23.7 | | 0.877 | 0.799 | 0.771 | 0.682 |
| 32.4 | | 0.721 | 0.715 | 0.791 | 0.87 |
| 49.7 | | 0.654 | 0.552 | 0.756 | 0.725 |
| 84.7 | | 0.591 | 0.58 | 0.62 | 0.718 |
| 154 | | 0.356 | 0.266 | 0.349 | 0.308 |

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 09:27 (p 1 of 2)
 Test Code: SP1617-029 HA | 13-1522-0967

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-----------------------------------|
| Analysis ID: 05-1874-4904 | Endpoint: 42-d Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:25 | Analysis: Linear Interpolation (ICPIN) | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 09-4919-8630 | Code: SP1617-029 | Client: |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Linear Interpolation Options

| X Transform | Y Transform | Seed | Resamples | Exp 95% CL | Method |
|-------------|-------------|---------|-----------|------------|-------------------------|
| Log(X+1) | Linear | 1250822 | 200 | Yes | Two-Point Interpolation |

Test Acceptability Criteria

| Attribute | Test Stat | TAC Limits | | Overlap | Decision |
|--------------|-----------|------------|-------|---------|-------------------------------|
| | | Lower | Upper | | |
| Control Resp | 0.8625 | 0.8 | >> | Yes | Passes Acceptability Criteria |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.357 | 3.224 | 1.0000 | No Outliers Detected |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| LC5 | 111.8 | 16.76 | n/a |
| LC10 | 144.7 | 101.7 | n/a |
| LC15 | >160 | n/a | n/a |
| LC20 | >160 | n/a | n/a |
| LC25 | >160 | n/a | n/a |
| LC40 | >160 | n/a | n/a |
| LC50 | >160 | n/a | n/a |

42-d Survival Rate Summary

| Conc-ug/L | Code | Count | Calculated Variate(A/B) | | | | | | | | |
|-----------|------|-------|-------------------------|--------|--------|---------|---------|--------|---------|----|----|
| | | | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect | A | B |
| 0 | N | 8 | 0.8625 | 0.7000 | 1.0000 | 0.0324 | 0.0916 | 10.62% | 0.00% | 69 | 80 |
| 14.9 | | 8 | 0.8625 | 0.7000 | 1.0000 | 0.0375 | 0.1061 | 12.30% | 0.00% | 69 | 80 |
| 19.8 | | 8 | 0.8500 | 0.7000 | 1.0000 | 0.0378 | 0.1069 | 12.58% | 1.45% | 68 | 80 |
| 24.3 | | 8 | 0.8500 | 0.6000 | 1.0000 | 0.0500 | 0.1414 | 16.64% | 1.45% | 68 | 80 |
| 33 | | 8 | 0.8000 | 0.7000 | 1.0000 | 0.0378 | 0.1069 | 13.36% | 7.25% | 64 | 80 |
| 51.6 | | 8 | 0.9250 | 0.8000 | 1.0000 | 0.0250 | 0.0707 | 7.64% | -7.25% | 74 | 80 |
| 86.4 | | 8 | 0.9125 | 0.8000 | 1.0000 | 0.0295 | 0.0835 | 9.15% | -5.80% | 73 | 80 |
| 160 | | 8 | 0.7625 | 0.6000 | 1.0000 | 0.0498 | 0.1408 | 18.46% | 11.59% | 61 | 80 |

42-d Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 0.8000 | 0.7000 | 0.9000 | 0.9000 | 0.9000 | 0.9000 | 1.0000 | 0.8000 |
| 14.9 | | 0.9000 | 0.8000 | 0.7000 | 1.0000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 |
| 19.8 | | 0.7000 | 1.0000 | 0.7000 | 0.9000 | 0.9000 | 0.8000 | 0.9000 | 0.9000 |
| 24.3 | | 0.8000 | 1.0000 | 0.9000 | 1.0000 | 0.9000 | 0.7000 | 0.9000 | 0.6000 |
| 33 | | 0.9000 | 1.0000 | 0.7000 | 0.7000 | 0.8000 | 0.7000 | 0.8000 | 0.8000 |
| 51.6 | | 0.9000 | 0.9000 | 0.8000 | 0.9000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 |
| 86.4 | | 0.9000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 | 0.9000 | 1.0000 | 1.0000 |
| 160 | | 0.8000 | 0.6000 | 0.8000 | 0.6000 | 0.7000 | 0.7000 | 0.9000 | 1.0000 |

CETIS Analytical Report

Report Date: 16 Aug-17 09:27 (p 2 of 2)
 Test Code: SP1617-029 HA | 13-1522-0967

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 05-1874-4904
 Analyzed: 16 Aug-17 9:25

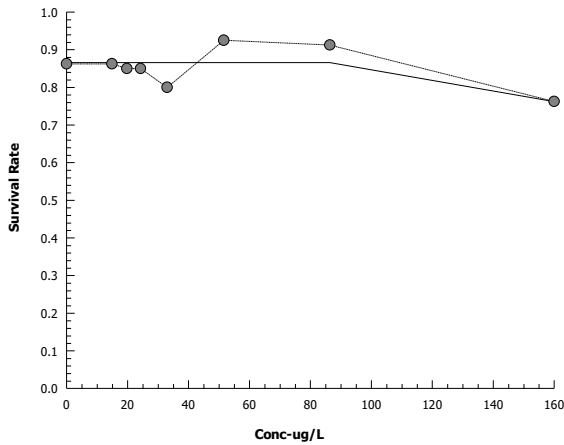
Endpoint: 42-d Survival Rate
 Analysis: Linear Interpolation (ICPIN)

CETIS Version: CETISv1.9.0
 Official Results: Yes

42-d Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | N | 8/10 | 7/10 | 9/10 | 9/10 | 9/10 | 9/10 | 10/10 | 8/10 |
| 14.9 | | 9/10 | 8/10 | 7/10 | 10/10 | 10/10 | 8/10 | 8/10 | 9/10 |
| 19.8 | | 7/10 | 10/10 | 7/10 | 9/10 | 9/10 | 8/10 | 9/10 | 9/10 |
| 24.3 | | 8/10 | 10/10 | 9/10 | 10/10 | 9/10 | 7/10 | 9/10 | 6/10 |
| 33 | | 9/10 | 10/10 | 7/10 | 7/10 | 8/10 | 7/10 | 8/10 | 8/10 |
| 51.6 | | 9/10 | 9/10 | 8/10 | 9/10 | 10/10 | 9/10 | 10/10 | 10/10 |
| 86.4 | | 9/10 | 10/10 | 8/10 | 8/10 | 9/10 | 9/10 | 10/10 | 10/10 |
| 160 | | 8/10 | 6/10 | 8/10 | 6/10 | 7/10 | 7/10 | 9/10 | 10/10 |

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 09:28 (p 1 of 3)
 Test Code: SP1617-029 HA | 13-1522-0967

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-----------------------------------|
| Analysis ID: 15-2361-2716 | Endpoint: 42-d Survival Rate | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:27 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 09-4919-8630 | Code: SP1617-029 | Client: |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|---------------------|---------|--------|------|-------|------|-------|------|----|-------|
| Angular (Corrected) | C > T | n/a | n/a | n/a | 160 | > 160 | n/a | | 15.6% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|------|----|--------|---------|------------------------|
| Negative Control | | 14.9 | -0.03513 | 2.399 | 0.18 | 14 | CDF | 0.8836 | Non-Significant Effect |
| | | 19.8 | 0.1934 | 2.399 | 0.18 | 14 | CDF | 0.8199 | Non-Significant Effect |
| | | 24.3 | 0.09687 | 2.399 | 0.18 | 14 | CDF | 0.8491 | Non-Significant Effect |
| | | 33 | 1.096 | 2.399 | 0.18 | 14 | CDF | 0.4326 | Non-Significant Effect |
| | | 51.6 | -1.21 | 2.399 | 0.18 | 14 | CDF | 0.9955 | Non-Significant Effect |
| | | 86.4 | -0.9734 | 2.399 | 0.18 | 14 | CDF | 0.9901 | Non-Significant Effect |
| | | 160 | 1.64 | 2.399 | 0.18 | 14 | CDF | 0.2113 | Non-Significant Effect |

Test Acceptability Criteria

| Attribute | Test Stat | TAC Limits | | Overlap | Decision |
|--------------|-----------|------------|-------|---------|-------------------------------|
| | | Lower | Upper | | |
| Control Resp | 0.8625 | 0.8 | >> | Yes | Passes Acceptability Criteria |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.357 | 3.224 | 1.0000 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|------------------------|
| Between | 0.281983 | 0.0402833 | 7 | 1.792 | 0.1071 | Non-Significant Effect |
| Error | 1.25916 | 0.022485 | 56 | | | |
| Total | 1.54115 | | 63 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 3.015 | 18.48 | 0.8836 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.98 | 0.9488 | 0.3839 | Normal Distribution |

42-d Survival Rate Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|--------|--------|---------|--------|---------|
| 0 | N | 8 | 0.8625 | 0.7859 | 0.9391 | 0.9000 | 0.7000 | 1.0000 | 0.0324 | 10.62% | 0.00% |
| 14.9 | | 8 | 0.8625 | 0.7738 | 0.9512 | 0.8500 | 0.7000 | 1.0000 | 0.0375 | 12.30% | 0.00% |
| 19.8 | | 8 | 0.8500 | 0.7606 | 0.9394 | 0.9000 | 0.7000 | 1.0000 | 0.0378 | 12.58% | 1.45% |
| 24.3 | | 8 | 0.8500 | 0.7318 | 0.9682 | 0.9000 | 0.6000 | 1.0000 | 0.0500 | 16.64% | 1.45% |
| 33 | | 8 | 0.8000 | 0.7106 | 0.8894 | 0.8000 | 0.7000 | 1.0000 | 0.0378 | 13.36% | 7.25% |
| 51.6 | | 8 | 0.9250 | 0.8659 | 0.9841 | 0.9000 | 0.8000 | 1.0000 | 0.0250 | 7.64% | -7.25% |
| 86.4 | | 8 | 0.9125 | 0.8427 | 0.9823 | 0.9000 | 0.8000 | 1.0000 | 0.0295 | 9.15% | -5.80% |
| 160 | | 8 | 0.7625 | 0.6448 | 0.8802 | 0.7500 | 0.6000 | 1.0000 | 0.0498 | 18.46% | 11.59% |

CETIS Analytical Report

Report Date: 16 Aug-17 09:28 (p 2 of 3)
Test Code: SP1617-029 HA | 13-1522-0967

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 15-2361-2716 **Endpoint:** 42-d Survival Rate **CETIS Version:** CETISv1.9.0
Analyzed: 16 Aug-17 9:27 **Analysis:** Parametric-Control vs Treatments **Official Results:** Yes

Angular (Corrected) Transformed Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|-------|---------|---------|--------|--------|-------|---------|--------|---------|
| 0 | N | 8 | 1.202 | 1.094 | 1.309 | 1.249 | 0.9912 | 1.412 | 0.0454 | 10.68% | 0.00% |
| 14.9 | | 8 | 1.204 | 1.076 | 1.332 | 1.178 | 0.9912 | 1.412 | 0.05412 | 12.71% | -0.22% |
| 19.8 | | 8 | 1.187 | 1.065 | 1.309 | 1.249 | 0.9912 | 1.412 | 0.0516 | 12.29% | 1.21% |
| 24.3 | | 8 | 1.194 | 1.037 | 1.352 | 1.249 | 0.8861 | 1.412 | 0.0665 | 15.75% | 0.60% |
| 33 | | 8 | 1.119 | 0.9962 | 1.243 | 1.107 | 0.9912 | 1.412 | 0.05214 | 13.17% | 6.84% |
| 51.6 | | 8 | 1.292 | 1.2 | 1.384 | 1.249 | 1.107 | 1.412 | 0.0389 | 8.51% | -7.55% |
| 86.4 | | 8 | 1.275 | 1.168 | 1.382 | 1.249 | 1.107 | 1.412 | 0.04525 | 10.04% | -6.07% |
| 160 | | 8 | 1.079 | 0.9268 | 1.231 | 1.049 | 0.8861 | 1.412 | 0.06426 | 16.85% | 10.23% |

42-d Survival Rate Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | N | 0.8000 | 0.7000 | 0.9000 | 0.9000 | 0.9000 | 0.9000 | 1.0000 | 0.8000 |
| 14.9 | | 0.9000 | 0.8000 | 0.7000 | 1.0000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 |
| 19.8 | | 0.7000 | 1.0000 | 0.7000 | 0.9000 | 0.9000 | 0.8000 | 0.9000 | 0.9000 |
| 24.3 | | 0.8000 | 1.0000 | 0.9000 | 1.0000 | 0.9000 | 0.7000 | 0.9000 | 0.6000 |
| 33 | | 0.9000 | 1.0000 | 0.7000 | 0.7000 | 0.8000 | 0.7000 | 0.8000 | 0.8000 |
| 51.6 | | 0.9000 | 0.9000 | 0.8000 | 0.9000 | 1.0000 | 0.9000 | 1.0000 | 1.0000 |
| 86.4 | | 0.9000 | 1.0000 | 0.8000 | 0.8000 | 0.9000 | 0.9000 | 1.0000 | 1.0000 |
| 160 | | 0.8000 | 0.6000 | 0.8000 | 0.6000 | 0.7000 | 0.7000 | 0.9000 | 1.0000 |

Angular (Corrected) Transformed Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|--------|--------|--------|--------|--------|--------|-------|--------|
| 0 | N | 1.107 | 0.9912 | 1.249 | 1.249 | 1.249 | 1.249 | 1.412 | 1.107 |
| 14.9 | | 1.249 | 1.107 | 0.9912 | 1.412 | 1.412 | 1.107 | 1.107 | 1.249 |
| 19.8 | | 0.9912 | 1.412 | 0.9912 | 1.249 | 1.249 | 1.107 | 1.249 | 1.249 |
| 24.3 | | 1.107 | 1.412 | 1.249 | 1.412 | 1.249 | 0.9912 | 1.249 | 0.8861 |
| 33 | | 1.249 | 1.412 | 0.9912 | 0.9912 | 1.107 | 0.9912 | 1.107 | 1.107 |
| 51.6 | | 1.249 | 1.249 | 1.107 | 1.249 | 1.412 | 1.249 | 1.412 | 1.412 |
| 86.4 | | 1.249 | 1.412 | 1.107 | 1.107 | 1.249 | 1.249 | 1.412 | 1.412 |
| 160 | | 1.107 | 0.8861 | 1.107 | 0.8861 | 0.9912 | 0.9912 | 1.249 | 1.412 |

42-d Survival Rate Binomials

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | N | 8/10 | 7/10 | 9/10 | 9/10 | 9/10 | 9/10 | 10/10 | 8/10 |
| 14.9 | | 9/10 | 8/10 | 7/10 | 10/10 | 10/10 | 8/10 | 8/10 | 9/10 |
| 19.8 | | 7/10 | 10/10 | 7/10 | 9/10 | 9/10 | 8/10 | 9/10 | 9/10 |
| 24.3 | | 8/10 | 10/10 | 9/10 | 10/10 | 9/10 | 7/10 | 9/10 | 6/10 |
| 33 | | 9/10 | 10/10 | 7/10 | 7/10 | 8/10 | 7/10 | 8/10 | 8/10 |
| 51.6 | | 9/10 | 9/10 | 8/10 | 9/10 | 10/10 | 9/10 | 10/10 | 10/10 |
| 86.4 | | 9/10 | 10/10 | 8/10 | 8/10 | 9/10 | 9/10 | 10/10 | 10/10 |
| 160 | | 8/10 | 6/10 | 8/10 | 6/10 | 7/10 | 7/10 | 9/10 | 10/10 |

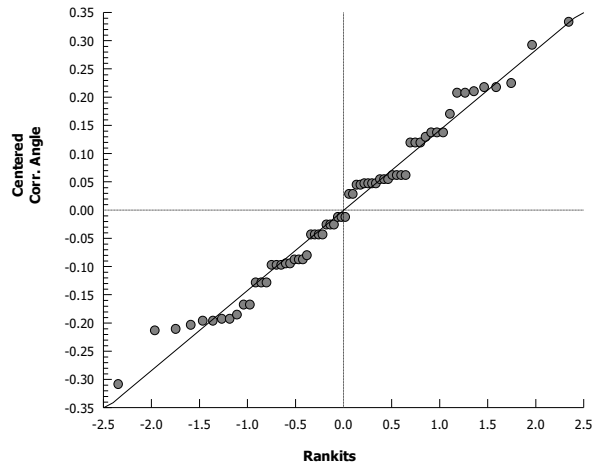
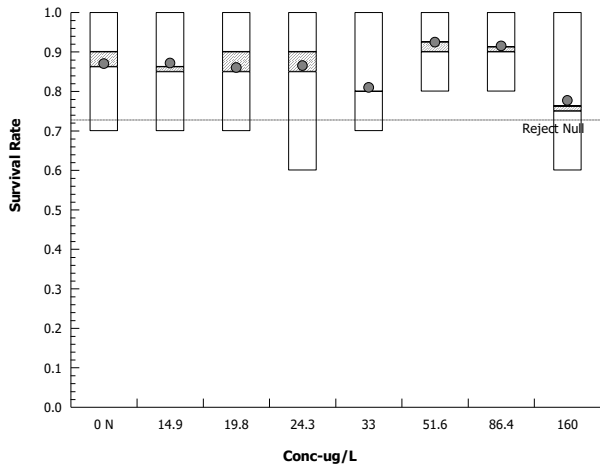
Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 15-2361-2716 Endpoint: 42-d Survival Rate
Analyzed: 16 Aug-17 9:27 Analysis: Parametric-Control vs Treatments

CETIS Version: CETISv1.9.0
Official Results: Yes

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 09:29 (p 1 of 2)
 Test Code: SP1617-029 HA | 13-1522-0967

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-----------------------------------|
| Analysis ID: 07-5739-6086 | Endpoint: 42-d Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:29 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 09-4919-8630 | Code: SP1617-029 | Client: |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Non-Linear Regression Options

| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
|---|--------------------|------------------|---------|---------|
| 3P Cumulative Log-Normal: $\mu=\alpha[1-\Phi[\log[x/\delta]/\gamma]]$ | Normal: $\omega=1$ | Off: $\mu^*=\mu$ | None | None |

Regression Summary

| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|-------|--------|--------|--------|--------|----------|--------|----------|---------|-----------------------------|
| 13 | 133.3 | -260.1 | -254.1 | 0.5602 | Yes | 0.8738 | 2.38 | 0.5046 | Non-Significant Lack of Fit |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| IC5 | 57.79 | n/a | 75.68 |
| IC10 | 72.89 | 45.14 | 91.86 |
| IC15 | 85.25 | 62.78 | 104.2 |
| IC20 | 96.55 | 76.83 | 114.9 |
| IC25 | 107.4 | 89.51 | 125.1 |
| IC40 | 140.6 | 122.2 | 160.5 |
| IC50 | 165.3 | 140.2 | 194.9 |

Regression Parameters

| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
|-----------|----------|-----------|---------|---------|--------|----------|--------------------------|
| α | 0.9181 | 0.02061 | 0.8768 | 0.9593 | 44.54 | <1.0E-37 | Significant Parameter |
| γ | 0.6391 | 0.1492 | 0.3408 | 0.9373 | 4.284 | 6.6E-05 | Significant Parameter |
| δ | 165.3 | 13.54 | 138.3 | 192.4 | 12.21 | <1.0E-37 | Significant Parameter |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Model | 46.54 | 15.51 | 3 | 967.1 | <1.0E-37 | Significant |
| Lack of Fit | 0.07082 | 0.01416 | 5 | 0.8738 | 0.5046 | Non-Significant |
| Pure Error | 0.9077 | 0.01621 | 56 | | | |
| Residual | 0.9785 | 0.01604 | 61 | | | |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|---------------|------------------------------------|-----------|----------|---------|--------------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.943 | 3.224 | 0.1504 | No Outliers Detected |
| Variances | Bartlett Equality of Variance Test | 6.045 | 14.07 | 0.5345 | Equal Variances |
| | Mod Levene Equality of Variance | 1.128 | 2.178 | 0.3591 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.976 | 0.9626 | 0.2466 | Normal Distribution |
| | Anderson-Darling A2 Normality Te | 0.2879 | 2.492 | 0.6489 | Normal Distribution |

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

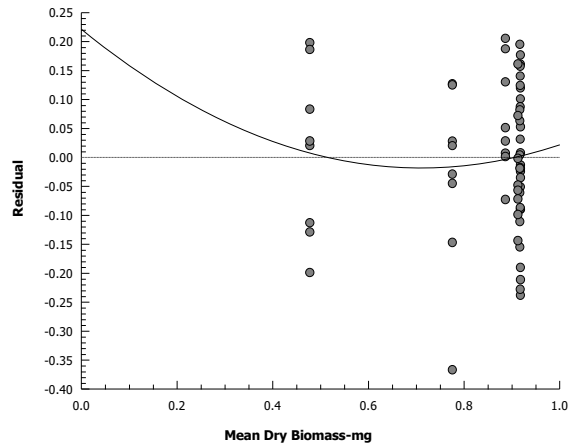
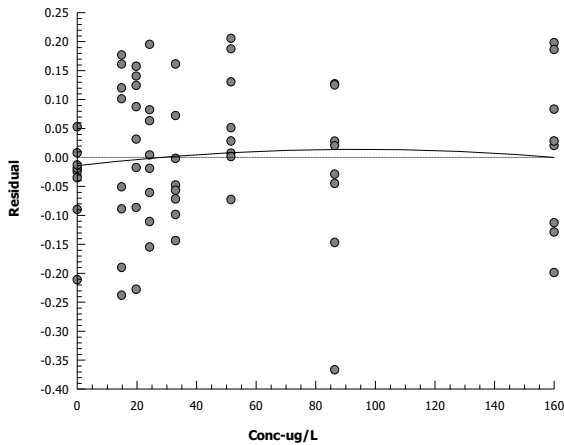
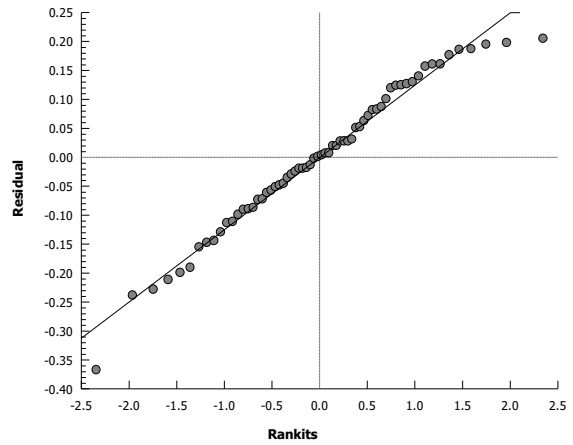
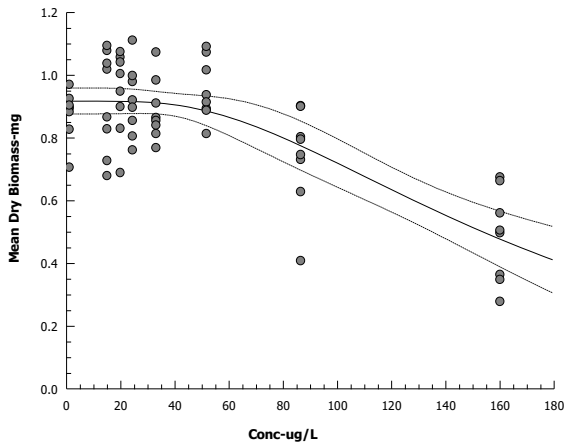
Analysis ID: 07-5739-6086 Endpoint: 42-d Mean Dry Biomass-mg CETIS Version: CETISv1.9.0
 Analyzed: 16 Aug-17 9:29 Analysis: Nonlinear Regression (NLR) Official Results: Yes

| 42-d Mean Dry Biomass-mg Summary | | | Calculated Variate | | | | | | |
|----------------------------------|------|-------|--------------------|-------|-------|---------|---------|--------|---------|
| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
| 0 | N | 8 | 0.8766 | 0.707 | 0.971 | 0.02807 | 0.0794 | 9.06% | 0.00% |
| 14.9 | | 8 | 0.9169 | 0.68 | 1.095 | 0.05749 | 0.1626 | 17.74% | -4.59% |
| 19.8 | | 8 | 0.9438 | 0.69 | 1.075 | 0.04681 | 0.1324 | 14.03% | -7.66% |
| 24.3 | | 8 | 0.9167 | 0.762 | 1.112 | 0.0399 | 0.1129 | 12.31% | -4.58% |
| 33 | | 8 | 0.8894 | 0.769 | 1.074 | 0.03483 | 0.0985 | 11.08% | -1.45% |
| 51.6 | | 8 | 0.954 | 0.814 | 1.092 | 0.03452 | 0.09765 | 10.24% | -8.83% |
| 86.4 | | 8 | 0.74 | 0.409 | 0.903 | 0.05697 | 0.1611 | 21.77% | 15.59% |
| 160 | | 8 | 0.4872 | 0.279 | 0.676 | 0.05179 | 0.1465 | 30.06% | 44.42% |

| 42-d Mean Dry Biomass-mg Detail | | | | | | | | | |
|---------------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
| 0 | N | 0.894 | 0.707 | 0.828 | 0.926 | 0.899 | 0.883 | 0.971 | 0.905 |
| 14.9 | | 1.079 | 0.829 | 0.728 | 1.019 | 1.095 | 0.68 | 0.867 | 1.038 |
| 19.8 | | 0.831 | 1.058 | 0.69 | 0.949 | 1.042 | 0.9 | 1.075 | 1.005 |
| 24.3 | | 0.856 | 0.98 | 0.921 | 1.112 | 0.898 | 0.806 | 0.999 | 0.762 |
| 33 | | 0.985 | 1.074 | 0.911 | 0.865 | 0.814 | 0.769 | 0.856 | 0.841 |
| 51.6 | | 0.938 | 0.894 | 0.814 | 0.915 | 1.074 | 0.888 | 1.092 | 1.017 |
| 86.4 | | 0.731 | 0.903 | 0.901 | 0.629 | 0.409 | 0.804 | 0.747 | 0.796 |
| 160 | | 0.676 | 0.279 | 0.498 | 0.506 | 0.365 | 0.349 | 0.561 | 0.664 |

Graphics Model: 3P Cumulative Log-Normal: $\mu = \alpha [1 - \Phi[\log(x/\delta)/\gamma]]$

Distribution: Normal [$\omega=1$]



CETIS Analytical Report

Report Date: 16 Aug-17 09:30 (p 1 of 2)
 Test Code: SP1617-029 HA | 13-1522-0967

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-----------------------------------|
| Analysis ID: 01-3612-0734 | Endpoint: 42-d Mean Dry Biomass-mg | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:30 | Analysis: Parametric-Control vs Treatments | Official Results: Yes |
| Batch ID: 09-2303-4928 | Test Type: Survival-Growth | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 09-4919-8630 | Code: SP1617-029 | Client: |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|------|-------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 86.4 | 160 | 117.6 | | 17.4% |

Dunnett Multiple Comparison Test

| Control | vs | Conc-ug/L | Test Stat | Critical | MSD | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|-------|----|--------|---------|------------------------|
| Negative Control | | 14.9 | -0.6323 | 2.399 | 0.153 | 14 | CDF | 0.9725 | Non-Significant Effect |
| | | 19.8 | -1.054 | 2.399 | 0.153 | 14 | CDF | 0.9924 | Non-Significant Effect |
| | | 24.3 | -0.6303 | 2.399 | 0.153 | 14 | CDF | 0.9723 | Non-Significant Effect |
| | | 33 | -0.2003 | 2.399 | 0.153 | 14 | CDF | 0.9184 | Non-Significant Effect |
| | | 51.6 | -1.215 | 2.399 | 0.153 | 14 | CDF | 0.9956 | Non-Significant Effect |
| | | 86.4 | 2.146 | 2.399 | 0.153 | 14 | CDF | 0.0854 | Non-Significant Effect |
| | | 160* | 6.117 | 2.399 | 0.153 | 14 | CDF | 9.5E-07 | Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|----------------------|
| Extreme Value | Grubbs Extreme Value Test | 2.758 | 3.224 | 0.2919 | No Outliers Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|----------|--------------------|
| Between | 1.39016 | 0.198594 | 7 | 12.25 | <1.0E-37 | Significant Effect |
| Error | 0.907723 | 0.0162093 | 56 | | | |
| Total | 2.29788 | | 63 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|---------------------|
| Variances | Bartlett Equality of Variance Test | 6.045 | 18.48 | 0.5345 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9761 | 0.9488 | 0.2486 | Normal Distribution |

42-d Mean Dry Biomass-mg Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|-------|-------|---------|--------|---------|
| 0 | N | 8 | 0.8766 | 0.8102 | 0.943 | 0.8965 | 0.707 | 0.971 | 0.02807 | 9.06% | 0.00% |
| 14.9 | | 8 | 0.9169 | 0.7809 | 1.053 | 0.943 | 0.68 | 1.095 | 0.05749 | 17.74% | -4.59% |
| 19.8 | | 8 | 0.9438 | 0.8331 | 1.054 | 0.977 | 0.69 | 1.075 | 0.04681 | 14.03% | -7.66% |
| 24.3 | | 8 | 0.9167 | 0.8224 | 1.011 | 0.9095 | 0.762 | 1.112 | 0.0399 | 12.31% | -4.58% |
| 33 | | 8 | 0.8894 | 0.807 | 0.9717 | 0.8605 | 0.769 | 1.074 | 0.03483 | 11.08% | -1.45% |
| 51.6 | | 8 | 0.954 | 0.8724 | 1.036 | 0.9265 | 0.814 | 1.092 | 0.03452 | 10.24% | -8.83% |
| 86.4 | | 8 | 0.74 | 0.6053 | 0.8747 | 0.7715 | 0.409 | 0.903 | 0.05697 | 21.77% | 15.59% |
| 160 | | 8 | 0.4872 | 0.3648 | 0.6097 | 0.502 | 0.279 | 0.676 | 0.05179 | 30.06% | 44.42% |

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

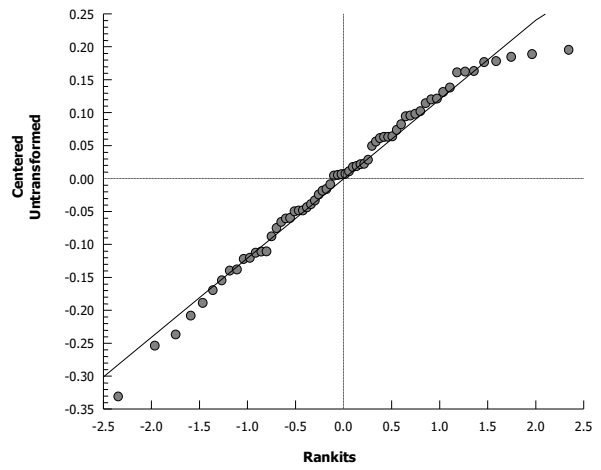
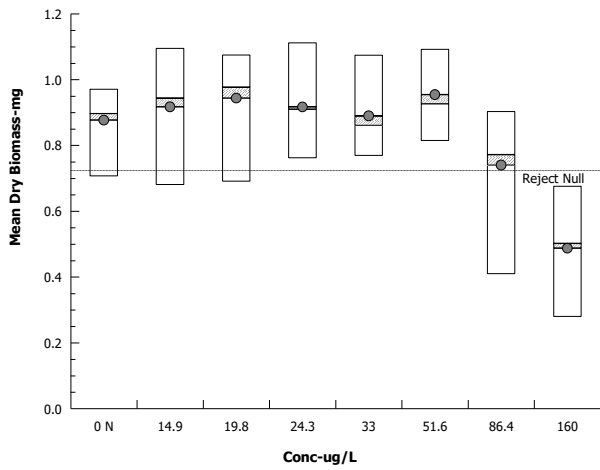
Nautilus Environmental Calgary

Analysis ID: 01-3612-0734 **Endpoint:** 42-d Mean Dry Biomass-mg **CETIS Version:** CETISv1.9.0
Analyzed: 16 Aug-17 9:30 **Analysis:** Parametric-Control vs Treatments **Official Results:** Yes

42-d Mean Dry Biomass-mg Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | N | 0.894 | 0.707 | 0.828 | 0.926 | 0.899 | 0.883 | 0.971 | 0.905 |
| 14.9 | | 1.079 | 0.829 | 0.728 | 1.019 | 1.095 | 0.68 | 0.867 | 1.038 |
| 19.8 | | 0.831 | 1.058 | 0.69 | 0.949 | 1.042 | 0.9 | 1.075 | 1.005 |
| 24.3 | | 0.856 | 0.98 | 0.921 | 1.112 | 0.898 | 0.806 | 0.999 | 0.762 |
| 33 | | 0.985 | 1.074 | 0.911 | 0.865 | 0.814 | 0.769 | 0.856 | 0.841 |
| 51.6 | | 0.938 | 0.894 | 0.814 | 0.915 | 1.074 | 0.888 | 1.092 | 1.017 |
| 86.4 | | 0.731 | 0.903 | 0.901 | 0.629 | 0.409 | 0.804 | 0.747 | 0.796 |
| 160 | | 0.676 | 0.279 | 0.498 | 0.506 | 0.365 | 0.349 | 0.561 | 0.664 |

Graphics



CETIS Analytical Report

Report Date: 16 Aug-17 09:38 (p 1 of 2)
 Test Code: SP1617-029 Har | 10-1411-0638

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 12-4389-8096 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:37 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes |
| Batch ID: 20-1465-8193 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Non-Linear Regression Options

| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
|---|----------------------|--------------------|---------|---------|
| 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$ | Normal: $\omega = 1$ | Off: $\mu^* = \mu$ | None | None |

Regression Summary

| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|-------|--------|-------|-------|--------|----------|--------|----------|---------|-----------------------------|
| 9 | -102.2 | 210.9 | 216.9 | 0.4479 | Yes | 1.91 | 2.383 | 0.1075 | Non-Significant Lack of Fit |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|--------|---------|---------|
| IC5 | 0.4234 | n/a | 3.92 |
| IC10 | 1.011 | n/a | 6.096 |
| IC15 | 1.732 | n/a | 8.697 |
| IC20 | 2.598 | n/a | 11.53 |
| IC25 | 3.632 | n/a | 14.46 |
| IC40 | 8.14 | 2.278 | 22.79 |
| IC50 | 13.05 | 6.105 | 27.9 |

Regression Parameters

| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
|-----------|----------|-----------|---------|---------|--------|----------|--------------------------|
| α | 17.68 | 1.82 | 14.04 | 21.33 | 9.715 | <1.0E-37 | Significant Parameter |
| γ | 0.8589 | 0.3385 | 0.1817 | 1.536 | 2.537 | 0.0138 | Significant Parameter |
| δ | 13.05 | 5.605 | 1.839 | 24.26 | 2.328 | 0.0233 | Significant Parameter |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Model | 4309 | 1436 | 3 | 54.13 | <1.0E-37 | Significant |
| Lack of Fit | 235.5 | 47.1 | 5 | 1.91 | 0.1075 | Non-Significant |
| Pure Error | 1357 | 24.66 | 55 | | | |
| Residual | 1592 | 26.53 | 60 | | | |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|---------------|----------------------------------|-----------|----------|----------|--------------------------|
| Extreme Value | Grubbs Extreme Value Test | 4.996 | 3.218 | 2.0E-07 | Outlier Detected |
| Variances | Mod Levene Equality of Variance | 2.036 | 2.185 | 0.0671 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.8149 | 0.9621 | 1.9E-07 | Non-Normal Distribution |
| | Anderson-Darling A2 Normality Te | 3.078 | 2.492 | <1.0E-37 | Non-Normal Distribution |

CETIS Analytical Report

Report Date: 16 Aug-17 09:38 (p 2 of 2)
 Test Code: SP1617-029 Har | 10-1411-0638

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 12-4389-8096
 Analyzed: 16 Aug-17 9:37

Endpoint: Reproduction
 Analysis: Nonlinear Regression (NLR)

CETIS Version: CETISv1.9.0
 Official Results: Yes

Reproduction Summary

Calculated Variate

| Conc-ug/L | Code | Count | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
|-----------|------|-------|--------|-----|-----|---------|---------|---------|---------|
| 0 | N | 8 | 17.75 | 7 | 43 | 4.358 | 12.33 | 69.44% | 0.00% |
| 14.9 | | 8 | 6.75 | 4 | 13 | 1.031 | 2.915 | 43.19% | 61.97% |
| 19.8 | | 8 | 10.38 | 6 | 18 | 1.322 | 3.739 | 36.04% | 41.55% |
| 23.4 | | 8 | 3.5 | 0 | 5 | 0.5669 | 1.604 | 45.82% | 80.28% |
| 33 | | 8 | 7.75 | 5 | 11 | 0.7962 | 2.252 | 29.06% | 56.34% |
| 51.6 | | 8 | 4.375 | 3 | 10 | 0.8224 | 2.326 | 53.17% | 75.35% |
| 86.4 | | 8 | 2.875 | 0 | 8 | 0.875 | 2.475 | 86.08% | 83.80% |
| 160 | | 7 | 0.2857 | 0 | 1 | 0.1844 | 0.488 | 170.78% | 98.39% |

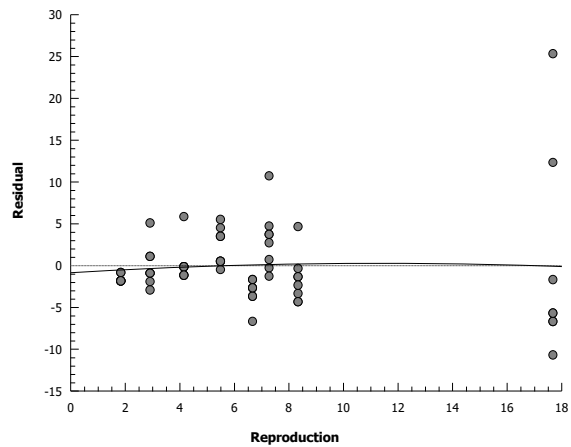
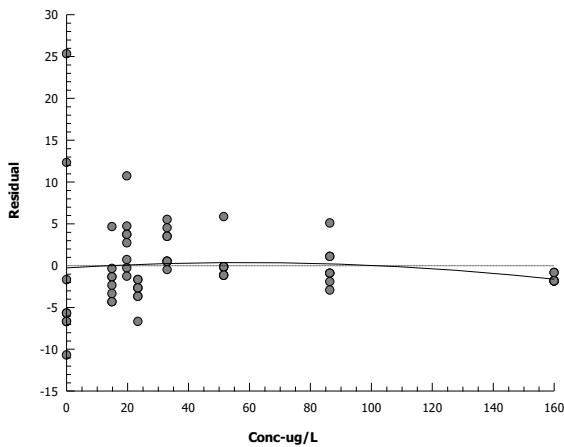
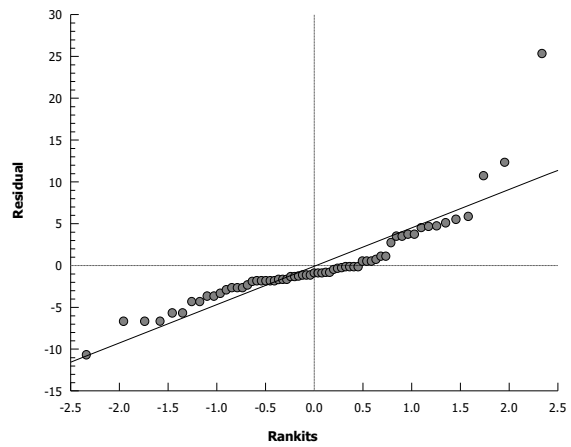
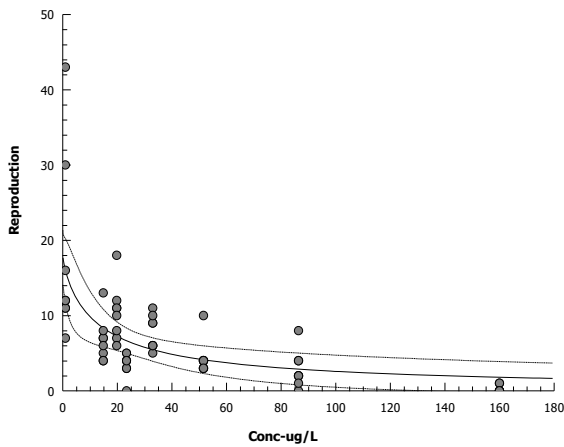
Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | N | 30 | 43 | 11 | 16 | 7 | 12 | 11 | 12 |
| 14.9 | | 5 | 7 | 7 | 13 | 4 | 6 | 8 | 4 |
| 19.8 | | 18 | 11 | 7 | 12 | 11 | 8 | 10 | 6 |
| 23.4 | | 5 | 3 | 4 | 4 | 3 | 0 | 5 | 4 |
| 33 | | 11 | 6 | 5 | 6 | 6 | 9 | 9 | 10 |
| 51.6 | | 3 | 4 | 10 | 3 | 4 | 4 | 4 | 3 |
| 86.4 | | 4 | 8 | 4 | 2 | 0 | 2 | 2 | 1 |
| 160 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |

Graphics

Model: 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$

Distribution: Normal [$\omega = 1$]



CETIS Analytical Report

Report Date: 16 Aug-17 09:39 (p 1 of 2)
 Test Code: SP1617-029 Har | 10-1411-0638

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|--|-------------------------------------|
| Analysis ID: 00-6127-6629 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 16 Aug-17 9:38 | Analysis: Nonparametric-Multiple Comparison | Official Results: Yes |
| Batch ID: 20-1465-8193 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|------|-------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 19.8 | 23.4 | 21.52 | | 36.6% |

Wilcoxon/Bonferroni Adj Test

| Control | vs | Control II | Test Stat | Critical | Ties | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|------------|-----------|----------|------|----|--------|---------|------------------------|
| Negative Control | | 14.9* | 43 | NA | 1 | 14 | Exact | 0.0250 | Significant Effect |
| | | 19.8 | 52.5 | NA | 3 | 14 | Exact | 0.3742 | Non-Significant Effect |
| | | 23.4* | 36 | NA | 0 | 14 | Exact | 5.4E-04 | Significant Effect |
| | | 33* | 41 | NA | 1 | 14 | Exact | 0.0082 | Significant Effect |
| | | 51.6* | 37 | NA | 0 | 14 | Exact | 0.0011 | Significant Effect |
| | | 86.4* | 37 | NA | 0 | 14 | Exact | 0.0011 | Significant Effect |
| | | 160* | 28 | NA | 0 | 13 | Exact | 0.0011 | Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 5.398 | 3.218 | 2.3E-07 | Outlier Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|---------|--------------------|
| Between | 1623.16 | 231.88 | 7 | 9.401 | 1.3E-07 | Significant Effect |
| Error | 1356.55 | 24.6646 | 55 | | | |
| Total | 2979.71 | | 62 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|----------|-------------------------|
| Variances | Bartlett Equality of Variance Test | 69.99 | 18.48 | <1.0E-37 | Unequal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.7527 | 0.9481 | 5.9E-09 | Non-Normal Distribution |

Reproduction Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|-----|-----|---------|---------|---------|
| 0 | N | 8 | 17.75 | 7.445 | 28.05 | | 7 | 43 | 4.358 | 69.44% | 0.00% |
| 14.9 | | 8 | 6.75 | 4.313 | 9.187 | | 4 | 13 | 1.031 | 43.19% | 61.97% |
| 19.8 | | 8 | 10.38 | 7.249 | 13.5 | | 6 | 18 | 1.322 | 36.04% | 41.55% |
| 23.4 | | 8 | 3.5 | 2.159 | 4.841 | | 0 | 5 | 0.5669 | 45.82% | 80.28% |
| 33 | | 8 | 7.75 | 5.867 | 9.633 | | 5 | 11 | 0.7962 | 29.06% | 56.34% |
| 51.6 | | 8 | 4.375 | 2.43 | 6.32 | | 3 | 10 | 0.8224 | 53.17% | 75.35% |
| 86.4 | | 8 | 2.875 | 0.806 | 4.944 | | 0 | 8 | 0.875 | 86.08% | 83.80% |
| 160 | | 7 | 0.2857 | -0.1656 | 0.737 | | 0 | 1 | 0.1844 | 170.78% | 98.39% |

CETIS Analytical Report

Report Date: 16 Aug-17 09:39 (p 2 of 2)
Test Code: SP1617-029 Har | 10-1411-0638

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 00-6127-6629 Endpoint: Reproduction CETIS Version: CETISv1.9.0
Analyzed: 16 Aug-17 9:38 Analysis: Nonparametric-Multiple Comparison Official Results: Yes

Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | N | 30 | 43 | 11 | 16 | 7 | 12 | 11 | 12 |
| 14.9 | | 5 | 7 | 7 | 13 | 4 | 6 | 8 | 4 |
| 19.8 | | 18 | 11 | 7 | 12 | 11 | 8 | 10 | 6 |
| 23.4 | | 5 | 3 | 4 | 4 | 3 | 0 | 5 | 4 |
| 33 | | 11 | 6 | 5 | 6 | 6 | 9 | 9 | 10 |
| 51.6 | | 3 | 4 | 10 | 3 | 4 | 4 | 4 | 3 |
| 86.4 | | 4 | 8 | 4 | 2 | 0 | 2 | 2 | 1 |
| 160 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | |

CETIS Analytical Report

Report Date: 27 Sep-17 10:53 (p 1 of 2)
 Test Code: SP1617-029 Har | 10-1411-0638

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|---|-------------------------------------|
| Analysis ID: 06-1575-9035 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 27 Sep-17 10:52 | Analysis: Nonlinear Regression (NLR) | Official Results: Yes |
| Batch ID: 20-1465-8193 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

Non-Linear Regression Options

| Model Name and Function | Weighting Function | PTBS Function | X Trans | Y Trans |
|---|----------------------|--------------------|---------|---------|
| 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$ | Normal: $\omega = 1$ | Off: $\mu^* = \mu$ | None | None |

Regression Summary

| Iters | Log LL | AICc | BIC | Adj R2 | Optimize | F Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|-------|--------|-------|-------|--------|----------|--------|----------|---------|--------------------------|
| 7 | -60.93 | 128.3 | 133.9 | 0.3726 | Yes | 8.272 | 2.565 | 0.0000 | Significant Lack of Fit |

Point Estimates

| Level | ug/L | 95% LCL | 95% UCL |
|-------|-------|---------|---------|
| IC5 | 21.27 | n/a | 38.85 |
| IC10 | 28.35 | n/a | 43.15 |
| IC15 | 33.86 | n/a | 50.04 |
| IC20 | 38.71 | n/a | 56.72 |
| IC25 | 43.23 | 17.53 | 62.88 |
| IC40 | 56.42 | 36.46 | 80.07 |
| IC50 | 65.94 | 46.08 | 94.35 |

Regression Parameters

| Parameter | Estimate | Std Error | 95% LCL | 95% UCL | t Stat | P-Value | Decision($\alpha:5\%$) |
|-----------|----------|-----------|---------|---------|--------|----------|---------------------------|
| α | 7.511 | 1.013 | 5.478 | 9.544 | 7.413 | <1.0E-37 | Significant Parameter |
| γ | 2.603 | 1.353 | -0.1123 | 5.318 | 1.924 | 0.0599 | Non-Significant Parameter |
| δ | 65.94 | 14.51 | 36.81 | 95.06 | 4.543 | 3.3E-05 | Significant Parameter |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision($\alpha:5\%$) |
|-------------|-------------|-------------|----|--------|----------|--------------------------|
| Model | 1822 | 607.3 | 3 | 63.79 | <1.0E-37 | Significant |
| Lack of Fit | 202 | 50.51 | 4 | 8.272 | 3.7E-05 | Significant |
| Pure Error | 293.1 | 6.105 | 48 | | | |
| Residual | 495.1 | 9.521 | 52 | | | |

Residual Analysis

| Attribute | Method | Test Stat | Critical | P-Value | Decision($\alpha:5\%$) |
|---------------|----------------------------------|-----------|----------|----------|--------------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.568 | 3.166 | 0.0080 | Outlier Detected |
| Variances | Mod Levene Equality of Variance | 1.364 | 2.299 | 0.2487 | Equal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9206 | 0.9575 | 0.0014 | Non-Normal Distribution |
| | Anderson-Darling A2 Normality Te | 1.787 | 2.492 | <1.0E-37 | Non-Normal Distribution |

Reproduction Summary

| Conc-ug/L | Code | Count | Calculated Variate | | | | | | |
|-----------|------|-------|--------------------|-----|-----|---------|---------|---------|---------|
| | | | Mean | Min | Max | Std Err | Std Dev | CV% | %Effect |
| 14.9 | N | 8 | 6.75 | 4 | 13 | 1.031 | 2.915 | 43.19% | 0.00% |
| 19.8 | | 8 | 10.38 | 6 | 18 | 1.322 | 3.739 | 36.04% | -53.70% |
| 23.4 | | 8 | 3.5 | 0 | 5 | 0.5669 | 1.604 | 45.82% | 48.15% |
| 33 | | 8 | 7.75 | 5 | 11 | 0.7962 | 2.252 | 29.06% | -14.81% |
| 51.6 | | 8 | 4.375 | 3 | 10 | 0.8224 | 2.326 | 53.17% | 35.19% |
| 86.4 | | 8 | 2.875 | 0 | 8 | 0.875 | 2.475 | 86.08% | 57.41% |
| 160 | | 7 | 0.2857 | 0 | 1 | 0.1844 | 0.488 | 170.78% | 95.77% |

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 06-1575-9035 Endpoint: Reproduction
 Analyzed: 27 Sep-17 10:52 Analysis: Nonlinear Regression (NLR)

CETIS Version: CETISv1.9.0
 Official Results: Yes

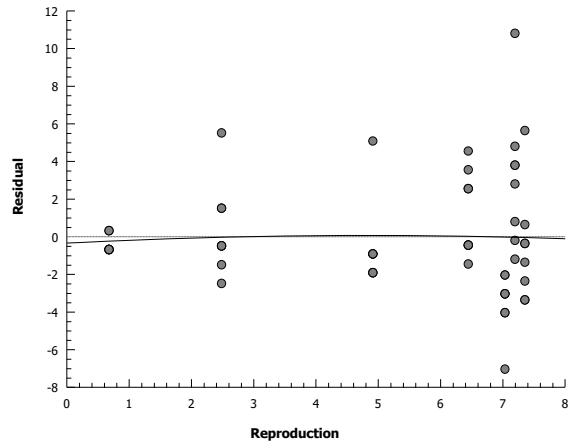
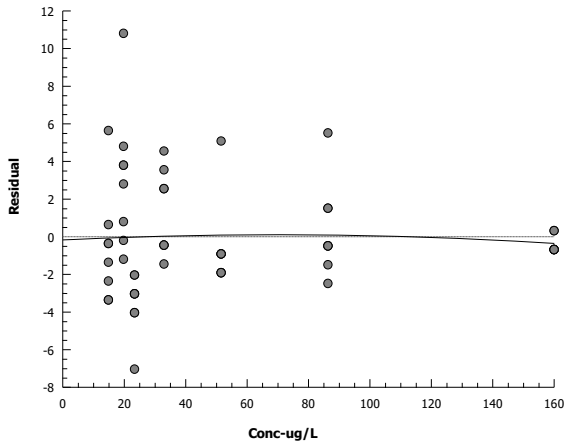
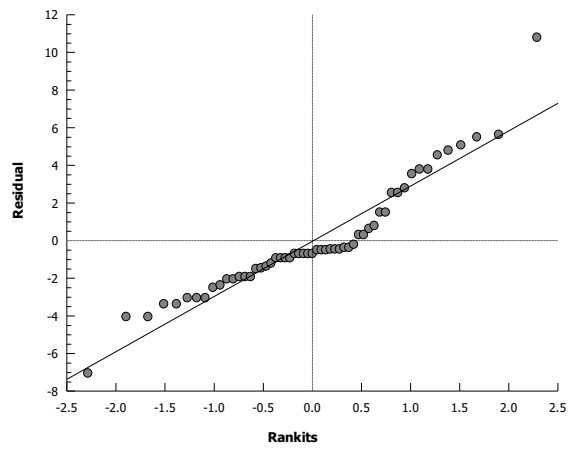
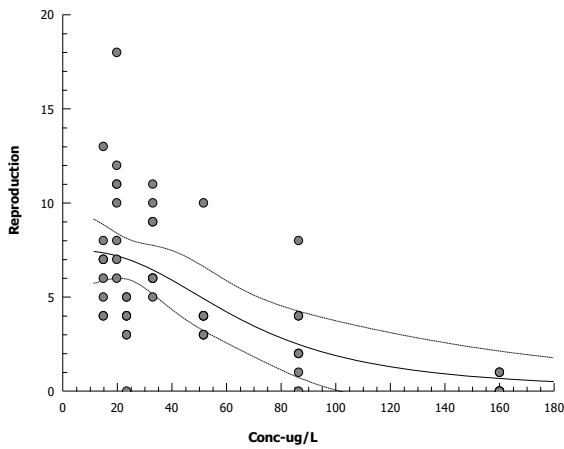
Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 14.9 | N | 5 | 7 | 7 | 13 | 4 | 6 | 8 | 4 |
| 19.8 | | 18 | 11 | 7 | 12 | 11 | 8 | 10 | 6 |
| 23.4 | | 5 | 3 | 4 | 4 | 3 | 0 | 5 | 4 |
| 33 | | 11 | 6 | 5 | 6 | 6 | 9 | 9 | 10 |
| 51.6 | | 3 | 4 | 10 | 3 | 4 | 4 | 4 | 3 |
| 86.4 | | 4 | 8 | 4 | 2 | 0 | 2 | 2 | 1 |
| 160 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | |

Graphics

Model: 3P Log-Logistic: $\mu = \alpha / [1 + (x/\delta)^\gamma]$

Distribution: Normal [$\omega = 1$]



CETIS Analytical Report

Report Date: 27 Sep-17 10:56 (p 1 of 2)
 Test Code: SP1617-029 Har | 10-1411-0638

Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

| | | |
|----------------------------------|--|-------------------------------------|
| Analysis ID: 18-0810-7755 | Endpoint: Reproduction | CETIS Version: CETISv1.9.0 |
| Analyzed: 27 Sep-17 10:55 | Analysis: Nonparametric-Multiple Comparison | Official Results: Yes |
| Batch ID: 20-1465-8193 | Test Type: Survival-Reproduction | Analyst: Leila Oosterbroek |
| Start Date: 25 May-17 | Protocol: EPA/600/R-99/064 (2000) | Diluent: Not Applicable |
| Ending Date: 06 Jul-17 | Species: Hyalella azteca | Brine: |
| Duration: 42d 0h | Source: Chesapeake Cultures | Age: |
| Sample ID: 02-7886-7783 | Code: SP1617-029 | Client: Minnow Environmental |
| Sample Date: 05 May-17 | Material: Dissolved Copper | Project: |
| Receipt Date: 12 May-17 | Source: Minnow Environmental | |
| Sample Age: 20d 0h (6 °C) | Station: Minto | |

| Data Transform | Alt Hyp | Trials | Seed | TST b | NOEL | LOEL | TOEL | TU | PMSD |
|----------------|---------|--------|------|-------|------|------|-------|----|-------|
| Untransformed | C > T | n/a | n/a | n/a | 51.6 | 86.4 | 66.77 | | 47.0% |

Wilcoxon/Bonferroni Adj Test

| Control | vs | Conc-ug/L | Test Stat | Critical | Ties | DF | P-Type | P-Value | Decision(α:5%) |
|------------------|----|-----------|-----------|----------|------|----|--------|---------|------------------------|
| Negative Control | | 19.8 | 87 | NA | 3 | 14 | Exact | 1.0000 | Non-Significant Effect |
| | | 23.4* | 44 | NA | 2 | 14 | Exact | 0.0312 | Significant Effect |
| | | 33 | 77 | NA | 2 | 14 | Exact | 1.0000 | Non-Significant Effect |
| | | 51.6 | 47 | NA | 1 | 14 | Exact | 0.0639 | Non-Significant Effect |
| | | 86.4* | 44.5 | NA | 2 | 14 | Exact | 0.0340 | Significant Effect |
| | | 160* | 28 | NA | 0 | 13 | Exact | 9.3E-04 | Significant Effect |

Auxiliary Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:5%) |
|---------------|---------------------------|-----------|----------|---------|------------------|
| Extreme Value | Grubbs Extreme Value Test | 3.273 | 3.166 | 0.0317 | Outlier Detected |

ANOVA Table

| Source | Sum Squares | Mean Square | DF | F Stat | P-Value | Decision(α:5%) |
|---------|-------------|-------------|----|--------|----------|--------------------|
| Between | 526.328 | 87.7214 | 6 | 14.37 | <1.0E-37 | Significant Effect |
| Error | 293.054 | 6.10528 | 48 | | | |
| Total | 819.382 | | 54 | | | |

Distributional Tests

| Attribute | Test | Test Stat | Critical | P-Value | Decision(α:1%) |
|--------------|------------------------------------|-----------|----------|---------|-------------------------|
| Variances | Bartlett Equality of Variance Test | 18.49 | 16.81 | 0.0051 | Unequal Variances |
| Distribution | Shapiro-Wilk W Normality Test | 0.9119 | 0.9417 | 6.6E-04 | Non-Normal Distribution |

Reproduction Summary

| Conc-ug/L | Code | Count | Mean | 95% LCL | 95% UCL | Median | Min | Max | Std Err | CV% | %Effect |
|-----------|------|-------|--------|---------|---------|--------|-----|-----|---------|---------|---------|
| 14.9 | N | 8 | 6.75 | 4.313 | 9.187 | 6.5 | 4 | 13 | 1.031 | 43.19% | 0.00% |
| 19.8 | | 8 | 10.38 | 7.249 | 13.5 | 10.5 | 6 | 18 | 1.322 | 36.04% | -53.70% |
| 23.4 | | 8 | 3.5 | 2.159 | 4.841 | 4 | 0 | 5 | 0.5669 | 45.82% | 48.15% |
| 33 | | 8 | 7.75 | 5.867 | 9.633 | 7.5 | 5 | 11 | 0.7962 | 29.06% | -14.81% |
| 51.6 | | 8 | 4.375 | 2.43 | 6.32 | 4 | 3 | 10 | 0.8224 | 53.17% | 35.19% |
| 86.4 | | 8 | 2.875 | 0.806 | 4.944 | 2 | 0 | 8 | 0.875 | 86.08% | 57.41% |
| 160 | | 7 | 0.2857 | -0.1656 | 0.737 | 0 | 0 | 1 | 0.1844 | 170.78% | 95.77% |

Reproduction Detail

| Conc-ug/L | Code | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep 6 | Rep 7 | Rep 8 |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 14.9 | N | 5 | 7 | 7 | 13 | 4 | 6 | 8 | 4 |
| 19.8 | | 18 | 11 | 7 | 12 | 11 | 8 | 10 | 6 |
| 23.4 | | 5 | 3 | 4 | 4 | 3 | 0 | 5 | 4 |
| 33 | | 11 | 6 | 5 | 6 | 6 | 9 | 9 | 10 |
| 51.6 | | 3 | 4 | 10 | 3 | 4 | 4 | 4 | 3 |
| 86.4 | | 4 | 8 | 4 | 2 | 0 | 2 | 2 | 1 |
| 160 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | |

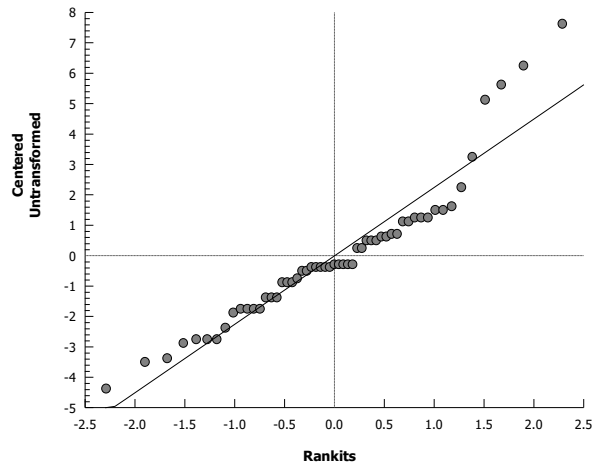
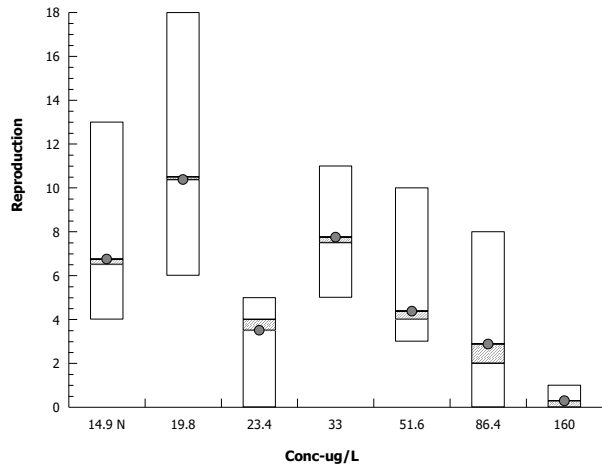
Hyalella 42-d Survival, Growth, and Reproduction Sediment Test

Nautilus Environmental Calgary

Analysis ID: 18-0810-7755 Endpoint: Reproduction
Analyzed: 27 Sep-17 10:55 Analysis: Nonparametric-Multiple Comparison

CETIS Version: CETISv1.9.0
Official Results: Yes

Graphics



APPENDIX E – Analytical Chemistry Data



NAUTILUS ENVIRONMENTAL
ATTN: Emma Marcus
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 25-MAY-17
Report Date: 01-JUN-17 18:14 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L1931693
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1931693-1 | L1931693-2 | L1931693-3 | L1931693-4 | L1931693-5 |
|-------------------------|--------------------------------------|--------------|--------------|-----------|---|--|---|---|---|
| | | | | | L1931693-1 WATER 25-MAY-17 MHW CONTROL | L1931693-2 WATER 25-MAY-17 5 UG/L | L1931693-3 WATER 25-MAY-17 10 UG/L | L1931693-4 WATER 25-MAY-17 20 UG/L | L1931693-5 WATER 25-MAY-17 40 UG/L |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Total Metals | Copper (Cu)-Total (mg/L) | 0.00054 | 0.0266 | 0.0323 | 0.0425 | 0.0615 | | | |
| Dissolved Metals | Dissolved Metals Filtration Location | LAB | LAB | LAB | LAB | LAB | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00032 | 0.0249 | 0.0304 | 0.0394 | 0.0569 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1931693-6 WATER 25-MAY-17 80 UG/L | L1931693-7 WATER 25-MAY-17 160 UG/L | L1931693-8 WATER 25-MAY-17 SITE CONTROL | | |
|-------------------------|--|---|--|--|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Total Metals | Copper (Cu)-Total (mg/L) | 0.0999 | 0.173 | 0.0231 | | |
| Dissolved Metals | Dissolved Metals Filtration Location | LAB | LAB | LAB | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0897 | 0.173 | 0.0201 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Samples Listed:

| Sample Number | Client Sample ID | Qualifier | Description |
|---------------|------------------|-----------|---|
| L1931693-7 | 160 UG/L | LPMB | Lab-Preserved for Total Metals. Sample received with pH > 2 and preserved at the lab. Total Metals results may be biased low. |
| L1931693-8 | SITE CONTROL | LPMB | Lab-Preserved for Total Metals. Sample received with pH > 2 and preserved at the lab. Total Metals results may be biased low. |

QC Samples with Qualifiers & Comments:

| QC Type | Description | Parameter | Qualifier | Applies to Sample Number(s) |
|--------------|-------------|-----------------------|-----------|--------------------------------|
| Matrix Spike | | Copper (Cu)-Dissolved | MS-B | L1931693-1, -2, -3, -4, -5, -6 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|------------------------|
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



TESTING LOCATION (Please Circle)

Burnaby (circle)
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8273

Calgary
#4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

Chain of Custody

Date: May 25 17 Page 17 of 1

Receipt Temperature (°C)

ANALYSES REQUIRED

(Cu total (low levels))
(Cu dissolved (low levels))

Invoice To: Company: _____ Address: _____ City/Prov/PC: _____ Contact: _____ Phone: _____ Email: _____ PO No.: _____

Report to: Company: Nautilus Environmental Address: _____ City/Prov/PC: _____ Contact: Emma Marus Phone: 604 420 8273 Email: emma@nautilusenvironmental.ca

Sample Collection By: _____

| SAMPLE ID | DATE (DD/MM/YY) | TIME | MATRIX | # OF CONTAINERS AND VOLUME (e.g. 1 x 20 L) | COMMENTS |
|-------------|-----------------|------|--------|--|------------------|
| MHW control | 25/05/17 | MA | water | 1 x 125ml | test termination |
| 5 µg/L Cu | | | | | |
| 10 µg/L Cu | | | | | |
| 20 µg/L Cu | | | | | |
| 40 µg/L Cu | | | | | |
| 80 µg/L Cu | | | | | |
| 160 µg/L Cu | | | | | |
| SMB control | | | | | |

| SAMPLE DESCRIPTION AND COMMENTS (LABORATORY) | 4. Ice Present in Cooler? | Y/N |
|--|---------------------------|-----|
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| SPECIAL INSTRUCTIONS/COMMENTS (CLIENT) | 1. Total No. of Containers | 4. Ice Present in Cooler? | Y/N |
|---|----------------------------|---------------------------|-------|
| * (low levels) * not filtered, not preserved | | | |
| RECEIVED BY (LABORATORY) | | | |
| EMMA MARUS (Signature) _____ | 5/25/17 | 17:15 | |
| Nautilus Environmental (Company) | 170517 | 05/25/17 | 17:15 |
| | 22°C | | |

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.



NAUTILUS ENVIRONMENTAL
ATTN: Emma Marcus
8664 Commerce Court
Imperial Square Lake City
Burnaby BC V5A 4N7

Date Received: 23-MAY-17
Report Date: 01-JUN-17 17:04 (MT)
Version: FINAL

Client Phone: 604-420-8773

Certificate of Analysis

Lab Work Order #: L1930018
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Heather McKenzie
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | Description | Sampled Date | Sampled Time | Client ID | L1930018-1 | L1930018-2 | L1930018-3 | L1930018-4 | L1930018-5 |
|-----------------------------------|--------------------------------------|--------------|--------------|-----------|---|---|--|--|--|
| | | | | | L1930018-1 Water 10-MAY-17 MHW CONTROL | L1930018-2 Water 10-MAY-17 5 UG/L CU | L1930018-3 Water 10-MAY-17 10 UG/L CU | L1930018-4 Water 10-MAY-17 20 UG/L CU | L1930018-5 Water 10-MAY-17 40 UG/L CU |
| Grouping | Analyte | | | | | | | | |
| WATER | | | | | | | | | |
| Anions and Nutrients | Alkalinity, Total (as CaCO3) (mg/L) | | | | 71 | | | | |
| | Chloride (Cl) (mg/L) | | | | 2.86 | | | | |
| | Sulfate (SO4) (mg/L) | | | | 21.6 | | | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | | | | | | | |
| Total Metals | Copper (Cu)-Total (mg/L) | | | | 0.00088 | 0.0301 | 0.0357 | 0.0447 | 0.0654 |
| Dissolved Metals | Dissolved Metals Filtration Location | | | | LAB | LAB | LAB | LAB | LAB |
| | Copper (Cu)-Dissolved (mg/L) | | | | 0.00034 | 0.0242 | 0.0295 | 0.0386 | 0.0558 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1930018-6 Water 10-MAY-17 80 UG/L CU | L1930018-7 Water 10-MAY-17 160 UG/L CU | L1930018-8 Water 10-MAY-17 RATIO WATER | | |
|-----------------------------------|--|--|---|---|--|--|
| Grouping | Analyte | | | | | |
| WATER | | | | | | |
| Anions and Nutrients | Alkalinity, Total (as CaCO3) (mg/L) | | | 87 | | |
| | Chloride (Cl) (mg/L) | | | 2.84 | | |
| | Sulfate (SO4) (mg/L) | | | 21.4 | | |
| Organic / Inorganic Carbon | Dissolved Organic Carbon (mg/L) | | | 25.5 | | |
| Total Metals | Copper (Cu)-Total (mg/L) | 0.0953 | 0.186 | 0.0241 | | |
| Dissolved Metals | Dissolved Metals Filtration Location | LAB | LAB | LAB | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0909 | 0.163 | 0.0199 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

| Qualifier | Description |
|-----------|---|
| LPML | Lab-Preserved for Total Metals. Sample received with pH > 2 and preserved at the lab. Total Metals results may be biased low. |

QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---------------------|--------------------------|-----------|-----------------------------|
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1930018-8 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1930018-8 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1930018-1, -8 |

Qualifiers for Individual Parameters Listed:

| Qualifier | Description |
|-----------|--|
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|---|---------------------------------------|
| ALK-COL-VA | Water | Alkalinity by Colourimetric (Automated) | EPA 310.2 |
| This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method. | | | |
| CARBONS-DOC-VA | Water | Dissolved organic carbon by combustion | APHA 5310B TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| CL-IC-N-VA | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| EC-SCREEN-VA | Water | Conductivity Screen (Internal Use Only) | APHA 2510 |
| Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc. | | | |
| MET-D-CCMS-VA | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-T-CCMS-VA | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| SO4-IC-N-VA | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L1930018-COFC

SAL

TESTING LOCATION (Please Circle)

Burnaby 8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 2K7
Phone 604.420.8773

Calgary #4, 6125 12 Street SE
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

Chain of Custody

Date May 17 Page 1 of 1

| Report to: Company: Nautilus Environmental Address: <u>(+)</u> City/Prov/PC: <u>EMMA MANUS</u> Contact: <u>emma@nautilusenvironmental.ca</u> Phone: <u>604 420 8773</u> Email: <u>ca</u> | | Invoice To: Company: <u>Same as report to</u> Address: _____ City/Prov/PC: _____ Contact: _____ Phone: _____ Email: _____ PO No.: _____ | | | |
|---|-----------------|---|--------|--|-------------------------|
| Sample Collection By: _____ Sample Type: <input type="radio"/> Grab <input type="radio"/> OR <input type="radio"/> Composite | | | | | |
| SAMPLE ID | DATE (DD/MM/YY) | TIME | MATRIX | # OF CONTAINERS AND VOLUME (e.g. 1 x 20 L) | COMMENTS |
| 1 | 10517 | 12:12 | water | ONE 125 mL plastic | Day 0 - test initiation |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | ONE 1-L plastic | ↓ |
| 9 | | | | | |
| 10 | | | | | |

| ANALYSES REQUIRED | Receipt Temperature (°C) |
|---------------------------|--------------------------|
| Total Cu (low levels) | X |
| Dissolved Cu (low levels) | X |
| low level metals | X |
| alkalinity | X |
| Sulphate | X |
| Chloride | X |
| DOC | X |

| SPECIAL INSTRUCTIONS/COMMENTS (CLIENT) | SAMPLE RECEIPT DETAILS (LABORATORY) | | |
|---|-------------------------------------|---------------------------|-----|
| | 1. Total No. of Containers | 4. Ice Present in Cooler? | Y/N |
| * low levels * not filtered, not preserved | | | |
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Short Holding Time
Rush Processing

| RELINQUISHED BY (CLIENT) | RECEIVED BY (LABORATORY) |
|--|---|
| (Printed Name): <u>EMMA MANUS</u> (Signature): <u>[Signature]</u> (Date DD/MM/YY and Time): <u>10517 12:12</u> | RECEIVED BY (LABORATORY) (Printed Name): <u>Moneer Shaq</u> (Signature): <u>[Signature]</u> (Date DD/MM/YY and Time): <u>16:55 May 23/17</u> |

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.



Nautilus Environmental
ATTN: Leila Oosterbroek / Bryon Shore
#4, 6125 - 12 Street SE
Calgary AB T2H 2K1

Date Received: 24-MAY-17
Report Date: 31-MAY-17 18:47 (MT)
Version: FINAL

Client Phone: 403-253-7121

Certificate of Analysis

Lab Work Order #: L1930675
Project P.O. #: 2016-1161
Job Reference:
C of C Numbers:
Legal Site Desc:

Nelson Kwan, B.Sc.
Account Manager

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ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|----------|------------|---------|-------|-----------|-----------|----------|
| L1930675-1 SP1617-029; LAB CONTROL DA - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 30-MAY-17 | R3735671 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | | 30-MAY-17 | R3735690 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | <0.00050 | | 0.00050 | mg/L | | 30-MAY-17 | R3735690 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 1.70 | | 0.50 | mg/L | | 25-MAY-17 | R3735229 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 30-MAY-17 | R3735845 |
| Calcium (Ca)-Dissolved | 9.90 | | 0.10 | mg/L | | 30-MAY-17 | R3735915 |
| Magnesium (Mg)-Dissolved | 10.7 | | 0.10 | mg/L | | 30-MAY-17 | R3735915 |
| Potassium (K)-Dissolved | 2.22 | | 0.50 | mg/L | | 30-MAY-17 | R3735915 |
| Sodium (Na)-Dissolved | 27.7 | | 1.0 | mg/L | | 30-MAY-17 | R3735915 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | <0.020 | | 0.020 | mg/L | | 25-MAY-17 | R3735229 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 99.1 | | | % | | 31-MAY-17 | |
| TDS (Calculated) | 156 | | | mg/L | | 31-MAY-17 | |
| Hardness (as CaCO3) | 68.8 | | | mg/L | | 31-MAY-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | <0.020 | | 0.020 | mg/L | | 25-MAY-17 | R3735229 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | <0.050 | | 0.050 | mg/L | | 29-MAY-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 25-MAY-17 | R3735229 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 68.5 | | 0.30 | mg/L | | 25-MAY-17 | R3735229 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 7.90 | | 0.10 | pH | | 31-MAY-17 | R3736730 |
| Conductivity (EC) | 245 | | 2.0 | uS/cm | | 31-MAY-17 | R3736730 |
| Bicarbonate (HCO3) | 72.4 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Alkalinity, Total (as CaCO3) | 59.3 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| L1930675-2 SP1617-029; LAB CONTROL FM - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 30-MAY-17 | R3735671 |
| Copper (Cu)-Dissolved | 0.00055 | | 0.00020 | mg/L | | 30-MAY-17 | R3735690 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.00069 | | 0.00050 | mg/L | | 30-MAY-17 | R3735690 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 14.2 | | 0.50 | mg/L | | 25-MAY-17 | R3735229 |
| Dissolved Metals by ICPOES | | | | | | | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|----------|------------|---------|-------|-----------|-----------|----------|
| L1930675-2 SP1617-029; LAB CONTROL FM - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER | | | | | | | |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 30-MAY-17 | R3735845 |
| Calcium (Ca)-Dissolved | 59.4 | | 0.10 | mg/L | | 30-MAY-17 | R3735915 |
| Magnesium (Mg)-Dissolved | 16.6 | | 0.10 | mg/L | | 30-MAY-17 | R3735915 |
| Potassium (K)-Dissolved | 3.26 | | 0.50 | mg/L | | 30-MAY-17 | R3735915 |
| Sodium (Na)-Dissolved | 11.4 | | 1.0 | mg/L | | 30-MAY-17 | R3735915 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.135 | | 0.020 | mg/L | | 25-MAY-17 | R3735229 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 102 | | | % | | 31-MAY-17 | |
| TDS (Calculated) | 269 | | | mg/L | | 31-MAY-17 | |
| Hardness (as CaCO3) | 217 | | | mg/L | | 31-MAY-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.077 | | 0.020 | mg/L | | 25-MAY-17 | R3735229 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.077 | | 0.050 | mg/L | | 29-MAY-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 25-MAY-17 | R3735229 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 84.8 | | 0.30 | mg/L | | 25-MAY-17 | R3735229 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.41 | | 0.10 | pH | | 31-MAY-17 | R3736730 |
| Conductivity (EC) | 411 | | 2.0 | uS/cm | | 31-MAY-17 | R3736730 |
| Bicarbonate (HCO3) | 147 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Carbonate (CO3) | 6.2 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Alkalinity, Total (as CaCO3) | 131 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| L1930675-3 SP1617-029; LAB CONTROL HA - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 30-MAY-17 | R3735671 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | | 30-MAY-17 | R3735690 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | <0.00050 | | 0.00050 | mg/L | | 30-MAY-17 | R3735690 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 74.9 | | 0.50 | mg/L | | 25-MAY-17 | R3735229 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 30-MAY-17 | R3735845 |
| Calcium (Ca)-Dissolved | 44.6 | | 0.10 | mg/L | | 30-MAY-17 | R3735915 |
| Magnesium (Mg)-Dissolved | 6.45 | | 0.10 | mg/L | | 30-MAY-17 | R3735915 |
| Potassium (K)-Dissolved | 2.51 | | 0.50 | mg/L | | 30-MAY-17 | R3735915 |
| Sodium (Na)-Dissolved | 27.4 | | 1.0 | mg/L | | 30-MAY-17 | R3735915 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | <0.020 | | 0.020 | mg/L | | 25-MAY-17 | R3735229 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 106 | | | % | | 31-MAY-17 | |
| TDS (Calculated) | 215 | | | mg/L | | 31-MAY-17 | |
| Hardness (as CaCO3) | 138 | | | mg/L | | 31-MAY-17 | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|--------|------------|--------|-------|-----------|-----------|----------|
| L1930675-3 SP1617-029; LAB CONTROL HA - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER | | | | | | | |
| Nitrate in Water by IC Nitrate (as N) | <0.020 | | 0.020 | mg/L | | 25-MAY-17 | R3735229 |
| Nitrate+Nitrite Nitrate and Nitrite (as N) | <0.050 | | 0.050 | mg/L | | 29-MAY-17 | |
| Nitrite in Water by IC Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 25-MAY-17 | R3735229 |
| Sulfate in Water by IC Sulfate (SO4) | 24.8 | | 0.30 | mg/L | | 25-MAY-17 | R3735229 |
| pH, Conductivity and Total Alkalinity pH | 7.99 | | 0.10 | pH | | 31-MAY-17 | R3736730 |
| Conductivity (EC) | 381 | | 2.0 | uS/cm | | 31-MAY-17 | R3736730 |
| Bicarbonate (HCO3) | 69.7 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Alkalinity, Total (as CaCO3) | 57.1 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| L1930675-4 SP1617-029; SITE CONTROL DA,FM - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location | LAB | | | | | 30-MAY-17 | R3735671 |
| Copper (Cu)-Dissolved | 0.0121 | DLM | 0.0010 | mg/L | | 30-MAY-17 | R3735690 |
| Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | 0.0140 | DLM | 0.0025 | mg/L | | 30-MAY-17 | R3735690 |
| Miscellaneous Parameters Dissolved Organic Carbon | 32 | DLM | 10 | mg/L | | 27-MAY-17 | R3732892 |
| Routine Water Analysis Chloride in Water by IC Chloride (Cl) | 2.40 | | 0.50 | mg/L | | 25-MAY-17 | R3735229 |
| Dissolved Metals by ICPOES Dissolved Metals Filtration Location | LAB | | | | | 30-MAY-17 | R3735845 |
| Calcium (Ca)-Dissolved | 26.7 | | 0.10 | mg/L | | 30-MAY-17 | R3735915 |
| Magnesium (Mg)-Dissolved | 7.94 | | 0.10 | mg/L | | 30-MAY-17 | R3735915 |
| Potassium (K)-Dissolved | 2.04 | | 0.50 | mg/L | | 30-MAY-17 | R3735915 |
| Sodium (Na)-Dissolved | 7.2 | | 1.0 | mg/L | | 30-MAY-17 | R3735915 |
| Fluoride in Water by IC Fluoride (F) | 0.126 | | 0.020 | mg/L | | 25-MAY-17 | R3735229 |
| Ion Balance Calculation Ion Balance | 107 | | | % | | 31-MAY-17 | |
| TDS (Calculated) | 118 | | | mg/L | | 31-MAY-17 | |
| Hardness (as CaCO3) | 99.4 | | | mg/L | | 31-MAY-17 | |
| Nitrate in Water by IC Nitrate (as N) | 0.571 | | 0.020 | mg/L | | 25-MAY-17 | R3735229 |
| Nitrate+Nitrite Nitrate and Nitrite (as N) | 0.587 | | 0.050 | mg/L | | 29-MAY-17 | |
| Nitrite in Water by IC Nitrite (as N) | 0.016 | | 0.010 | mg/L | | 25-MAY-17 | R3735229 |
| Sulfate in Water by IC Sulfate (SO4) | 17.4 | | 0.30 | mg/L | | 25-MAY-17 | R3735229 |
| pH, Conductivity and Total Alkalinity pH | 7.57 | | 0.10 | pH | | 31-MAY-17 | R3736730 |
| Conductivity (EC) | 192 | | 2.0 | uS/cm | | 31-MAY-17 | R3736730 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|--------|------------|--------|-------|-----------|-----------|----------|
| L1930675-4 SP1617-029; SITE CONTROL DA,FM - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER pH, Conductivity and Total Alkalinity | | | | | | | |
| Bicarbonate (HCO3) | 105 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Alkalinity, Total (as CaCO3) | 85.7 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| L1930675-5 SP1617-029; SITE CONTROL HA - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER Miscellaneous Parameters | | | | | | | |
| Dissolved Organic Carbon | 32 | DLM | 10 | mg/L | | 27-MAY-17 | R3732892 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 25.5 | | 0.50 | mg/L | | 25-MAY-17 | R3735229 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 30-MAY-17 | R3735845 |
| Calcium (Ca)-Dissolved | 26.9 | | 0.10 | mg/L | | 30-MAY-17 | R3735915 |
| Magnesium (Mg)-Dissolved | 8.00 | | 0.10 | mg/L | | 30-MAY-17 | R3735915 |
| Potassium (K)-Dissolved | 2.05 | | 0.50 | mg/L | | 30-MAY-17 | R3735915 |
| Sodium (Na)-Dissolved | 24.2 | | 1.0 | mg/L | | 30-MAY-17 | R3735915 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.127 | | 0.020 | mg/L | | 25-MAY-17 | R3735229 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 110 | | | % | | 31-MAY-17 | |
| TDS (Calculated) | 157 | | | mg/L | | 31-MAY-17 | |
| Hardness (as CaCO3) | 100 | | | mg/L | | 31-MAY-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.550 | | 0.020 | mg/L | | 25-MAY-17 | R3735229 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.564 | | 0.050 | mg/L | | 29-MAY-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | 0.014 | | 0.010 | mg/L | | 25-MAY-17 | R3735229 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 17.2 | | 0.30 | mg/L | | 25-MAY-17 | R3735229 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 7.60 | | 0.10 | pH | | 31-MAY-17 | R3736730 |
| Conductivity (EC) | 265 | | 2.0 | uS/cm | | 31-MAY-17 | R3736730 |
| Bicarbonate (HCO3) | 103 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| Alkalinity, Total (as CaCO3) | 84.2 | | 5.0 | mg/L | | 31-MAY-17 | R3736730 |
| L1930675-6 SP1617-029; 5 UG/L CU - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 30-MAY-17 | R3735671 |
| Copper (Cu)-Dissolved | 0.0165 | DLM | 0.0010 | mg/L | | 30-MAY-17 | R3735690 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.0199 | DLM | 0.0025 | mg/L | | 30-MAY-17 | R3735690 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|---|------------------------------------|--|--------------------------------------|--|---|--|
| L1930675-7 SP1617-029; 10 UG/L CU - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0223 0.0242 | DLM DLM | 0.0010 0.0025 | mg/L mg/L | | 30-MAY-17 30-MAY-17 30-MAY-17 | R3735671 R3735690 R3735690 |
| L1930675-8 SP1617-029; 20 UG/L CU - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0297 0.0329 | DLM DLM | 0.0010 0.0025 | mg/L mg/L | | 30-MAY-17 30-MAY-17 30-MAY-17 | R3735671 R3735690 R3735690 |
| L1930675-9 SP1617-029; 40 UG/L CU - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0466 0.0514 | DLM DLM | 0.0010 0.0025 | mg/L mg/L | | 30-MAY-17 30-MAY-17 30-MAY-17 | R3735671 R3735690 R3735690 |
| L1930675-10 SP1617-029; 80 UG/L CU - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0850 0.0951 | DLM DLM | 0.0010 0.0025 | mg/L mg/L | | 30-MAY-17 30-MAY-17 30-MAY-17 | R3735671 R3735690 R3735690 |
| L1930675-11 SP1617-029; 160 UG/L CU - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.144 0.168 | DLM DLM | 0.0010 0.0025 | mg/L mg/L | | 30-MAY-17 30-MAY-17 30-MAY-17 | R3735671 R3735690 R3735690 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|--------|------------|------|-------|-----------|----------|-------|
| L1930675-11 SP1617-029; 160 UG/L CU - WEEK 1 Sampled By: CLIENT on 24-MAY-17 @ 12:00 Matrix: WATER | | | | | | | |
| | | | | | | | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Qualifiers for Sample Submission Listed:

| Qualifier | Description |
|-----------|---|
| SFPL | DOC, MET-DISS - Sample was Filtered and Preserved at the laboratory |
| EXTEMP10 | 12C (SAME DAY SAMPLING) - Samples Received with temperature >10 Degrees C |

Sample Parameter Qualifier Key:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|--------------------------|
| C-DIS-ORG-CL | Water | Dissolved Organic Carbon | APHA 5310 B-Instrumental |
| <p>This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.</p> <p>The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC. TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.</p> | | | |
| CL-IC-N-CL | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| F-IC-N-CL | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| IONBALANCE-CL | Water | Ion Balance Calculation | APHA 1030E |
| MET-D-CCMS-CL | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| <p>Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| MET-DIS-ICP-CL | Water | Dissolved Metals by ICPOES | APHA 3030B/EPA 6010B |
| <p>"This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (APHA Method 3030B) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).</p> | | | |
| MET-T-CCMS-CL | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| <p>Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| N2N3-CALC-CL | Water | Nitrate+Nitrite | CALCULATION |
| NO2-IC-N-CL | Water | Nitrite in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| NO3-IC-N-CL | Water | Nitrate in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| PH/EC/ALK-CL | Water | pH, Conductivity and Total Alkalinity | APHA 4500H,2510,2320 |
| <p>All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current</p> | | | |
| SO4-IC-N-CL | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|------------------|--------------------|
|---------------|--------|------------------|--------------------|

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

Chain of Custody Numbers:
GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1930675

Report Date: 31-MAY-17

Page 1 of 5

Client: Nautilus Environmental
 #4, 6125 - 12 Street SE
 Calgary AB T2H 2K1
 Contact: Leila Oosterbroek / Bryon Shore

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|------------|-------------------|----------|-----------|-------|-----|--------|-----------|
| C-DIS-ORG-CL | | Water | | | | | | |
| Batch | R3732892 | | | | | | | |
| WG2536271-10 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 102.9 | | % | | 80-120 | 27-MAY-17 |
| WG2536271-6 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 101.7 | | % | | 80-120 | 27-MAY-17 |
| WG2536271-5 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <1.0 | | mg/L | | 1 | 27-MAY-17 |
| WG2536271-9 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <1.0 | | mg/L | | 1 | 27-MAY-17 |
| CL-IC-N-CL | | Water | | | | | | |
| Batch | R3735229 | | | | | | | |
| WG2537022-3 | DUP | L1930675-3 | | | | | | |
| Chloride (Cl) | | | 74.9 | | mg/L | 0.0 | 20 | 25-MAY-17 |
| WG2537022-2 | LCS | | | | | | | |
| Chloride (Cl) | | | 97.0 | | % | | 90-110 | 25-MAY-17 |
| WG2537022-1 | MB | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 25-MAY-17 |
| WG2537022-4 | MS | L1930675-3 | | | | | | |
| Chloride (Cl) | | | 89.6 | | % | | 75-125 | 25-MAY-17 |
| F-IC-N-CL | | Water | | | | | | |
| Batch | R3735229 | | | | | | | |
| WG2537022-3 | DUP | L1930675-3 | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | N/A | 20 | 25-MAY-17 |
| WG2537022-2 | LCS | | | | | | | |
| Fluoride (F) | | | 91.8 | | % | | 90-110 | 25-MAY-17 |
| WG2537022-1 | MB | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 25-MAY-17 |
| WG2537022-4 | MS | L1930675-3 | | | | | | |
| Fluoride (F) | | | 85.6 | | % | | 75-125 | 25-MAY-17 |
| MET-D-CCMS-CL | | Water | | | | | | |
| Batch | R3735690 | | | | | | | |
| WG2537603-8 | DUP | L1930675-1 | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | N/A | 20 | 30-MAY-17 |
| WG2537603-10 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 94.3 | | % | | 80-120 | 30-MAY-17 |
| WG2537603-13 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 90.7 | | % | | 80-120 | 30-MAY-17 |
| WG2537603-16 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 100.4 | | % | | 80-120 | 30-MAY-17 |



Quality Control Report

Workorder: L1930675

Report Date: 31-MAY-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|-------------------|----------|-----------|-------|-----|--------|-----------|
| MET-D-CCMS-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3735690 | | | | | | | |
| WG2537603-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 99.0 | | % | | 80-120 | 30-MAY-17 |
| WG2537603-7 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 94.8 | | % | | 80-120 | 30-MAY-17 |
| WG2537603-1 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 30-MAY-17 |
| WG2537603-12 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 30-MAY-17 |
| WG2537603-6 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 30-MAY-17 |
| WG2537603-9 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 30-MAY-17 |
| MET-DIS-ICP-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3735915 | | | | | | | |
| WG2537775-2 | DUP | L1930675-1 | | | | | | |
| Calcium (Ca)-Dissolved | | 9.90 | 9.99 | | mg/L | 0.9 | 20 | 30-MAY-17 |
| Magnesium (Mg)-Dissolved | | 10.7 | 10.8 | | mg/L | 1.0 | 20 | 30-MAY-17 |
| Potassium (K)-Dissolved | | 2.22 | 2.23 | | mg/L | 0.3 | 20 | 30-MAY-17 |
| Sodium (Na)-Dissolved | | 27.7 | 28.0 | | mg/L | 1.2 | 20 | 30-MAY-17 |
| WG2537762-2 | LCS | TMRM | | | | | | |
| Calcium (Ca)-Dissolved | | | 97.9 | | % | | 80-120 | 30-MAY-17 |
| Magnesium (Mg)-Dissolved | | | 93.7 | | % | | 80-120 | 30-MAY-17 |
| Potassium (K)-Dissolved | | | 95.4 | | % | | 80-120 | 30-MAY-17 |
| Sodium (Na)-Dissolved | | | 97.6 | | % | | 80-120 | 30-MAY-17 |
| WG2537762-6 | LCS | TMRM | | | | | | |
| Calcium (Ca)-Dissolved | | | 94.9 | | % | | 80-120 | 30-MAY-17 |
| Magnesium (Mg)-Dissolved | | | 100.2 | | % | | 80-120 | 30-MAY-17 |
| Potassium (K)-Dissolved | | | 99.2 | | % | | 80-120 | 30-MAY-17 |
| Sodium (Na)-Dissolved | | | 100.1 | | % | | 80-120 | 30-MAY-17 |
| WG2537762-9 | LCS | TMRM | | | | | | |
| Calcium (Ca)-Dissolved | | | 97.6 | | % | | 80-120 | 30-MAY-17 |
| Magnesium (Mg)-Dissolved | | | 95.4 | | % | | 80-120 | 30-MAY-17 |
| Potassium (K)-Dissolved | | | 96.7 | | % | | 80-120 | 30-MAY-17 |
| Sodium (Na)-Dissolved | | | 94.7 | | % | | 80-120 | 30-MAY-17 |
| WG2537762-1 | MB | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 30-MAY-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 30-MAY-17 |



Quality Control Report

Workorder: L1930675

Report Date: 31-MAY-17

Page 3 of 5

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|-------------------|----------|-----------|-------|-----|--------|-----------|
| MET-DIS-ICP-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3735915 | | | | | | | |
| WG2537762-1 | MB | | | | | | | |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 30-MAY-17 |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 30-MAY-17 |
| WG2537762-5 | MB | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 30-MAY-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 30-MAY-17 |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 30-MAY-17 |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 30-MAY-17 |
| WG2537762-8 | MB | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 30-MAY-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 30-MAY-17 |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 30-MAY-17 |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 30-MAY-17 |
| MET-T-CCMS-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3732362 | | | | | | | |
| WG2535665-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 94.1 | | % | | 80-120 | 26-MAY-17 |
| WG2535665-5 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 95.7 | | % | | 80-120 | 26-MAY-17 |
| WG2535665-1 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 26-MAY-17 |
| WG2535665-4 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 26-MAY-17 |
| NO2-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3735229 | | | | | | | |
| WG2537022-3 | DUP | L1930675-3 | | | | | | |
| Nitrite (as N) | | <0.010 | <0.010 | RPD-NA | mg/L | N/A | 20 | 25-MAY-17 |
| WG2537022-2 | LCS | | | | | | | |
| Nitrite (as N) | | | 100.1 | | % | | 90-110 | 25-MAY-17 |
| WG2537022-1 | MB | | | | | | | |
| Nitrite (as N) | | | <0.010 | | mg/L | | 0.01 | 25-MAY-17 |
| WG2537022-4 | MS | L1930675-3 | | | | | | |
| Nitrite (as N) | | | 92.8 | | % | | 75-125 | 25-MAY-17 |
| NO3-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |



Quality Control Report

Workorder: L1930675

Report Date: 31-MAY-17

Page 4 of 5

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|-------------------|--------|-----------|-------|------|---------|-----------|
| NO3-IC-N-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3735229 | | | | | | | |
| WG2537022-3 | DUP | L1930675-3 | | | | | | |
| Nitrate (as N) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 20 | 25-MAY-17 |
| WG2537022-2 | LCS | | | | | | | |
| Nitrate (as N) | | | 97.1 | | % | | 90-110 | 25-MAY-17 |
| WG2537022-1 | MB | | | | | | | |
| Nitrate (as N) | | | <0.020 | | mg/L | | 0.02 | 25-MAY-17 |
| WG2537022-4 | MS | L1930675-3 | | | | | | |
| Nitrate (as N) | | | 90.4 | | % | | 75-125 | 25-MAY-17 |
| PH/EC/ALK-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3736730 | | | | | | | |
| WG2538754-3 | DUP | L1930675-1 | | | | | | |
| pH | | 7.90 | 7.94 | J | pH | 0.04 | 0.2 | 31-MAY-17 |
| Conductivity (EC) | | 245 | 247 | | uS/cm | 0.8 | 10 | 31-MAY-17 |
| Bicarbonate (HCO3) | | 72.4 | 72.1 | | mg/L | 0.3 | 20 | 31-MAY-17 |
| Carbonate (CO3) | | <5.0 | <5.0 | RPD-NA | mg/L | N/A | 20 | 31-MAY-17 |
| Hydroxide (OH) | | <5.0 | <5.0 | RPD-NA | mg/L | N/A | 20 | 31-MAY-17 |
| Alkalinity, Total (as CaCO3) | | 59.3 | 59.1 | | mg/L | 0.3 | 20 | 31-MAY-17 |
| WG2538754-2 | LCS | | | | | | | |
| pH | | | 6.98 | | pH | | 6.9-7.1 | 31-MAY-17 |
| Conductivity (EC) | | | 97.5 | | % | | 90-110 | 31-MAY-17 |
| Alkalinity, Total (as CaCO3) | | | 102.5 | | % | | 85-115 | 31-MAY-17 |
| WG2538754-1 | MB | | | | | | | |
| Conductivity (EC) | | | <2.0 | | uS/cm | | 2 | 31-MAY-17 |
| Bicarbonate (HCO3) | | | <5.0 | | mg/L | | 5 | 31-MAY-17 |
| Carbonate (CO3) | | | <5.0 | | mg/L | | 5 | 31-MAY-17 |
| Hydroxide (OH) | | | <5.0 | | mg/L | | 5 | 31-MAY-17 |
| Alkalinity, Total (as CaCO3) | | | <5.0 | | mg/L | | 5 | 31-MAY-17 |
| SO4-IC-N-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3735229 | | | | | | | |
| WG2537022-3 | DUP | L1930675-3 | | | | | | |
| Sulfate (SO4) | | 24.8 | 24.8 | | mg/L | 0.0 | 20 | 25-MAY-17 |
| WG2537022-2 | LCS | | | | | | | |
| Sulfate (SO4) | | | 98.0 | | % | | 90-110 | 25-MAY-17 |
| WG2537022-1 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 25-MAY-17 |
| WG2537022-4 | MS | L1930675-3 | | | | | | |
| Sulfate (SO4) | | | 90.9 | | % | | 75-125 | 25-MAY-17 |

Quality Control Report

Workorder: L1930675

Report Date: 31-MAY-17

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Sample Parameter Qualifier Definitions:

| Qualifier | Description |
|-----------|---|
| J | Duplicate results and limits are expressed in terms of absolute difference. |
| RPD-NA | Relative Percent Difference Not Available due to result(s) being less than detection limit. |

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L1930675-COCF

COC Number: 14 -

Page of



| | | | | | |
|---|--|---|--|--|--|
| Report To | | Report Format / Distribution | | Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests) | |
| Company: Nautilus Environmental | | Select Report Format: <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL) | | R <input checked="" type="checkbox"/> Regular (Standard TAT if received by 3 pm - business days) | |
| Contact: Leila Oosterbroek | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | | P <input type="checkbox"/> Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT | |
| Address: #4, 6125 12 St SE | | <input type="checkbox"/> Criteria on Report - provide details below if box checked | | E <input type="checkbox"/> Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT | |
| Calgary, AB T2H 2K1 | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | E2 <input type="checkbox"/> Same day or weekend emergency - contact ALS to confirm TAT and surcharge | |
| Phone: 403-253-7121 | | Email 1 or Fax leila@nautilusenvironmental.ca | | Specify Date Required for E2,E or P: | |
| Email 2 bryon@nautilusenvironmental.ca | | Invoice Distribution | | Analysis Request | |
| Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | Email 1 or Fax abaccounts@nautilusenvironmental.ca | | indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | |
| Email 2 leila@nautilusenvironmental.ca | | Oil and Gas Required Fields (client use) | | | |
| Approver ID: | | Cost Center: | | | |
| GL Account: | | Routing Code: | | | |
| Activity Code: | | Location: | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Jesse Eagle | | Sampler: | |
| ALS Sample # (lab use only) | | Date (dd-mm-yy) | | Time (hr:mm) | |
| 1 | | SP1617-029; Lab Control DA - Week 1 | | water | |
| 2 | | SP1617-029; Lab Control FM - Week 1 | | water | |
| 3 | | SP1617-029; Lab Control HA - Week 1 | | water | |
| 4 | | SP1617-029; Site Control DA, FM - Week 1 | | water | |
| 5 | | SP1617-029; Site Control HA - Week 1 | | water | |
| 6 | | SP1617-029; 5 ug/L Cu - Week 1 | | water | |
| 7 | | SP1617-029; 10 ug/L Cu - Week 1 | | water | |
| 8 | | SP1617-029; 20 ug/L Cu - Week 1 | | water | |
| 9 | | SP1617-029; 40 ug/L Cu - Week 1 | | water | |
| 10 | | SP1617-029; 80 ug/L Cu - Week 1 | | water | |
| 11 | | SP1617-029; 160 ug/L Cu - Week 1 | | water | |
| Drinking Water (DW) Samples (client use) | | Special Instructions / Specify Criteria to add on report (client use) | | SAMPLE CONDITION AS RECEIVED (lab use only) | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> Yes <input type="checkbox"/> No | | ****For total metals, samples have been preserved. For dissolved parameters (DOC, dissolved metals), samples have not been filtered or preserved; please sub-sample and filter/preserve at the lab (SFPL)**** | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | |
| Are samples for human drinking water use? <input type="checkbox"/> Yes <input type="checkbox"/> No | | | | Ice packs Yes <input type="checkbox"/> No <input type="checkbox"/> Custody seal intact Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | Cooling Initiated <input checked="" type="checkbox"/> | |
| Released by: [Signature] | | Date: 05/04/13 | | INITIAL COOLER TEMPERATURES °C | |
| Date: 05/04/13 | | Time: 1:55 | | FINAL COOLER TEMPERATURES °C | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | Received by: [Signature] | |
| Date: 05/04/13 | | Time: 1:55 | | Date: [] Time: [] | |
| REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | | WHITE - LABORATORY COPY YELLOW - CLIENT COPY | | Number of Containers | |

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Nautilus Environmental
ATTN: Leila Oosterbroek / Bryon Shore
#4, 6125 - 12 Street SE
Calgary AB T2H 2K1

Date Received: 31-MAY-17
Report Date: 07-JUN-17 16:16 (MT)
Version: FINAL

Client Phone: 403-253-7121

Certificate of Analysis

Lab Work Order #: L1934434
Project P.O. #: 2016-1166
Job Reference:
C of C Numbers:
Legal Site Desc:

Nelson Kwan, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|----------|------------|---------|-------|-----------|-----------|----------|
| L1934434-1 SP1617-029; LAB CONTROL DA - WEEK 2 | | | | | | | |
| Sampled By: CLIENT | | | | | | | |
| Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 06-JUN-17 | R3740803 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | | 07-JUN-17 | R3740827 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | <0.00050 | | 0.00050 | mg/L | | 07-JUN-17 | R3740827 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 1.68 | | 0.50 | mg/L | | 01-JUN-17 | R3739045 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 01-JUN-17 | R3737130 |
| Calcium (Ca)-Dissolved | 14.9 | | 0.10 | mg/L | | 01-JUN-17 | R3737139 |
| Magnesium (Mg)-Dissolved | 11.8 | | 0.10 | mg/L | | 01-JUN-17 | R3737139 |
| Potassium (K)-Dissolved | 2.18 | | 0.50 | mg/L | | 01-JUN-17 | R3737139 |
| Sodium (Na)-Dissolved | 28.3 | | 1.0 | mg/L | | 01-JUN-17 | R3737139 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | <0.020 | | 0.020 | mg/L | | 01-JUN-17 | R3739045 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 102 | | | % | | 07-JUN-17 | |
| TDS (Calculated) | 178 | | | mg/L | | 07-JUN-17 | |
| Hardness (as CaCO3) | 85.8 | | | mg/L | | 07-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | <0.020 | | 0.020 | mg/L | | 01-JUN-17 | R3739045 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | <0.050 | | 0.050 | mg/L | | 02-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 01-JUN-17 | R3739045 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 84.2 | | 0.30 | mg/L | | 01-JUN-17 | R3739045 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.07 | | 0.10 | pH | | 03-JUN-17 | R3739944 |
| Conductivity (EC) | 289 | | 2.0 | uS/cm | | 03-JUN-17 | R3739944 |
| Bicarbonate (HCO3) | 70.4 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Alkalinity, Total (as CaCO3) | 57.7 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| L1934434-2 SP1617-029; LAB CONTROL FM - WEEK 2 | | | | | | | |
| Sampled By: CLIENT | | | | | | | |
| Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 06-JUN-17 | R3740803 |
| Copper (Cu)-Dissolved | 0.00076 | | 0.00020 | mg/L | | 07-JUN-17 | R3740827 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.00102 | | 0.00050 | mg/L | | 07-JUN-17 | R3740827 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 13.7 | | 0.50 | mg/L | | 01-JUN-17 | R3739045 |
| Dissolved Metals by ICPOES | | | | | | | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|----------|------------|---------|-------|-----------|-----------|----------|
| L1934434-2 SP1617-029; LAB CONTROL FM - WEEK 2 | | | | | | | |
| Sampled By: CLIENT | | | | | | | |
| Matrix: WATER | | | | | | | |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 01-JUN-17 | R3737130 |
| Calcium (Ca)-Dissolved | 51.7 | | 0.10 | mg/L | | 01-JUN-17 | R3737139 |
| Magnesium (Mg)-Dissolved | 15.7 | | 0.10 | mg/L | | 01-JUN-17 | R3737139 |
| Potassium (K)-Dissolved | 3.24 | | 0.50 | mg/L | | 01-JUN-17 | R3737139 |
| Sodium (Na)-Dissolved | 11.0 | | 1.0 | mg/L | | 01-JUN-17 | R3737139 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.136 | | 0.020 | mg/L | | 01-JUN-17 | R3739045 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 106 | | | % | | 07-JUN-17 | |
| TDS (Calculated) | 244 | | | mg/L | | 07-JUN-17 | |
| Hardness (as CaCO3) | 194 | | | mg/L | | 07-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.175 | | 0.020 | mg/L | | 01-JUN-17 | R3739045 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.175 | | 0.050 | mg/L | | 02-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 01-JUN-17 | R3739045 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 80.0 | | 0.30 | mg/L | | 01-JUN-17 | R3739045 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.35 | | 0.10 | pH | | 03-JUN-17 | R3739944 |
| Conductivity (EC) | 396 | | 2.0 | uS/cm | | 03-JUN-17 | R3739944 |
| Bicarbonate (HCO3) | 130 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Alkalinity, Total (as CaCO3) | 113 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| L1934434-3 SP1617-029; LAB CONTROL HA - WEEK 2 | | | | | | | |
| Sampled By: CLIENT | | | | | | | |
| Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 06-JUN-17 | R3740803 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | | 07-JUN-17 | R3740827 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | <0.00050 | | 0.00050 | mg/L | | 07-JUN-17 | R3740827 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 70.8 | | 0.50 | mg/L | | 01-JUN-17 | R3739045 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 01-JUN-17 | R3737130 |
| Calcium (Ca)-Dissolved | 40.9 | | 0.10 | mg/L | | 01-JUN-17 | R3737139 |
| Magnesium (Mg)-Dissolved | 5.95 | | 0.10 | mg/L | | 01-JUN-17 | R3737139 |
| Potassium (K)-Dissolved | 2.19 | | 0.50 | mg/L | | 01-JUN-17 | R3737139 |
| Sodium (Na)-Dissolved | 25.4 | | 1.0 | mg/L | | 01-JUN-17 | R3737139 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | <0.020 | | 0.020 | mg/L | | 01-JUN-17 | R3739045 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 106 | | | % | | 07-JUN-17 | |
| TDS (Calculated) | 199 | | | mg/L | | 07-JUN-17 | |
| Hardness (as CaCO3) | 127 | | | mg/L | | 07-JUN-17 | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|--------|------------|--------|-------|-----------|-----------|----------|
| L1934434-3 SP1617-029; LAB CONTROL HA - WEEK 2 Sampled By: CLIENT Matrix: WATER | | | | | | | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | <0.020 | | 0.020 | mg/L | | 01-JUN-17 | R3739045 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | <0.050 | | 0.050 | mg/L | | 02-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 01-JUN-17 | R3739045 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 23.1 | | 0.30 | mg/L | | 01-JUN-17 | R3739045 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.02 | | 0.10 | pH | | 03-JUN-17 | R3739944 |
| Conductivity (EC) | 368 | | 2.0 | uS/cm | | 03-JUN-17 | R3739944 |
| Bicarbonate (HCO3) | 61.5 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Alkalinity, Total (as CaCO3) | 50.4 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| L1934434-4 SP1617-029; SITE CONTROL DA, FM - WEEK 2 Sampled By: CLIENT Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 06-JUN-17 | R3740803 |
| Copper (Cu)-Dissolved | 0.0130 | DLM | 0.0010 | mg/L | | 07-JUN-17 | R3740827 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.0153 | DLM | 0.0025 | mg/L | | 07-JUN-17 | R3740827 |
| Miscellaneous Parameters | | | | | | | |
| Dissolved Organic Carbon | 25.3 | DLA | 5.0 | mg/L | | 05-JUN-17 | R3740834 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | <2.5 | DLHC | 2.5 | mg/L | | 01-JUN-17 | R3739045 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 01-JUN-17 | R3737130 |
| Calcium (Ca)-Dissolved | 25.8 | | 0.10 | mg/L | | 01-JUN-17 | R3737139 |
| Magnesium (Mg)-Dissolved | 7.83 | | 0.10 | mg/L | | 01-JUN-17 | R3737139 |
| Potassium (K)-Dissolved | 1.92 | | 0.50 | mg/L | | 01-JUN-17 | R3737139 |
| Sodium (Na)-Dissolved | 7.1 | | 1.0 | mg/L | | 01-JUN-17 | R3737139 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.14 | DLHC | 0.10 | mg/L | | 01-JUN-17 | R3739045 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 114 | BL:INT | | % | | 07-JUN-17 | |
| TDS (Calculated) | 112 | | | mg/L | | 07-JUN-17 | |
| Hardness (as CaCO3) | 96.7 | | | mg/L | | 07-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.97 | DLHC | 0.10 | mg/L | | 01-JUN-17 | R3739045 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.97 | | 0.11 | mg/L | | 02-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.050 | DLHC | 0.050 | mg/L | | 01-JUN-17 | R3739045 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 19.9 | DLHC | 1.5 | mg/L | | 01-JUN-17 | R3739045 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.02 | | 0.10 | pH | | 03-JUN-17 | R3739944 |
| Conductivity (EC) | 196 | | 2.0 | uS/cm | | 03-JUN-17 | R3739944 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|--------|------------|--------|-------|-----------|-----------|----------|
| L1934434-4 SP1617-029; SITE CONTROL DA, FM - WEEK 2 Sampled By: CLIENT Matrix: WATER pH, Conductivity and Total Alkalinity | | | | | | | |
| Bicarbonate (HCO3) | 92.2 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Alkalinity, Total (as CaCO3) | 75.6 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| L1934434-5 SP1617-029; SITE CONTROL HA - WEEK 2 Sampled By: CLIENT Matrix: WATER Miscellaneous Parameters | | | | | | | |
| Dissolved Organic Carbon | 24.4 | DLA | 5.0 | mg/L | | 05-JUN-17 | R3740834 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 18.0 | DLHC | 2.5 | mg/L | | 01-JUN-17 | R3739045 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 01-JUN-17 | R3737130 |
| Calcium (Ca)-Dissolved | 26.0 | | 0.10 | mg/L | | 01-JUN-17 | R3737139 |
| Magnesium (Mg)-Dissolved | 7.82 | | 0.10 | mg/L | | 01-JUN-17 | R3737139 |
| Potassium (K)-Dissolved | 1.94 | | 0.50 | mg/L | | 01-JUN-17 | R3737139 |
| Sodium (Na)-Dissolved | 19.1 | | 1.0 | mg/L | | 01-JUN-17 | R3737139 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | <0.10 | DLHC | 0.10 | mg/L | | 01-JUN-17 | R3739045 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 110 | | | % | | 05-JUN-17 | |
| TDS (Calculated) | 142 | | | mg/L | | 05-JUN-17 | |
| Hardness (as CaCO3) | 97.1 | | | mg/L | | 05-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.60 | DLHC | 0.10 | mg/L | | 01-JUN-17 | R3739045 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.60 | | 0.11 | mg/L | | 02-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.050 | DLHC | 0.050 | mg/L | | 01-JUN-17 | R3739045 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 16.0 | DLHC | 1.5 | mg/L | | 01-JUN-17 | R3739045 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.01 | | 0.10 | pH | | 03-JUN-17 | R3739944 |
| Conductivity (EC) | 250 | | 2.0 | uS/cm | | 03-JUN-17 | R3739944 |
| Bicarbonate (HCO3) | 102 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| Alkalinity, Total (as CaCO3) | 83.9 | | 5.0 | mg/L | | 03-JUN-17 | R3739944 |
| L1934434-6 SP1617-029; 5 UG/L CU - WEEK 2 Sampled By: CLIENT Matrix: WATER Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 06-JUN-17 | R3740803 |
| Copper (Cu)-Dissolved | 0.0179 | DLM | 0.0010 | mg/L | | 07-JUN-17 | R3740827 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.0234 | DLM | 0.0025 | mg/L | | 07-JUN-17 | R3740827 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---------------|------------|--------|-------|-----------|------------------------|----------------------|
| L1934434-7 SP1617-029; 10 UG/L CU - WEEK 2 Sampled By: CLIENT Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0219 | DLM | 0.0010 | mg/L | | 06-JUN-17 07-JUN-17 | R3740803 R3740827 |
| L1934434-8 SP1617-029; 20 UG/L CU - WEEK 2 Sampled By: CLIENT Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0315 | DLM | 0.0010 | mg/L | | 06-JUN-17 07-JUN-17 | R3740803 R3740827 |
| L1934434-9 SP1617-029; 40 UG/L CU - WEEK 2 Sampled By: CLIENT Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0502 | DLM | 0.0010 | mg/L | | 06-JUN-17 07-JUN-17 | R3740803 R3740827 |
| L1934434-10 SP1617-029; 80 UG/L CU - WEEK 2 Sampled By: CLIENT Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0838 | DLM | 0.0010 | mg/L | | 06-JUN-17 07-JUN-17 | R3740803 R3740827 |
| L1934434-11 SP1617-029; 160 UG/L CU - WEEK 2 Sampled By: CLIENT Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.154 | DLM | 0.0010 | mg/L | | 06-JUN-17 07-JUN-17 | R3740803 R3740827 |
| | 0.0239 | DLM | 0.0025 | mg/L | | 07-JUN-17 | R3740827 |
| | 0.0346 | DLM | 0.0025 | mg/L | | 07-JUN-17 | R3740827 |
| | 0.0531 | DLM | 0.0025 | mg/L | | 07-JUN-17 | R3740827 |
| | 0.0956 | DLM | 0.0025 | mg/L | | 07-JUN-17 | R3740827 |
| | 0.173 | DLM | 0.0025 | mg/L | | 07-JUN-17 | R3740827 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|--------|------------|------|-------|-----------|----------|-------|
| L1934434-11 SP1617-029; 160 UG/L CU - WEEK 2 Sampled By: CLIENT Matrix: WATER | | | | | | | |
| | | | | | | | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Qualifiers for Sample Submission Listed:

| Qualifier | Description |
|-----------|--|
| SFPL | DISSOLVED CU (EXCEPT FOR -5), DOC FOR -4-5 - Sample was Filtered and Preserved at the laboratory |

Sample Parameter Qualifier Key:

| Qualifier | Description |
|-----------|--|
| BL:INT | Balance Reviewed: Interference Or Non-Measured Component |
| DLA | Detection Limit adjusted for required dilution |
| DLHC | Detection Limit Raised: Dilution required due to high concentration of test analyte(s). |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|--------------------------|
| C-DIS-ORG-CL | Water | Dissolved Organic Carbon | APHA 5310 B-Instrumental |
| This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide. | | | |
| The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC. TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved. | | | |
| CL-IC-N-CL | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| F-IC-N-CL | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| IONBALANCE-CL | Water | Ion Balance Calculation | APHA 1030E |
| MET-D-CCMS-CL | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| MET-DIS-ICP-CL | Water | Dissolved Metals by ICPOES | APHA 3030B/EPA 6010B |
| "This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (APHA Method 3030B) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B). | | | |
| MET-T-CCMS-CL | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. | | | |
| Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. | | | |
| N2N3-CALC-CL | Water | Nitrate+Nitrite | CALCULATION |
| NO2-IC-N-CL | Water | Nitrite in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| NO3-IC-N-CL | Water | Nitrate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |
| PH/EC/ALK-CL | Water | pH, Conductivity and Total Alkalinity | APHA 4500H,2510,2320 |
| All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current | | | |
| SO4-IC-N-CL | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|------------------|--------------------|
|---------------|--------|------------------|--------------------|

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1934434

Report Date: 07-JUN-17

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Client: Nautilus Environmental
 #4, 6125 - 12 Street SE
 Calgary AB T2H 2K1
 Contact: Leila Oosterbroek / Bryon Shore

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|-------------------|--------|-----------|-------|-----|--------|-----------|
| C-DIS-ORG-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3740834 | | | | | | | |
| WG2542500-2 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 86.7 | | % | | 80-120 | 05-JUN-17 |
| WG2542500-1 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <1.0 | | mg/L | | 1 | 05-JUN-17 |
| CL-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3739045 | | | | | | | |
| WG2540495-3 | DUP | L1934434-3 | | | | | | |
| Chloride (Cl) | | 70.8 | 71.1 | | mg/L | 0.4 | 20 | 01-JUN-17 |
| WG2540495-2 | LCS | | | | | | | |
| Chloride (Cl) | | | 100.2 | | % | | 90-110 | 01-JUN-17 |
| WG2540495-1 | MB | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 01-JUN-17 |
| WG2540495-4 | MS | L1934434-3 | | | | | | |
| Chloride (Cl) | | | 117.7 | | % | | 75-125 | 01-JUN-17 |
| F-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3739045 | | | | | | | |
| WG2540495-3 | DUP | L1934434-3 | | | | | | |
| Fluoride (F) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 20 | 01-JUN-17 |
| WG2540495-2 | LCS | | | | | | | |
| Fluoride (F) | | | 97.6 | | % | | 90-110 | 01-JUN-17 |
| WG2540495-1 | MB | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 01-JUN-17 |
| WG2540495-4 | MS | L1934434-3 | | | | | | |
| Fluoride (F) | | | 114.7 | | % | | 75-125 | 01-JUN-17 |
| MET-D-CCMS-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3740827 | | | | | | | |
| WG2542512-11 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 94.7 | | % | | 80-120 | 07-JUN-17 |
| WG2542512-14 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 94.3 | | % | | 80-120 | 07-JUN-17 |
| WG2542512-17 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 94.4 | | % | | 80-120 | 07-JUN-17 |
| WG2542512-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 98.0 | | % | | 80-120 | 06-JUN-17 |
| WG2542512-20 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 94.6 | | % | | 80-120 | 07-JUN-17 |
| WG2542512-5 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 94.9 | | % | | 80-120 | 07-JUN-17 |



Quality Control Report

Workorder: L1934434

Report Date: 07-JUN-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|-------------|----------|-----------|-------|-----|--------|-----------|
| MET-D-CCMS-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3740827 | | | | | | | |
| WG2542512-8 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 100.5 | | % | | 80-120 | 07-JUN-17 |
| WG2542512-1 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 06-JUN-17 |
| WG2542512-10 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 07-JUN-17 |
| WG2542512-13 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 07-JUN-17 |
| WG2542512-16 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 07-JUN-17 |
| WG2542512-19 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 07-JUN-17 |
| WG2542512-4 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 07-JUN-17 |
| WG2542512-7 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 07-JUN-17 |
| MET-DIS-ICP-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3737139 | | | | | | | |
| WG2539249-2 | LCS | TMRM | | | | | | |
| Calcium (Ca)-Dissolved | | | 98.3 | | % | | 80-120 | 01-JUN-17 |
| Magnesium (Mg)-Dissolved | | | 106.0 | | % | | 80-120 | 01-JUN-17 |
| Potassium (K)-Dissolved | | | 98.7 | | % | | 80-120 | 01-JUN-17 |
| Sodium (Na)-Dissolved | | | 104.0 | | % | | 80-120 | 01-JUN-17 |
| WG2539249-6 | LCS | TMRM | | | | | | |
| Calcium (Ca)-Dissolved | | | 98.3 | | % | | 80-120 | 01-JUN-17 |
| Magnesium (Mg)-Dissolved | | | 105.4 | | % | | 80-120 | 01-JUN-17 |
| Potassium (K)-Dissolved | | | 98.4 | | % | | 80-120 | 01-JUN-17 |
| Sodium (Na)-Dissolved | | | 101.7 | | % | | 80-120 | 01-JUN-17 |
| WG2539249-9 | LCS | TMRM | | | | | | |
| Calcium (Ca)-Dissolved | | | 96.9 | | % | | 80-120 | 01-JUN-17 |
| Magnesium (Mg)-Dissolved | | | 106.3 | | % | | 80-120 | 01-JUN-17 |
| Potassium (K)-Dissolved | | | 97.7 | | % | | 80-120 | 01-JUN-17 |
| Sodium (Na)-Dissolved | | | 102.4 | | % | | 80-120 | 01-JUN-17 |
| WG2539249-1 | MB | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 01-JUN-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 01-JUN-17 |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 01-JUN-17 |



Quality Control Report

Workorder: L1934434

Report Date: 07-JUN-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|--------------------|----------|-----------|-------|-----|--------|-----------|
| MET-DIS-ICP-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3737139 | | | | | | | |
| WG2539249-1 | MB | | | | | | | |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 01-JUN-17 |
| WG2539249-5 | MB | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 01-JUN-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 01-JUN-17 |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 01-JUN-17 |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 01-JUN-17 |
| WG2539249-8 | MB | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 01-JUN-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 01-JUN-17 |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 01-JUN-17 |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 01-JUN-17 |
| MET-T-CCMS-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3740827 | | | | | | | |
| WG2541694-9 | DUP | L1934434-11 | | | | | | |
| Copper (Cu)-Total | | 0.173 | 0.171 | | mg/L | 1.2 | 20 | 07-JUN-17 |
| WG2541694-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 98.8 | | % | | 80-120 | 07-JUN-17 |
| WG2541694-5 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 97.7 | | % | | 80-120 | 07-JUN-17 |
| WG2541694-1 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 07-JUN-17 |
| WG2541694-4 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 07-JUN-17 |
| NO2-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3739045 | | | | | | | |
| WG2540495-3 | DUP | L1934434-3 | | | | | | |
| Nitrite (as N) | | <0.010 | <0.010 | RPD-NA | mg/L | N/A | 20 | 01-JUN-17 |
| WG2540495-2 | LCS | | | | | | | |
| Nitrite (as N) | | | 107.2 | | % | | 90-110 | 01-JUN-17 |
| WG2540495-1 | MB | | | | | | | |
| Nitrite (as N) | | | <0.010 | | mg/L | | 0.01 | 01-JUN-17 |
| WG2540495-4 | MS | L1934434-3 | | | | | | |
| Nitrite (as N) | | | 119.9 | | % | | 75-125 | 01-JUN-17 |
| NO3-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |



Quality Control Report

Workorder: L1934434

Report Date: 07-JUN-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|-------------------|--------|-----------|-------|-----|---------|-----------|
| NO3-IC-N-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3739045 | | | | | | | |
| WG2540495-3 | DUP | L1934434-3 | | | | | | |
| Nitrate (as N) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 20 | 01-JUN-17 |
| WG2540495-2 | LCS | | | | | | | |
| Nitrate (as N) | | | 100.6 | | % | | 90-110 | 01-JUN-17 |
| WG2540495-1 | MB | | | | | | | |
| Nitrate (as N) | | | <0.020 | | mg/L | | 0.02 | 01-JUN-17 |
| WG2540495-4 | MS | L1934434-3 | | | | | | |
| Nitrate (as N) | | | 118.1 | | % | | 75-125 | 01-JUN-17 |
| PH/EC/ALK-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3739944 | | | | | | | |
| WG2541404-11 | LCS | | | | | | | |
| pH | | | 7.01 | | pH | | 6.9-7.1 | 03-JUN-17 |
| Conductivity (EC) | | | 96.4 | | % | | 90-110 | 03-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | 94.4 | | % | | 85-115 | 03-JUN-17 |
| WG2541404-10 | MB | | | | | | | |
| Conductivity (EC) | | | <2.0 | | uS/cm | | 2 | 03-JUN-17 |
| Bicarbonate (HCO3) | | | <5.0 | | mg/L | | 5 | 03-JUN-17 |
| Carbonate (CO3) | | | <5.0 | | mg/L | | 5 | 03-JUN-17 |
| Hydroxide (OH) | | | <5.0 | | mg/L | | 5 | 03-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | <5.0 | | mg/L | | 5 | 03-JUN-17 |
| SO4-IC-N-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3739045 | | | | | | | |
| WG2540495-3 | DUP | L1934434-3 | | | | | | |
| Sulfate (SO4) | | 23.1 | 23.2 | | mg/L | 0.4 | 20 | 01-JUN-17 |
| WG2540495-2 | LCS | | | | | | | |
| Sulfate (SO4) | | | 102.0 | | % | | 90-110 | 01-JUN-17 |
| WG2540495-1 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 01-JUN-17 |
| WG2540495-4 | MS | L1934434-3 | | | | | | |
| Sulfate (SO4) | | | 118.3 | | % | | 75-125 | 01-JUN-17 |

Quality Control Report

Workorder: L1934434

Report Date: 07-JUN-17

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Sample Parameter Qualifier Definitions:

| Qualifier | Description |
|-----------|---|
| RPD-NA | Relative Percent Difference Not Available due to result(s) being less than detection limit. |

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



OC Number: 14 -

Page _____ of _____

L1934434-COCF

| | | | |
|--|---|---|------------------------|
| Report To | | Report Format / Distribution | |
| Company: Nautilus Environmental | | Select Report Format: <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL) | |
| Contact: Leila Oosterbroek | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | |
| Address: #4, 6125 12 St SE | | <input type="checkbox"/> Criteria on Report - provide details below if box checked | |
| Calgary, AB T2H 2K1 | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | |
| Phone: 403-253-7121 | | Email 1 or Fax: leila@nautilusenvironmental.ca | |
| | | Email 2: bryon@nautilusenvironmental.ca | |
| Invoice To | | Invoice Distribution | |
| Same as Report To <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | |
| Copy of Invoice with Report <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | | Email 1 or Fax: abaccounts@nautilusenvironmental.ca | |
| | | Email 2: leila@nautilusenvironmental.ca | |
| Project Information | | Oil and Gas Required Fields (client use) | |
| ALS Quote #: Q55972 | | Approver ID: _____ | |
| Job #: _____ | | GL Account: _____ | |
| PO / A/E: PO 2016-1106 | | Activity Code: _____ | |
| LSD: _____ | | Location: _____ | |
| ALS Lab Work Order # (lab use only) | | Jesse Eagle Sampler: | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mm-yy) | Time (hh:mm) |
| 1 | SP1617-029; Lab Control DA - Week 2 | | water |
| 2 | SP1617-029; Lab Control FM - Week 2 | | water |
| 3 | SP1617-029; Lab Control HA - Week 2 | | water |
| 4 | SP1617-029; Site Control DA, FM - Week 2 | | water |
| 5 | SP1617-029; Site Control HA - Week 2 | | water |
| 6 | SP1617-029; 5 ug/L Cu - Week 2 | | water |
| 7 | SP1617-029; 10 ug/L Cu - Week 2 | | water |
| 8 | SP1617-029; 20 ug/L Cu - Week 2 | | water |
| 9 | SP1617-029; 40 ug/L Cu - Week 2 | | water |
| 10 | SP1617-029; 80 ug/L Cu - Week 2 | | water |
| 11 | SP1617-029; 160 ug/L Cu - Week 2 | | water |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report (client use) | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> Yes <input type="checkbox"/> No | | ****For total metals, samples have been preserved. For dissolved parameters (DOC, dissolved metals), samples have not been filtered or preserved; please sub-sample and filter/preserve at the lab (SPPL)**** | |
| Are samples for human drinking water use? <input type="checkbox"/> Yes <input type="checkbox"/> No | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | |
| Released by: <i>Chayla</i> Date: 2016/05/31/130 | | Received by: <i>John</i> Date: 5/31/16 | |
| Time: 11:30 | | Time: 12:30 | |
| REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | | | |
| Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy. | | | |
| 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form. | | | |



Nautilus Environmental
ATTN: Leila Oosterbroek / Bryon Shore
#4, 6125 - 12 Street SE
Calgary AB T2H 2K1

Date Received: 08-JUN-17
Report Date: 19-JUN-17 12:14 (MT)
Version: FINAL

Client Phone: 403-253-7121

Certificate of Analysis

Lab Work Order #: L1939142
Project P.O. #: 2016-1171
Job Reference:
C of C Numbers:
Legal Site Desc:

Nelson Kwan, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
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ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|----------|------------|---------|-------|-----------|-----------|----------|
| L1939142-1 SP1617-029; LAB CONTROL DA - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 14-JUN-17 | R3748795 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | | 15-JUN-17 | R3748654 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | <0.00050 | | 0.00050 | mg/L | | 15-JUN-17 | R3748654 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 1.64 | | 0.50 | mg/L | | 09-JUN-17 | R3747721 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 14-JUN-17 | R3747677 |
| Calcium (Ca)-Dissolved | 14.6 | | 0.10 | mg/L | | 14-JUN-17 | R3747514 |
| Magnesium (Mg)-Dissolved | 12.8 | | 0.10 | mg/L | | 14-JUN-17 | R3747514 |
| Potassium (K)-Dissolved | 2.31 | | 0.50 | mg/L | | 14-JUN-17 | R3747514 |
| Sodium (Na)-Dissolved | 29.6 | | 1.0 | mg/L | | 14-JUN-17 | R3747514 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | <0.020 | | 0.020 | mg/L | | 09-JUN-17 | R3747721 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 108 | | | % | | 15-JUN-17 | |
| TDS (Calculated) | 177 | | | mg/L | | 15-JUN-17 | |
| Hardness (as CaCO3) | 89.2 | | | mg/L | | 15-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | <0.020 | | 0.020 | mg/L | | 09-JUN-17 | R3747721 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | <0.050 | | 0.050 | mg/L | | 14-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 09-JUN-17 | R3747721 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 81.8 | | 0.30 | mg/L | | 09-JUN-17 | R3747721 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.02 | | 0.10 | pH | | 11-JUN-17 | R3745812 |
| Conductivity (EC) | 295 | | 2.0 | uS/cm | | 11-JUN-17 | R3745812 |
| Bicarbonate (HCO3) | 70.5 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Alkalinity, Total (as CaCO3) | 57.8 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| L1939142-2 SP1617-029; LAB CONTROL FM - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 14-JUN-17 | R3748795 |
| Copper (Cu)-Dissolved | 0.00075 | | 0.00020 | mg/L | | 15-JUN-17 | R3748654 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.00088 | | 0.00050 | mg/L | | 15-JUN-17 | R3748654 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 10.7 | | 0.50 | mg/L | | 09-JUN-17 | R3747721 |
| Dissolved Metals by ICPOES | | | | | | | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|----------|------------|---------|-------|-----------|-----------|----------|
| L1939142-2 SP1617-029; LAB CONTROL FM - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER | | | | | | | |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 14-JUN-17 | R3747677 |
| Calcium (Ca)-Dissolved | 55.2 | | 0.10 | mg/L | | 14-JUN-17 | R3747514 |
| Magnesium (Mg)-Dissolved | 15.4 | | 0.10 | mg/L | | 14-JUN-17 | R3747514 |
| Potassium (K)-Dissolved | 3.21 | | 0.50 | mg/L | | 14-JUN-17 | R3747514 |
| Sodium (Na)-Dissolved | 8.4 | | 1.0 | mg/L | | 14-JUN-17 | R3747514 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.153 | | 0.020 | mg/L | | 09-JUN-17 | R3747721 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 105 | | | % | | 15-JUN-17 | |
| TDS (Calculated) | 236 | | | mg/L | | 15-JUN-17 | |
| Hardness (as CaCO3) | 201 | | | mg/L | | 15-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.149 | | 0.020 | mg/L | | 09-JUN-17 | R3747721 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.149 | | 0.050 | mg/L | | 14-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 09-JUN-17 | R3747721 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 65.9 | | 0.30 | mg/L | | 09-JUN-17 | R3747721 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.39 | | 0.10 | pH | | 11-JUN-17 | R3745812 |
| Conductivity (EC) | 385 | | 2.0 | uS/cm | | 11-JUN-17 | R3745812 |
| Bicarbonate (HCO3) | 145 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Carbonate (CO3) | 5.8 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Alkalinity, Total (as CaCO3) | 128 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| L1939142-3 SP1617-029; LAB CONTROL HA - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 14-JUN-17 | R3748795 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | | 15-JUN-17 | R3748654 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | <0.00050 | | 0.00050 | mg/L | | 15-JUN-17 | R3748654 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 73.1 | | 0.50 | mg/L | | 09-JUN-17 | R3747721 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 14-JUN-17 | R3747677 |
| Calcium (Ca)-Dissolved | 44.9 | | 0.10 | mg/L | | 14-JUN-17 | R3747514 |
| Magnesium (Mg)-Dissolved | 6.79 | | 0.10 | mg/L | | 14-JUN-17 | R3747514 |
| Potassium (K)-Dissolved | 2.51 | | 0.50 | mg/L | | 14-JUN-17 | R3747514 |
| Sodium (Na)-Dissolved | 27.8 | | 1.0 | mg/L | | 14-JUN-17 | R3747514 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | <0.020 | | 0.020 | mg/L | | 09-JUN-17 | R3747721 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 109 | | | % | | 15-JUN-17 | |
| TDS (Calculated) | 214 | | | mg/L | | 15-JUN-17 | |
| Hardness (as CaCO3) | 140 | | | mg/L | | 15-JUN-17 | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|--------|------------|--------|-------|-----------|-----------|----------|
| L1939142-3 SP1617-029; LAB CONTROL HA - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER | | | | | | | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | <0.020 | | 0.020 | mg/L | | 09-JUN-17 | R3747721 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | <0.050 | | 0.050 | mg/L | | 14-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 09-JUN-17 | R3747721 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 24.0 | | 0.30 | mg/L | | 09-JUN-17 | R3747721 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.01 | | 0.10 | pH | | 11-JUN-17 | R3745812 |
| Conductivity (EC) | 411 | | 2.0 | uS/cm | | 11-JUN-17 | R3745812 |
| Bicarbonate (HCO3) | 71.0 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Alkalinity, Total (as CaCO3) | 58.2 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| L1939142-4 SP1617-029; SITE CONTROL DA, FM - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 14-JUN-17 | R3748795 |
| Copper (Cu)-Dissolved | 0.0162 | DLM | 0.0010 | mg/L | | 15-JUN-17 | R3748654 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.0205 | DLM | 0.0025 | mg/L | | 15-JUN-17 | R3748654 |
| Miscellaneous Parameters | | | | | | | |
| Dissolved Organic Carbon | 27.4 | | 1.0 | mg/L | | 18-JUN-17 | R3750146 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 3.1 | DLHC | 2.5 | mg/L | | 09-JUN-17 | R3747721 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 14-JUN-17 | R3747677 |
| Calcium (Ca)-Dissolved | 24.8 | DLM | 0.50 | mg/L | | 14-JUN-17 | R3747514 |
| Magnesium (Mg)-Dissolved | 7.63 | DLM | 0.50 | mg/L | | 14-JUN-17 | R3747514 |
| Potassium (K)-Dissolved | <2.5 | DLM | 2.5 | mg/L | | 14-JUN-17 | R3747514 |
| Sodium (Na)-Dissolved | 6.6 | DLM | 5.0 | mg/L | | 14-JUN-17 | R3747514 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | <0.10 | DLHC | 0.10 | mg/L | | 09-JUN-17 | R3747721 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 89.4 | BL:INT | | % | | 15-JUN-17 | |
| TDS (Calculated) | 123 | | | mg/L | | 15-JUN-17 | |
| Hardness (as CaCO3) | 93.3 | | | mg/L | | 15-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.60 | DLHC | 0.10 | mg/L | | 09-JUN-17 | R3747721 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.60 | | 0.11 | mg/L | | 14-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.050 | DLHC | 0.050 | mg/L | | 09-JUN-17 | R3747721 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 26.8 | DLHC | 1.5 | mg/L | | 09-JUN-17 | R3747721 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 7.98 | | 0.10 | pH | | 11-JUN-17 | R3745812 |
| Conductivity (EC) | 202 | | 2.0 | uS/cm | | 11-JUN-17 | R3745812 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|--------|------------|--------|-------|-----------|-----------|----------|
| L1939142-4 SP1617-029; SITE CONTROL DA, FM - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER pH, Conductivity and Total Alkalinity | | | | | | | |
| Bicarbonate (HCO3) | 105 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Alkalinity, Total (as CaCO3) | 85.7 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| L1939142-5 SP1617-029; SITE CONTROL HA - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER Miscellaneous Parameters | | | | | | | |
| Dissolved Organic Carbon | 28.3 | | 1.0 | mg/L | | 18-JUN-17 | R3750146 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 20.1 | DLHC | 2.5 | mg/L | | 09-JUN-17 | R3747721 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 14-JUN-17 | R3747677 |
| Calcium (Ca)-Dissolved | 24.5 | DLM | 0.50 | mg/L | | 14-JUN-17 | R3747514 |
| Magnesium (Mg)-Dissolved | 7.50 | DLM | 0.50 | mg/L | | 14-JUN-17 | R3747514 |
| Potassium (K)-Dissolved | <2.5 | DLM | 2.5 | mg/L | | 14-JUN-17 | R3747514 |
| Sodium (Na)-Dissolved | 19.0 | DLM | 5.0 | mg/L | | 14-JUN-17 | R3747514 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | <0.10 | DLHC | 0.10 | mg/L | | 09-JUN-17 | R3747721 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 99.7 | | | % | | 14-JUN-17 | |
| TDS (Calculated) | 141 | | | mg/L | | 14-JUN-17 | |
| Hardness (as CaCO3) | 92.1 | | | mg/L | | 14-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.60 | DLHC | 0.10 | mg/L | | 09-JUN-17 | R3747721 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.60 | | 0.11 | mg/L | | 14-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.050 | DLHC | 0.050 | mg/L | | 09-JUN-17 | R3747721 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 15.7 | DLHC | 1.5 | mg/L | | 09-JUN-17 | R3747721 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 7.99 | | 0.10 | pH | | 11-JUN-17 | R3745812 |
| Conductivity (EC) | 266 | | 2.0 | uS/cm | | 11-JUN-17 | R3745812 |
| Bicarbonate (HCO3) | 106 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| Alkalinity, Total (as CaCO3) | 86.6 | | 5.0 | mg/L | | 11-JUN-17 | R3745812 |
| L1939142-6 SP1617-029; 5 UG/L CU - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 14-JUN-17 | R3748795 |
| Copper (Cu)-Dissolved | 0.0196 | DLM | 0.0010 | mg/L | | 15-JUN-17 | R3748654 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.0249 | DLM | 0.0025 | mg/L | | 15-JUN-17 | R3748654 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|---|------------------------------------|--|--------------------------------------|--|---|--|
| L1939142-7 SP1617-029; 10 UG/L CU - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0241 0.0288 | DLM DLM | 0.0010 0.0025 | mg/L mg/L | | 14-JUN-17 15-JUN-17 15-JUN-17 | R3748795 R3748654 R3748654 |
| L1939142-8 SP1617-029; 20 UG/L CU - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0328 0.0392 | DLM DLM | 0.0010 0.0025 | mg/L mg/L | | 14-JUN-17 15-JUN-17 15-JUN-17 | R3748795 R3748654 R3748654 |
| L1939142-9 SP1617-029; 40 UG/L CU - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0503 0.0570 | DLM DLM | 0.0010 0.0025 | mg/L mg/L | | 14-JUN-17 15-JUN-17 15-JUN-17 | R3748795 R3748654 R3748654 |
| L1939142-10 SP1617-029; 80 UG/L CU - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0820 0.0920 | DLM DLM | 0.0010 0.0025 | mg/L mg/L | | 14-JUN-17 15-JUN-17 15-JUN-17 | R3748795 R3748654 R3748654 |
| L1939142-11 SP1617-029; 160 UG/L CU - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.150 0.160 | DLM DLM | 0.0010 0.0025 | mg/L mg/L | | 14-JUN-17 15-JUN-17 15-JUN-17 | R3748795 R3748654 R3748654 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|--------|------------|------|-------|-----------|----------|-------|
| L1939142-11 SP1617-029; 160 UG/L CU - WEEK 3 Sampled By: CLIENT on 07-JUN-17 Matrix: WATER | | | | | | | |
| | | | | | | | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Qualifiers for Sample Submission Listed:

| Qualifier | Description |
|-----------|---|
| EXTEMP | 17C (SAME DAY SAMPLING) - Samples Received with temperature >15 Degrees C |
| SFPL | DISSOLVED CU (EXCEPT -5) - Sample was Filtered and Preserved at the laboratory |
| SFPL | DOC FOR -4-5 - Sample was Filtered and Preserved at the laboratory |

Sample Parameter Qualifier Key:

| Qualifier | Description |
|-----------|--|
| BL:INT | Balance Reviewed: Interference Or Non-Measured Component |
| DLHC | Detection Limit Raised: Dilution required due to high concentration of test analyte(s). |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|--------------------------|
| C-DIS-ORG-CL | Water | Dissolved Organic Carbon | APHA 5310 B-Instrumental |
| <p>This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.</p> <p>The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC. TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.</p> | | | |
| CL-IC-N-CL | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| F-IC-N-CL | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| IONBALANCE-CL | Water | Ion Balance Calculation | APHA 1030E |
| MET-D-CCMS-CL | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| <p>Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| MET-DIS-ICP-CL | Water | Dissolved Metals by ICPOES | APHA 3030B/EPA 6010B |
| <p>"This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (APHA Method 3030B) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).</p> | | | |
| MET-T-CCMS-CL | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| <p>Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| N2N3-CALC-CL | Water | Nitrate+Nitrite | CALCULATION |
| NO2-IC-N-CL | Water | Nitrite in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| NO3-IC-N-CL | Water | Nitrate in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| PH/EC/ALK-CL | Water | pH, Conductivity and Total Alkalinity | APHA 4500H,2510,2320 |
| <p>All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current</p> | | | |
| SO4-IC-N-CL | Water | Sulfate in Water by IC | EPA 300.1 (mod) |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|------------------|--------------------|
|---------------|--------|------------------|--------------------|

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1939142

Report Date: 19-JUN-17

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Client: Nautilus Environmental
 #4, 6125 - 12 Street SE
 Calgary AB T2H 2K1
 Contact: Leila Oosterbroek / Bryon Shore

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|--------------------|--------|-----------|-------|-----|--------|-----------|
| C-DIS-ORG-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3750146 | | | | | | | |
| WG2551177-10 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 90.4 | | % | | 80-120 | 18-JUN-17 |
| WG2551177-9 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <1.0 | | mg/L | | 1 | 18-JUN-17 |
| CL-IC-N-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3747721 | | | | | | | |
| WG2548793-23 | DUP | L1939142-1 | | | | | | |
| Chloride (Cl) | | 1.64 | 1.63 | | mg/L | 0.5 | 20 | 09-JUN-17 |
| WG2548793-14 | LCS | | | | | | | |
| Chloride (Cl) | | | 98.5 | | % | | 90-110 | 09-JUN-17 |
| WG2548793-22 | LCS | | | | | | | |
| Chloride (Cl) | | | 99.7 | | % | | 90-110 | 09-JUN-17 |
| WG2548793-13 | MB | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 09-JUN-17 |
| WG2548793-21 | MB | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 09-JUN-17 |
| WG2548793-24 | MS | L1939142-1 | | | | | | |
| Chloride (Cl) | | | 106.0 | | % | | 75-125 | 09-JUN-17 |
| F-IC-N-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3747721 | | | | | | | |
| WG2548793-23 | DUP | L1939142-1 | | | | | | |
| Fluoride (F) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 20 | 09-JUN-17 |
| WG2548793-14 | LCS | | | | | | | |
| Fluoride (F) | | | 91.1 | | % | | 90-110 | 09-JUN-17 |
| WG2548793-22 | LCS | | | | | | | |
| Fluoride (F) | | | 96.1 | | % | | 90-110 | 09-JUN-17 |
| WG2548793-13 | MB | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 09-JUN-17 |
| WG2548793-21 | MB | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 09-JUN-17 |
| WG2548793-24 | MS | L1939142-1 | | | | | | |
| Fluoride (F) | | | 104.5 | | % | | 75-125 | 09-JUN-17 |
| MET-D-CCMS-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3748654 | | | | | | | |
| WG2549593-3 | DUP | L1939142-11 | | | | | | |
| Copper (Cu)-Dissolved | | 0.150 | 0.143 | | mg/L | 4.3 | 20 | 15-JUN-17 |
| WG2549593-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 92.3 | | % | | 80-120 | 15-JUN-17 |



Quality Control Report

Workorder: L1939142

Report Date: 19-JUN-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------------|--------|-----------|----------|-----------|-------|-----|--------|-----------|
| MET-D-CCMS-CL Water | | | | | | | | |
| Batch R3748654 | | | | | | | | |
| WG2549593-1 MB | | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 15-JUN-17 |
| MET-DIS-ICP-CL Water | | | | | | | | |
| Batch R3747514 | | | | | | | | |
| WG2548742-2 LCS TMRM | | | | | | | | |
| Calcium (Ca)-Dissolved | | | 101.0 | | % | | 80-120 | 14-JUN-17 |
| Magnesium (Mg)-Dissolved | | | 104.2 | | % | | 80-120 | 14-JUN-17 |
| Potassium (K)-Dissolved | | | 101.9 | | % | | 80-120 | 14-JUN-17 |
| Sodium (Na)-Dissolved | | | 103.9 | | % | | 80-120 | 14-JUN-17 |
| WG2548742-6 LCS TMRM | | | | | | | | |
| Calcium (Ca)-Dissolved | | | 94.2 | | % | | 80-120 | 14-JUN-17 |
| Magnesium (Mg)-Dissolved | | | 99.4 | | % | | 80-120 | 14-JUN-17 |
| Potassium (K)-Dissolved | | | 95.1 | | % | | 80-120 | 14-JUN-17 |
| Sodium (Na)-Dissolved | | | 97.6 | | % | | 80-120 | 14-JUN-17 |
| WG2548742-1 MB | | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 14-JUN-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 14-JUN-17 |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 14-JUN-17 |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 14-JUN-17 |
| MET-T-CCMS-CL Water | | | | | | | | |
| Batch R3748654 | | | | | | | | |
| WG2547843-2 LCS TMRM | | | | | | | | |
| Copper (Cu)-Total | | | 101.6 | | % | | 80-120 | 15-JUN-17 |
| WG2547843-5 LCS TMRM | | | | | | | | |
| Copper (Cu)-Total | | | 93.6 | | % | | 80-120 | 15-JUN-17 |
| WG2547843-8 LCS TMRM | | | | | | | | |
| Copper (Cu)-Total | | | 99.4 | | % | | 80-120 | 15-JUN-17 |
| WG2547843-1 MB | | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 15-JUN-17 |
| WG2547843-4 MB | | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 15-JUN-17 |
| WG2547843-7 MB | | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 15-JUN-17 |
| NO2-IC-N-CL Water | | | | | | | | |



Quality Control Report

Workorder: L1939142

Report Date: 19-JUN-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|-------------------|--------|-----------|-------|------|---------|-----------|
| NO2-IC-N-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3747721 | | | | | | | |
| WG2548793-23 | DUP | L1939142-1 | | | | | | |
| Nitrite (as N) | | <0.010 | <0.010 | RPD-NA | mg/L | N/A | 20 | 09-JUN-17 |
| WG2548793-14 | LCS | | | | | | | |
| Nitrite (as N) | | | 98.7 | | % | | 90-110 | 09-JUN-17 |
| WG2548793-22 | LCS | | | | | | | |
| Nitrite (as N) | | | 99.8 | | % | | 90-110 | 09-JUN-17 |
| WG2548793-13 | MB | | | | | | | |
| Nitrite (as N) | | | <0.010 | | mg/L | | 0.01 | 09-JUN-17 |
| WG2548793-21 | MB | | | | | | | |
| Nitrite (as N) | | | <0.010 | | mg/L | | 0.01 | 09-JUN-17 |
| WG2548793-24 | MS | L1939142-1 | | | | | | |
| Nitrite (as N) | | | 105.3 | | % | | 75-125 | 09-JUN-17 |
| NO3-IC-N-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3747721 | | | | | | | |
| WG2548793-23 | DUP | L1939142-1 | | | | | | |
| Nitrate (as N) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 20 | 09-JUN-17 |
| WG2548793-14 | LCS | | | | | | | |
| Nitrate (as N) | | | 98.4 | | % | | 90-110 | 09-JUN-17 |
| WG2548793-22 | LCS | | | | | | | |
| Nitrate (as N) | | | 99.6 | | % | | 90-110 | 09-JUN-17 |
| WG2548793-13 | MB | | | | | | | |
| Nitrate (as N) | | | <0.020 | | mg/L | | 0.02 | 09-JUN-17 |
| WG2548793-21 | MB | | | | | | | |
| Nitrate (as N) | | | <0.020 | | mg/L | | 0.02 | 09-JUN-17 |
| WG2548793-24 | MS | L1939142-1 | | | | | | |
| Nitrate (as N) | | | 107.9 | | % | | 75-125 | 09-JUN-17 |
| PH/EC/ALK-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3745812 | | | | | | | |
| WG2546566-18 | DUP | L1939142-1 | | | | | | |
| pH | | 8.02 | 8.01 | J | pH | 0.01 | 0.2 | 11-JUN-17 |
| Conductivity (EC) | | 295 | 295 | | uS/cm | 0.0 | 10 | 11-JUN-17 |
| Bicarbonate (HCO3) | | 70.5 | 72.6 | | mg/L | 2.9 | 20 | 11-JUN-17 |
| Carbonate (CO3) | | <5.0 | <5.0 | RPD-NA | mg/L | N/A | 20 | 11-JUN-17 |
| Hydroxide (OH) | | <5.0 | <5.0 | RPD-NA | mg/L | N/A | 20 | 11-JUN-17 |
| Alkalinity, Total (as CaCO3) | | 57.8 | 59.5 | | mg/L | 2.9 | 20 | 11-JUN-17 |
| WG2546566-14 | LCS | | | | | | | |
| pH | | | 6.98 | | pH | | 6.9-7.1 | 11-JUN-17 |
| Conductivity (EC) | | | 101.4 | | % | | 90-110 | 11-JUN-17 |



Quality Control Report

Workorder: L1939142

Report Date: 19-JUN-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|-------------------|--------|-----------|-------|-----|---------|-----------|
| PH/EC/ALK-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3745812 | | | | | | | |
| WG2546566-14 | LCS | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 98.0 | | % | | 85-115 | 11-JUN-17 |
| WG2546566-17 | LCS | | | | | | | |
| pH | | | 6.98 | | pH | | 6.9-7.1 | 11-JUN-17 |
| Conductivity (EC) | | | 101.7 | | % | | 90-110 | 11-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | 92.1 | | % | | 85-115 | 11-JUN-17 |
| WG2546566-13 | MB | | | | | | | |
| Conductivity (EC) | | | <2.0 | | uS/cm | | 2 | 11-JUN-17 |
| Bicarbonate (HCO3) | | | <5.0 | | mg/L | | 5 | 11-JUN-17 |
| Carbonate (CO3) | | | <5.0 | | mg/L | | 5 | 11-JUN-17 |
| Hydroxide (OH) | | | <5.0 | | mg/L | | 5 | 11-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | <5.0 | | mg/L | | 5 | 11-JUN-17 |
| WG2546566-16 | MB | | | | | | | |
| Conductivity (EC) | | | <2.0 | | uS/cm | | 2 | 11-JUN-17 |
| Bicarbonate (HCO3) | | | <5.0 | | mg/L | | 5 | 11-JUN-17 |
| Carbonate (CO3) | | | <5.0 | | mg/L | | 5 | 11-JUN-17 |
| Hydroxide (OH) | | | <5.0 | | mg/L | | 5 | 11-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | <5.0 | | mg/L | | 5 | 11-JUN-17 |
| SO4-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3747721 | | | | | | | |
| WG2548793-23 | DUP | L1939142-1 | | | | | | |
| Sulfate (SO4) | | 81.8 | 81.9 | | mg/L | 0.1 | 20 | 09-JUN-17 |
| WG2548793-14 | LCS | | | | | | | |
| Sulfate (SO4) | | | 99.5 | | % | | 90-110 | 09-JUN-17 |
| WG2548793-22 | LCS | | | | | | | |
| Sulfate (SO4) | | | 100.8 | | % | | 90-110 | 09-JUN-17 |
| WG2548793-13 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 09-JUN-17 |
| WG2548793-21 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 09-JUN-17 |
| WG2548793-24 | MS | L1939142-1 | | | | | | |
| Sulfate (SO4) | | | 104.1 | | % | | 75-125 | 09-JUN-17 |

Quality Control Report

Workorder: L1939142

Report Date: 19-JUN-17

Page 5 of 5

Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Sample Parameter Qualifier Definitions:

| Qualifier | Description |
|-----------|---|
| J | Duplicate results and limits are expressed in terms of absolute difference. |
| RPD-NA | Relative Percent Difference Not Available due to result(s) being less than detection limit. |

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



iber: 14 - Page of

L1939142-COFC

| | | | | | |
|---|---|--|------------------------|---|-----------------------------|
| Report To Company: Nautilus Environmental Contact: Leila Oosterbroek Address: #4, 6125 12 St SE Calgary, AB T2H 2K1 Phone: 403-253-7121 | | Report Format / Distribution Select Report Format: <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> BDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: leila@nautilusenvironmental.ca Email 2: bryon@nautilusenvironmental.ca | | Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests) <input checked="" type="checkbox"/> Regular (Standard TAT if received by 3 pm - business days) <input type="checkbox"/> Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT <input type="checkbox"/> Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT <input type="checkbox"/> Same day or weekend emergency - contact ALS to confirm TAT and surcharge Specify Date Required for E2,E or P: | |
| Invoice To Same as Report To <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Copy of Invoice with Report <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | | Invoice Distribution <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below | |
| Company: Contact: Leila Oosterbroek Address: #4, 6125 12 St SE Calgary, AB T2H 2K1 Phone: 403-253-7121 | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: abaccounts@nautilusenvironmental.ca Email 2: leila@nautilusenvironmental.ca | | MET-T-COMS-1-CL (total copper in water) - (F) MET-D-COMS-1-CL (dissolved copper in water) FILTER-CL (lab filtered and preserved) | |
| ALS Quote #: Q55972 Job #: PO / AFE: PO 2016-1141 LSD: | | Project Information Approver ID: GL Account: Activity Code: Location: | | ROU-CL (Ca, Mg, Na, S, Cl, alk) C-DIS-ORG-CL (dissolved organic carbon) | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: Jesse Eagle | | Sampler: | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | Number of Containers |
| 1 | SP1617-029; Lab Control DA - Week 3 | 1/27/16 | | water | |
| 2 | SP1617-029; Lab Control FM - Week 3 | | | water | |
| 3 | SP1617-029; Lab Control HA - Week 3 | | | water | |
| 4 | SP1617-029; Site Control DA, FM - Week 3 | | | water | |
| 5 | SP1617-029; Site Control HA - Week 3 | | | water | |
| 6 | SP1617-029; 5 ug/L Cu - Week 3 | | | water | |
| 7 | SP1617-029; 10 ug/L Cu - Week 3 | | | water | |
| 8 | SP1617-029; 20 ug/L Cu - Week 3 | | | water | |
| 9 | SP1617-029; 40 ug/L Cu - Week 3 | | | water | |
| 10 | SP1617-029; 80 ug/L Cu - Week 3 | | | water | |
| 11 | SP1617-029; 160 ug/L Cu - Week 3 | | | water | |
| Drinking Water (DW) Samples¹ (client use) Are samples taken from a Regulated DW System? <input type="checkbox"/> Yes <input type="checkbox"/> No Are samples for human drinking water use? <input type="checkbox"/> Yes <input type="checkbox"/> No | | Special Instructions / Specify Criteria to add on report (client use) ****For total metals, samples have been preserved. For dissolved parameters (DOC, dissolved metals), samples have not been filtered or preserved; please sub-sample and filter/preserve at the lab (SFPL)**** | | | |
| Shipping / Release (client use) Released by: [Signature] Date: 1/27/16 Time: 1:30 | | Initial Shipment Reception (lab use only) Received by: [Signature] Date: 1/27/16 Time: 1:30 | | | |
| Final Shipment Reception (lab use only) | | Received by: [Signature] Date: 1/27/16 Time: 1:30 | | | |

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Nautilus Environmental
ATTN: Leila Oosterbroek
#4, 6125 - 12 Street SE
Calgary AB T2H 2K1

Date Received: 14-JUN-17
Report Date: 27-JUN-17 16:10 (MT)
Version: FINAL

Client Phone: 403-253-7121

Certificate of Analysis

Lab Work Order #: L1941966
Project P.O. #: PO 2016-1178
Job Reference:
C of C Numbers:
Legal Site Desc:

Nelson Kwan, B.Sc.
Account Manager

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ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|----------|------------|---------|-------|-----------|-----------|----------|
| L1941966-1 SP1617-029; LAB CONTROL FM - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 24-JUN-17 | R3755429 |
| Copper (Cu)-Dissolved | 0.00049 | | 0.00020 | mg/L | | 24-JUN-17 | R3755565 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.00058 | | 0.00050 | mg/L | | 24-JUN-17 | R3755565 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 9.22 | | 0.50 | mg/L | | 14-JUN-17 | R3748757 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 20-JUN-17 | R3751591 |
| Calcium (Ca)-Dissolved | 53.3 | | 0.10 | mg/L | | 20-JUN-17 | R3751650 |
| Magnesium (Mg)-Dissolved | 15.3 | | 0.10 | mg/L | | 20-JUN-17 | R3751650 |
| Potassium (K)-Dissolved | 3.13 | | 0.50 | mg/L | | 20-JUN-17 | R3751650 |
| Sodium (Na)-Dissolved | 7.3 | | 1.0 | mg/L | | 20-JUN-17 | R3751650 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.161 | | 0.020 | mg/L | | 14-JUN-17 | R3748757 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 112 | BL:INT | | % | | 26-JUN-17 | |
| TDS (Calculated) | 224 | | | mg/L | | 26-JUN-17 | |
| Hardness (as CaCO3) | 196 | | | mg/L | | 26-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.166 | | 0.020 | mg/L | | 14-JUN-17 | R3748757 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.166 | | 0.050 | mg/L | | 15-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 14-JUN-17 | R3748757 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 60.3 | | 0.30 | mg/L | | 14-JUN-17 | R3748757 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.40 | | 0.10 | pH | | 19-JUN-17 | R3751830 |
| Conductivity (EC) | 385 | | 2.0 | uS/cm | | 19-JUN-17 | R3751830 |
| Bicarbonate (HCO3) | 142 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Alkalinity, Total (as CaCO3) | 124 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| L1941966-2 SP1617-029; LAB CONTROL HA - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 24-JUN-17 | R3755429 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | | 24-JUN-17 | R3755565 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | <0.00050 | | 0.00050 | mg/L | | 24-JUN-17 | R3755565 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 72.8 | | 0.50 | mg/L | | 14-JUN-17 | R3748757 |
| Dissolved Metals by ICPOES | | | | | | | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|--------|------------|---------|-------|-----------|-----------|----------|
| L1941966-2 SP1617-029; LAB CONTROL HA - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER | | | | | | | |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 20-JUN-17 | R3751591 |
| Calcium (Ca)-Dissolved | 43.7 | | 0.10 | mg/L | | 20-JUN-17 | R3751650 |
| Magnesium (Mg)-Dissolved | 6.75 | | 0.10 | mg/L | | 20-JUN-17 | R3751650 |
| Potassium (K)-Dissolved | 2.47 | | 0.50 | mg/L | | 20-JUN-17 | R3751650 |
| Sodium (Na)-Dissolved | 26.4 | | 1.0 | mg/L | | 20-JUN-17 | R3751650 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | <0.020 | | 0.020 | mg/L | | 14-JUN-17 | R3748757 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 106 | | | % | | 26-JUN-17 | |
| TDS (Calculated) | 214 | | | mg/L | | 26-JUN-17 | |
| Hardness (as CaCO3) | 137 | | | mg/L | | 26-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.091 | | 0.020 | mg/L | | 14-JUN-17 | R3748757 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.104 | | 0.050 | mg/L | | 15-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | 0.012 | | 0.010 | mg/L | | 14-JUN-17 | R3748757 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 29.1 | | 0.30 | mg/L | | 14-JUN-17 | R3748757 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.03 | | 0.10 | pH | | 19-JUN-17 | R3751830 |
| Conductivity (EC) | 407 | | 2.0 | uS/cm | | 19-JUN-17 | R3751830 |
| Bicarbonate (HCO3) | 64.8 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Alkalinity, Total (as CaCO3) | 53.1 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| L1941966-3 SP1617-029; SITE CONTROL FM - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 24-JUN-17 | R3755429 |
| Copper (Cu)-Dissolved | 0.0173 | | 0.00020 | mg/L | | 24-JUN-17 | R3755565 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.0205 | | 0.00050 | mg/L | | 24-JUN-17 | R3755565 |
| Miscellaneous Parameters | | | | | | | |
| Dissolved Organic Carbon | 30.1 | | 1.0 | mg/L | | 21-JUN-17 | R3753275 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 2.31 | | 0.50 | mg/L | | 14-JUN-17 | R3748757 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 20-JUN-17 | R3751591 |
| Calcium (Ca)-Dissolved | 28.1 | | 0.10 | mg/L | | 20-JUN-17 | R3751650 |
| Magnesium (Mg)-Dissolved | 8.63 | | 0.10 | mg/L | | 20-JUN-17 | R3751650 |
| Potassium (K)-Dissolved | 2.12 | | 0.50 | mg/L | | 20-JUN-17 | R3751650 |
| Sodium (Na)-Dissolved | 7.3 | | 1.0 | mg/L | | 20-JUN-17 | R3751650 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.135 | | 0.020 | mg/L | | 14-JUN-17 | R3748757 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 117 | BL:INT | | % | | 26-JUN-17 | |
| TDS (Calculated) | 118 | | | mg/L | | 26-JUN-17 | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|--------|------------|-------|-------|-----------|-----------|----------|
| L1941966-3 SP1617-029; SITE CONTROL FM - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER | | | | | | | |
| Ion Balance Calculation | | | | | | | |
| Hardness (as CaCO3) | 106 | | | mg/L | | 26-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.590 | | 0.020 | mg/L | | 14-JUN-17 | R3748757 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.601 | | 0.050 | mg/L | | 15-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | 0.011 | | 0.010 | mg/L | | 14-JUN-17 | R3748757 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 17.2 | | 0.30 | mg/L | | 14-JUN-17 | R3748757 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.08 | | 0.10 | pH | | 19-JUN-17 | R3751830 |
| Conductivity (EC) | 205 | | 2.0 | uS/cm | | 19-JUN-17 | R3751830 |
| Bicarbonate (HCO3) | 101 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Alkalinity, Total (as CaCO3) | 82.4 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| L1941966-4 SP1617-029; SITE CONTROL HA - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER | | | | | | | |
| Miscellaneous Parameters | | | | | | | |
| Dissolved Organic Carbon | 30.4 | | 1.0 | mg/L | | 21-JUN-17 | R3753275 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 25.3 | | 0.50 | mg/L | | 14-JUN-17 | R3748757 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 20-JUN-17 | R3751591 |
| Calcium (Ca)-Dissolved | 28.2 | | 0.10 | mg/L | | 27-JUN-17 | R3751650 |
| Magnesium (Mg)-Dissolved | 8.02 | | 0.10 | mg/L | | 27-JUN-17 | R3751650 |
| Potassium (K)-Dissolved | 2.01 | | 0.50 | mg/L | | 27-JUN-17 | R3751650 |
| Sodium (Na)-Dissolved | 24.1 | | 1.0 | mg/L | | 27-JUN-17 | R3751650 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.129 | | 0.020 | mg/L | | 14-JUN-17 | R3748757 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 116 | RRV | | % | | 27-JUN-17 | |
| TDS (Calculated) | 156 | | | mg/L | | 27-JUN-17 | |
| Hardness (as CaCO3) | 103 | | | mg/L | | 27-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.558 | | 0.020 | mg/L | | 14-JUN-17 | R3748757 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.569 | | 0.050 | mg/L | | 15-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | 0.011 | | 0.010 | mg/L | | 14-JUN-17 | R3748757 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 17.0 | | 0.30 | mg/L | | 14-JUN-17 | R3748757 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.06 | | 0.10 | pH | | 19-JUN-17 | R3751830 |
| Conductivity (EC) | 286 | | 2.0 | uS/cm | | 19-JUN-17 | R3751830 |
| Bicarbonate (HCO3) | 99.2 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |
| Alkalinity, Total (as CaCO3) | 81.3 | | 5.0 | mg/L | | 19-JUN-17 | R3751830 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|---|--|--|--|--|---|--|
| L1941966-5 SP1617-029; 5 UG/L CU - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0222 0.0257 | | 0.00020 0.00050 | mg/L mg/L | | 24-JUN-17 24-JUN-17 24-JUN-17 | R3755429 R3755565 R3755565 |
| L1941966-6 SP1617-029; 10 UG/L CU - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0265 0.0298 | | 0.00020 0.00050 | mg/L mg/L | | 24-JUN-17 24-JUN-17 24-JUN-17 | R3755429 R3755565 R3755565 |
| L1941966-7 SP1617-029; 20 UG/L CU - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0357 0.0404 | | 0.00020 0.00050 | mg/L mg/L | | 24-JUN-17 24-JUN-17 24-JUN-17 | R3755429 R3755565 R3755565 |
| L1941966-8 SP1617-029; 40 UG/L CU - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0518 0.0562 | | 0.00020 0.00050 | mg/L mg/L | | 24-JUN-17 24-JUN-17 24-JUN-17 | R3755429 R3755565 R3755565 |
| L1941966-9 SP1617-029; 80 UG/L CU - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0880 0.101 | DLM DLM | 0.0010 0.0025 | mg/L mg/L | | 24-JUN-17 24-JUN-17 24-JUN-17 | R3755429 R3755565 R3755565 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|--------|------------|--------|-------|-----------|-----------|----------|
| L1941966-9 SP1617-029; 80 UG/L CU - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER | | | | | | | |
| L1941966-10 SP1617-029; 160 UG/L CU - WEEK 4 Sampled By: CLIENT on 14-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 24-JUN-17 | R3755429 |
| Copper (Cu)-Dissolved | 0.166 | DLM | 0.0010 | mg/L | | 24-JUN-17 | R3755565 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.175 | DLM | 0.0025 | mg/L | | 24-JUN-17 | R3755565 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Qualifiers for Sample Submission Listed:

| Qualifier | Description |
|-----------|--|
| SFPL | DOC (-3, -4) Diss-Metals (except -4) - Sample was Filtered and Preserved at the laboratory |

Sample Parameter Qualifier Key:

| Qualifier | Description |
|-----------|--|
| BL:INT | Balance Reviewed: Interference Or Non-Measured Component |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| RRV | Reported Result Verified By Repeat Analysis |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|--------------------------|
| C-DIS-ORG-CL | Water | Dissolved Organic Carbon | APHA 5310 B-Instrumental |
| <p>This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.</p> <p>The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC. TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.</p> | | | |
| CL-IC-N-CL | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| F-IC-N-CL | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| IONBALANCE-CL | Water | Ion Balance Calculation | APHA 1030E |
| MET-D-CCMS-CL | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| <p>Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| MET-DIS-ICP-CL | Water | Dissolved Metals by ICPOES | APHA 3030B/EPA 6010B |
| <p>"This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (APHA Method 3030B) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).</p> | | | |
| MET-T-CCMS-CL | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| <p>Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| N2N3-CALC-CL | Water | Nitrate+Nitrite | CALCULATION |
| NO2-IC-N-CL | Water | Nitrite in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| NO3-IC-N-CL | Water | Nitrate in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| PH/EC/ALK-CL | Water | pH, Conductivity and Total Alkalinity | APHA 4500H,2510,2320 |
| <p>All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current</p> | | | |
| SO4-IC-N-CL | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|------------------|--------------------|
|---------------|--------|------------------|--------------------|

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1941966

Report Date: 27-JUN-17

Page 1 of 5

Client: Nautilus Environmental
 #4, 6125 - 12 Street SE
 Calgary AB T2H 2K1
 Contact: Leila Oosterbroek

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|--------------|-------------------|----------|-----------|-------|-----|--------|-----------|
| C-DIS-ORG-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3753275 | | | | | | | |
| WG2554499-2 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 104.2 | | % | | 80-120 | 21-JUN-17 |
| WG2554499-1 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <1.0 | | mg/L | | 1 | 21-JUN-17 |
| CL-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3748757 | | | | | | | |
| WG2549700-3 | DUP | L1941966-1 | | | | | | |
| Chloride (Cl) | | 9.22 | 9.49 | | mg/L | 2.8 | 20 | 14-JUN-17 |
| WG2549700-2 | LCS | | | | | | | |
| Chloride (Cl) | | | 100.9 | | % | | 90-110 | 14-JUN-17 |
| WG2549700-1 | MB | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 14-JUN-17 |
| WG2549700-4 | MS | L1941966-1 | | | | | | |
| Chloride (Cl) | | | 104.3 | | % | | 75-125 | 14-JUN-17 |
| F-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3748757 | | | | | | | |
| WG2549700-3 | DUP | L1941966-1 | | | | | | |
| Fluoride (F) | | 0.161 | 0.164 | | mg/L | 1.5 | 20 | 14-JUN-17 |
| WG2549700-2 | LCS | | | | | | | |
| Fluoride (F) | | | 100.3 | | % | | 90-110 | 14-JUN-17 |
| WG2549700-1 | MB | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 14-JUN-17 |
| WG2549700-4 | MS | L1941966-1 | | | | | | |
| Fluoride (F) | | | 106.0 | | % | | 75-125 | 14-JUN-17 |
| MET-D-CCMS-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3755565 | | | | | | | |
| WG2556159-5 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 97.2 | | % | | 80-120 | 24-JUN-17 |
| WG2556256-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 97.4 | | % | | 80-120 | 24-JUN-17 |
| WG2556159-1 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 24-JUN-17 |
| WG2556159-4 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 24-JUN-17 |
| WG2556256-1 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 24-JUN-17 |
| MET-DIS-ICP-CL | | | | | | | | |
| | Water | | | | | | | |



Quality Control Report

Workorder: L1941966

Report Date: 27-JUN-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|-------------|----------|-----------|-------|-----|--------|-----------|
| MET-DIS-ICP-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3751650 | | | | | | | |
| WG2552874-2 | LCS | TMRM | | | | | | |
| Calcium (Ca)-Dissolved | | | 101.7 | | % | | 80-120 | 20-JUN-17 |
| Magnesium (Mg)-Dissolved | | | 100.4 | | % | | 80-120 | 20-JUN-17 |
| Potassium (K)-Dissolved | | | 100.5 | | % | | 80-120 | 20-JUN-17 |
| Sodium (Na)-Dissolved | | | 103.8 | | % | | 80-120 | 20-JUN-17 |
| WG2552874-5 | LCS | TMRM | | | | | | |
| Calcium (Ca)-Dissolved | | | 100.2 | | % | | 80-120 | 20-JUN-17 |
| Magnesium (Mg)-Dissolved | | | 102.9 | | % | | 80-120 | 20-JUN-17 |
| Potassium (K)-Dissolved | | | 101.5 | | % | | 80-120 | 20-JUN-17 |
| Sodium (Na)-Dissolved | | | 103.3 | | % | | 80-120 | 20-JUN-17 |
| WG2552874-9 | LCS | TMRM | | | | | | |
| Calcium (Ca)-Dissolved | | | 98.1 | | % | | 80-120 | 20-JUN-17 |
| Magnesium (Mg)-Dissolved | | | 103.3 | | % | | 80-120 | 20-JUN-17 |
| Potassium (K)-Dissolved | | | 102.6 | | % | | 80-120 | 20-JUN-17 |
| Sodium (Na)-Dissolved | | | 101.6 | | % | | 80-120 | 20-JUN-17 |
| WG2552874-1 | MB | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 20-JUN-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 20-JUN-17 |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 20-JUN-17 |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 20-JUN-17 |
| WG2552874-4 | MB | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 20-JUN-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 20-JUN-17 |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 20-JUN-17 |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 20-JUN-17 |
| WG2552874-8 | MB | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 20-JUN-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 20-JUN-17 |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 20-JUN-17 |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 20-JUN-17 |
| MET-T-CCMS-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3752567 | | | | | | | |
| WG2553139-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 96.9 | | % | | 80-120 | 21-JUN-17 |
| WG2553139-1 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 21-JUN-17 |



Quality Control Report

Workorder: L1941966

Report Date: 27-JUN-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|----------------------|-----------------|-------------------|----------|-----------|-------|-----|--------|-----------|
| MET-T-CCMS-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3755565 | | | | | | | |
| WG2553139-6 | DUP | L1941966-3 | | | | | | |
| Copper (Cu)-Total | | 0.0205 | 0.0204 | | mg/L | 0.4 | 20 | 24-JUN-17 |
| WG2556256-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 98.1 | | % | | 80-120 | 24-JUN-17 |
| WG2556256-1 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 24-JUN-17 |
| Batch | R3755647 | | | | | | | |
| WG2553139-5 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 98.0 | | % | | 80-120 | 24-JUN-17 |
| WG2553139-4 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 24-JUN-17 |
| Batch | R3756343 | | | | | | | |
| WG2553139-8 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 103.4 | | % | | 80-120 | 26-JUN-17 |
| WG2553139-7 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 26-JUN-17 |
| NO2-IC-N-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3748757 | | | | | | | |
| WG2549700-3 | DUP | L1941966-1 | | | | | | |
| Nitrite (as N) | | <0.010 | <0.010 | RPD-NA | mg/L | N/A | 20 | 14-JUN-17 |
| WG2549700-2 | LCS | | | | | | | |
| Nitrite (as N) | | | 103.1 | | % | | 90-110 | 14-JUN-17 |
| WG2549700-1 | MB | | | | | | | |
| Nitrite (as N) | | | <0.010 | | mg/L | | 0.01 | 14-JUN-17 |
| WG2549700-4 | MS | L1941966-1 | | | | | | |
| Nitrite (as N) | | | 105.1 | | % | | 75-125 | 14-JUN-17 |
| NO3-IC-N-CL | | | | | | | | |
| Water | | | | | | | | |
| Batch | R3748757 | | | | | | | |
| WG2549700-3 | DUP | L1941966-1 | | | | | | |
| Nitrate (as N) | | 0.166 | 0.150 | | mg/L | 9.8 | 20 | 15-JUN-17 |
| WG2549700-2 | LCS | | | | | | | |
| Nitrate (as N) | | | 101.0 | | % | | 90-110 | 14-JUN-17 |
| WG2549700-1 | MB | | | | | | | |
| Nitrate (as N) | | | <0.020 | | mg/L | | 0.02 | 14-JUN-17 |
| WG2549700-4 | MS | L1941966-1 | | | | | | |
| Nitrate (as N) | | | 103.1 | | % | | 75-125 | 14-JUN-17 |
| PH/EC/ALK-CL | | | | | | | | |
| Water | | | | | | | | |



Quality Control Report

Workorder: L1941966

Report Date: 27-JUN-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|-------------------|--------|-----------|-------|-----|---------|-----------|
| PH/EC/ALK-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3751830 | | | | | | | |
| WG2553023-11 | LCS | | | | | | | |
| pH | | | 7.02 | | pH | | 6.9-7.1 | 19-JUN-17 |
| Conductivity (EC) | | | 101.9 | | % | | 90-110 | 19-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | 103.3 | | % | | 85-115 | 19-JUN-17 |
| WG2553023-17 | LCS | | | | | | | |
| pH | | | 7.01 | | pH | | 6.9-7.1 | 19-JUN-17 |
| Conductivity (EC) | | | 102.5 | | % | | 90-110 | 19-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | 97.8 | | % | | 85-115 | 19-JUN-17 |
| WG2553023-10 | MB | | | | | | | |
| Conductivity (EC) | | | <2.0 | | uS/cm | | 2 | 19-JUN-17 |
| Bicarbonate (HCO3) | | | <5.0 | | mg/L | | 5 | 19-JUN-17 |
| Carbonate (CO3) | | | <5.0 | | mg/L | | 5 | 19-JUN-17 |
| Hydroxide (OH) | | | <5.0 | | mg/L | | 5 | 19-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | <5.0 | | mg/L | | 5 | 19-JUN-17 |
| WG2553023-16 | MB | | | | | | | |
| Conductivity (EC) | | | <2.0 | | uS/cm | | 2 | 19-JUN-17 |
| Bicarbonate (HCO3) | | | <5.0 | | mg/L | | 5 | 19-JUN-17 |
| Carbonate (CO3) | | | <5.0 | | mg/L | | 5 | 19-JUN-17 |
| Hydroxide (OH) | | | <5.0 | | mg/L | | 5 | 19-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | <5.0 | | mg/L | | 5 | 19-JUN-17 |
| SO4-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3748757 | | | | | | | |
| WG2549700-3 | DUP | L1941966-1 | | | | | | |
| Sulfate (SO4) | | 60.3 | 60.8 | | mg/L | 0.8 | 20 | 14-JUN-17 |
| WG2549700-2 | LCS | | | | | | | |
| Sulfate (SO4) | | | 101.5 | | % | | 90-110 | 14-JUN-17 |
| WG2549700-1 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 14-JUN-17 |
| WG2549700-4 | MS | L1941966-1 | | | | | | |
| Sulfate (SO4) | | | 102.5 | | % | | 75-125 | 14-JUN-17 |

Quality Control Report

Workorder: L1941966

Report Date: 27-JUN-17

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Sample Parameter Qualifier Definitions:

| Qualifier | Description |
|-----------|---|
| RPD-NA | Relative Percent Difference Not Available due to result(s) being less than detection limit. |

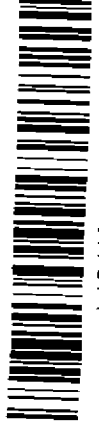
Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



L1941966-COFC

Chain of Custody (COC) / Analytical Request Form

Affix ALS barcode label (lab use only)

Canada Toll Free: 1 800 668 9878



www.alsglobal.com

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|---|---|--|---|---|---|---|---|--|--|--|--|--|----------------------------------|---|---|---|---|--|--|--|--|--|---|---|---|---|---|--|--|--|--|--|---|---|---|---|---|--|--|--|--|--|
| Report To Company: Nautilus Environmental Contact: Lella Oosterbroek Address: #4, 6125 12 St SE Calgary, AB T2H 2K1 Phone: 403-253-7121 | | Report Format / Distribution Select Report Format: <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: lella@nautilusenvironmental.ca Email 2: bryon@nautilusenvironmental.ca | | Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests) <input checked="" type="checkbox"/> Regular (Standard TAT if received by 3pm - business days) <input type="checkbox"/> Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT <input type="checkbox"/> Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT <input type="checkbox"/> E2 Same day or weekend emergency - contact ALS to confirm TAT and surcharge Specify Date Required for E2, E or P: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To <input checked="" type="checkbox"/> Same as Report To <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Copy of Invoice with Report <input type="checkbox"/> Yes <input type="checkbox"/> No | | Invoice Distribution <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Select Invoice Distribution: lella@nautilusenvironmental.ca Email 1 or Fax: abaccounts@nautilusenvironmental.ca Email 2: lella@nautilusenvironmental.ca | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below <table border="1"> <tr> <td>C-DIS-ORG-CL (dissolved organic carbon)</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>ROU-CL (Ca, Mg, Na, SK, Cl, etc)</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>MET-T-COMS-1-CL (total copper in water) - (</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>MET-D-COMS-1-CL (dissolved copper in water)</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> | | C-DIS-ORG-CL (dissolved organic carbon) | R | R | R | R | | | | | | ROU-CL (Ca, Mg, Na, SK, Cl, etc) | R | R | R | R | | | | | | MET-T-COMS-1-CL (total copper in water) - (| R | R | R | R | | | | | | MET-D-COMS-1-CL (dissolved copper in water) | R | R | R | R | | | | | |
| C-DIS-ORG-CL (dissolved organic carbon) | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ROU-CL (Ca, Mg, Na, SK, Cl, etc) | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MET-T-COMS-1-CL (total copper in water) - (| R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MET-D-COMS-1-CL (dissolved copper in water) | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information ALS Quote #: Q55972 Job #: PO / AFE: PO 2016-1178 LSD: | | Oil and Gas Required Fields (client use) Approver ID: GL Account: Activity Code: Location: | | ALS Contact: Jesse Eagle Date: 2016/06/14 Time (hr:mm): Sampler: Sample Type: water | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on the report) | | Special Instructions / Specify Criteria to add on report (client use) *****For total metals, samples have been preserved. For dissolved parameters (DOC, dissolved metals), samples have not been filtered or preserved; please sub-sample and filter/preserve at the lab (SFPL)***** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 SP1617-029; Lab Control FM - Week 4 2 SP1617-029; Lab Control HA - Week 4 3 SP1617-029; Site Control FM - Week 4 4 SP1617-029; Site Control HA - Week 4 5 SP1617-029; 5 ug/L Cu - Week 4 6 SP1617-029; 10 ug/L Cu - Week 4 7 SP1617-029; 20 ug/L Cu - Week 4 8 SP1617-029; 40 ug/L Cu - Week 4 9 SP1617-029; 80 ug/L Cu - Week 4 10 SP1617-029; 160 ug/L Cu - Week 4 | | Drinking Water (DW) Samples (client use) <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Are samples taken from a Regulated DW System? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Are samples for human drinking water use? <input type="checkbox"/> Yes <input type="checkbox"/> No | | Sample Condition as Received (lab use only) Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No Ice packs Yes <input type="checkbox"/> No <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No Cooling Initiated <input type="checkbox"/> INITIAL COOLER TEMPERATURES °C: FINAL COOLER TEMPERATURES °C: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) Released by: [Signature] Date: 2016/06/14 Time: 16:30 | | INITIAL SHIPMENT RECEPTION (lab use only) Received by: [Signature] Date: 6/19/2016 Time: 12:34 | | FINAL SHIPMENT RECEPTION (lab use only) Received by: Date: Time: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy. 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Nautilus Environmental
ATTN: Leila Oosterbroek
#4, 6125 - 12 Street SE
Calgary AB T2H 2K1

Date Received: 21-JUN-17
Report Date: 30-JUN-17 14:15 (MT)
Version: FINAL

Client Phone: 403-253-7121

Certificate of Analysis

Lab Work Order #: L1946182
Project P.O. #: PO 2016-1182
Job Reference:
C of C Numbers:
Legal Site Desc:

Nelson Kwan, B.Sc.
Account Manager

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ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
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ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|----------|------------|---------|-------|-----------|-----------|----------|
| L1946182-1 SP1617-029; LAB CONTROL FM - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 27-JUN-17 | R3757804 |
| Copper (Cu)-Dissolved | 0.00058 | | 0.00020 | mg/L | | 27-JUN-17 | R3756979 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.00070 | | 0.00050 | mg/L | | 27-JUN-17 | R3756979 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 9.79 | | 0.50 | mg/L | | 22-JUN-17 | R3756736 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 24-JUN-17 | R3756811 |
| Calcium (Ca)-Dissolved | 54.1 | | 0.10 | mg/L | | 24-JUN-17 | R3755547 |
| Magnesium (Mg)-Dissolved | 14.9 | | 0.10 | mg/L | | 24-JUN-17 | R3755547 |
| Potassium (K)-Dissolved | 3.17 | | 0.50 | mg/L | | 24-JUN-17 | R3755547 |
| Sodium (Na)-Dissolved | 7.9 | | 1.0 | mg/L | | 24-JUN-17 | R3755547 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.151 | | 0.020 | mg/L | | 22-JUN-17 | R3756736 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 107 | | | % | | 28-JUN-17 | |
| TDS (Calculated) | 226 | | | mg/L | | 28-JUN-17 | |
| Hardness (as CaCO3) | 196 | | | mg/L | | 28-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.179 | | 0.020 | mg/L | | 22-JUN-17 | R3756736 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.179 | | 0.050 | mg/L | | 27-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 22-JUN-17 | R3756736 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 59.0 | | 0.30 | mg/L | | 22-JUN-17 | R3756736 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.47 | | 0.10 | pH | | 22-JUN-17 | R3754910 |
| Conductivity (EC) | 401 | | 2.0 | uS/cm | | 22-JUN-17 | R3754910 |
| Bicarbonate (HCO3) | 141 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Carbonate (CO3) | 6.7 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Alkalinity, Total (as CaCO3) | 127 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| L1946182-2 SP1617-029; LAB CONTROL HA - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 27-JUN-17 | R3757804 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | | 27-JUN-17 | R3756979 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | <0.00050 | | 0.00050 | mg/L | | 27-JUN-17 | R3756979 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 74.2 | | 0.50 | mg/L | | 22-JUN-17 | R3756736 |
| Dissolved Metals by ICPOES | | | | | | | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|--------|------------|---------|-------|-----------|-----------|----------|
| L1946182-2 SP1617-029; LAB CONTROL HA - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER | | | | | | | |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 24-JUN-17 | R3756811 |
| Calcium (Ca)-Dissolved | 43.0 | | 0.10 | mg/L | | 24-JUN-17 | R3755547 |
| Magnesium (Mg)-Dissolved | 6.47 | | 0.10 | mg/L | | 24-JUN-17 | R3755547 |
| Potassium (K)-Dissolved | 2.50 | | 0.50 | mg/L | | 24-JUN-17 | R3755547 |
| Sodium (Na)-Dissolved | 28.2 | | 1.0 | mg/L | | 24-JUN-17 | R3755547 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.022 | | 0.020 | mg/L | | 22-JUN-17 | R3756736 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 108 | | | % | | 28-JUN-17 | |
| TDS (Calculated) | 211 | | | mg/L | | 28-JUN-17 | |
| Hardness (as CaCO3) | 134 | | | mg/L | | 28-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.030 | | 0.020 | mg/L | | 22-JUN-17 | R3756736 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | <0.050 | | 0.050 | mg/L | | 27-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 22-JUN-17 | R3756736 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 24.6 | | 0.30 | mg/L | | 22-JUN-17 | R3756736 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.00 | | 0.10 | pH | | 22-JUN-17 | R3754910 |
| Conductivity (EC) | 426 | | 2.0 | uS/cm | | 22-JUN-17 | R3754910 |
| Bicarbonate (HCO3) | 65.3 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Alkalinity, Total (as CaCO3) | 53.5 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| L1946182-3 SP1617-029; SITE CONTROL FM - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 27-JUN-17 | R3757804 |
| Copper (Cu)-Dissolved | 0.0177 | | 0.00020 | mg/L | | 27-JUN-17 | R3756979 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.0204 | | 0.00050 | mg/L | | 30-JUN-17 | R3756979 |
| Miscellaneous Parameters | | | | | | | |
| Dissolved Organic Carbon | 28.9 | | 1.0 | mg/L | | 28-JUN-17 | R3758972 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 2.73 | | 0.50 | mg/L | | 22-JUN-17 | R3756736 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 24-JUN-17 | R3756811 |
| Calcium (Ca)-Dissolved | 25.4 | DLM | 0.50 | mg/L | | 24-JUN-17 | R3755547 |
| Magnesium (Mg)-Dissolved | 7.50 | DLM | 0.50 | mg/L | | 24-JUN-17 | R3755547 |
| Potassium (K)-Dissolved | <2.5 | DLM | 2.5 | mg/L | | 24-JUN-17 | R3755547 |
| Sodium (Na)-Dissolved | 6.4 | DLM | 5.0 | mg/L | | 24-JUN-17 | R3755547 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.147 | | 0.020 | mg/L | | 22-JUN-17 | R3756736 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 102 | | | % | | 30-JUN-17 | |
| TDS (Calculated) | 112 | | | mg/L | | 30-JUN-17 | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|--------|------------|-------|-------|-----------|-----------|----------|
| L1946182-3 SP1617-029; SITE CONTROL FM - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER | | | | | | | |
| Ion Balance Calculation | | | | | | | |
| Hardness (as CaCO3) | 94.3 | | | mg/L | | 30-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.659 | | 0.020 | mg/L | | 22-JUN-17 | R3756736 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.659 | | 0.050 | mg/L | | 27-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 22-JUN-17 | R3756736 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 18.1 | | 0.30 | mg/L | | 22-JUN-17 | R3756736 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 7.87 | | 0.10 | pH | | 22-JUN-17 | R3754910 |
| Conductivity (EC) | 214 | | 2.0 | uS/cm | | 22-JUN-17 | R3754910 |
| Bicarbonate (HCO3) | 98.8 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Alkalinity, Total (as CaCO3) | 81.0 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| L1946182-4 SP1617-029; SITE CONTROL HA - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER | | | | | | | |
| Miscellaneous Parameters | | | | | | | |
| Dissolved Organic Carbon | 30.5 | | 1.0 | mg/L | | 28-JUN-17 | R3758972 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 20.0 | | 0.50 | mg/L | | 22-JUN-17 | R3756736 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 24-JUN-17 | R3756811 |
| Calcium (Ca)-Dissolved | 25.4 | DLM | 0.50 | mg/L | | 24-JUN-17 | R3755547 |
| Magnesium (Mg)-Dissolved | 7.37 | DLM | 0.50 | mg/L | | 24-JUN-17 | R3755547 |
| Potassium (K)-Dissolved | <2.5 | DLM | 2.5 | mg/L | | 24-JUN-17 | R3755547 |
| Sodium (Na)-Dissolved | 21.3 | DLM | 5.0 | mg/L | | 24-JUN-17 | R3755547 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.188 | | 0.020 | mg/L | | 22-JUN-17 | R3756736 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 108 | | | % | | 27-JUN-17 | |
| TDS (Calculated) | 143 | | | mg/L | | 27-JUN-17 | |
| Hardness (as CaCO3) | 93.8 | | | mg/L | | 27-JUN-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.635 | | 0.020 | mg/L | | 22-JUN-17 | R3756736 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.635 | | 0.050 | mg/L | | 27-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 22-JUN-17 | R3756736 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 17.7 | | 0.30 | mg/L | | 22-JUN-17 | R3756736 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 7.88 | | 0.10 | pH | | 22-JUN-17 | R3754910 |
| Conductivity (EC) | 274 | | 2.0 | uS/cm | | 22-JUN-17 | R3754910 |
| Bicarbonate (HCO3) | 98.0 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |
| Alkalinity, Total (as CaCO3) | 80.3 | | 5.0 | mg/L | | 22-JUN-17 | R3754910 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|---|------------|------|--|-----------|---|--|
| L1946182-5 SP1617-029; 5 UG/L CU - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0242 0.0265 | | | mg/L 0.00020 mg/L 0.00050 | | 27-JUN-17 27-JUN-17 27-JUN-17 | R3757804 R3756979 R3756979 |
| L1946182-6 SP1617-029; 10 UG/L CU - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0278 0.0315 | | | mg/L 0.00020 mg/L 0.00050 | | 27-JUN-17 27-JUN-17 27-JUN-17 | R3757804 R3756979 R3756979 |
| L1946182-7 SP1617-029; 20 UG/L CU - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0371 0.0453 | | | mg/L 0.00020 mg/L 0.00050 | | 27-JUN-17 27-JUN-17 27-JUN-17 | R3757804 R3756979 R3756979 |
| L1946182-8 SP1617-029; 40 UG/L CU - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0554 0.0602 | | | mg/L 0.00020 mg/L 0.00050 | | 27-JUN-17 27-JUN-17 27-JUN-17 | R3757804 R3756979 R3756979 |
| L1946182-9 SP1617-029; 80 UG/L CU - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0955 0.0947 | | | mg/L 0.00020 mg/L 0.00050 | | 27-JUN-17 27-JUN-17 27-JUN-17 | R3757804 R3756979 R3756979 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|--|--------|------------|---------|-------|-----------|-----------|----------|
| L1946182-9 SP1617-029; 80 UG/L CU - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER | | | | | | | |
| L1946182-10 SP1617-029; 160 UG/L CU - WEEK 5 Sampled By: CLIENT on 21-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 27-JUN-17 | R3757804 |
| Copper (Cu)-Dissolved | 0.178 | | 0.00020 | mg/L | | 27-JUN-17 | R3756979 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.181 | | 0.00050 | mg/L | | 27-JUN-17 | R3756979 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Qualifiers for Sample Submission Listed:

| Qualifier | Description |
|-----------|--|
| SFPL | DOC (-3, -4) Diss-CU (all except -4) - Sample was Filtered and Preserved at the laboratory |

Sample Parameter Qualifier Key:

| Qualifier | Description |
|-----------|--|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|--------------------------|
| C-DIS-ORG-CL | Water | Dissolved Organic Carbon | APHA 5310 B-Instrumental |
| <p>This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.</p> <p>The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC. TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.</p> | | | |
| CL-IC-N-CL | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| F-IC-N-CL | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| IONBALANCE-CL | Water | Ion Balance Calculation | APHA 1030E |
| MET-D-CCMS-CL | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| <p>Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| MET-DIS-ICP-CL | Water | Dissolved Metals by ICPOES | APHA 3030B/EPA 6010B |
| <p>"This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (APHA Method 3030B) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).</p> | | | |
| MET-T-CCMS-CL | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| <p>Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| N2N3-CALC-CL | Water | Nitrate+Nitrite | CALCULATION |
| NO2-IC-N-CL | Water | Nitrite in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| NO3-IC-N-CL | Water | Nitrate in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| PH/EC/ALK-CL | Water | pH, Conductivity and Total Alkalinity | APHA 4500H,2510,2320 |
| <p>All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current</p> | | | |
| SO4-IC-N-CL | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|------------------|--------------------|
|---------------|--------|------------------|--------------------|

| Laboratory Definition Code | Laboratory Location |
|----------------------------|---------------------|
|----------------------------|---------------------|

| | |
|----|--|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |
|----|--|

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1946182

Report Date: 30-JUN-17

Page 1 of 4

Client: Nautilus Environmental
 #4, 6125 - 12 Street SE
 Calgary AB T2H 2K1
 Contact: Leila Oosterbroek

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|-------------|----------|-----------|-------|-----|--------|-----------|
| C-DIS-ORG-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3758972 | | | | | | | |
| WG2560016-2 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 99.0 | | % | | 80-120 | 28-JUN-17 |
| WG2560016-1 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <1.0 | | mg/L | | 1 | 28-JUN-17 |
| CL-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3756736 | | | | | | | |
| WG2557676-2 | LCS | | | | | | | |
| Chloride (Cl) | | | 100.7 | | % | | 90-110 | 22-JUN-17 |
| WG2557676-1 | MB | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 22-JUN-17 |
| F-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3756736 | | | | | | | |
| WG2557676-2 | LCS | | | | | | | |
| Fluoride (F) | | | 99.6 | | % | | 90-110 | 22-JUN-17 |
| WG2557676-1 | MB | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 22-JUN-17 |
| MET-D-CCMS-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3756979 | | | | | | | |
| WG2557938-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 95.7 | | % | | 80-120 | 27-JUN-17 |
| WG2557938-5 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 98.6 | | % | | 80-120 | 27-JUN-17 |
| WG2557938-8 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 105.0 | | % | | 80-120 | 27-JUN-17 |
| WG2557938-1 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 27-JUN-17 |
| WG2557938-4 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 27-JUN-17 |
| WG2557938-7 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 27-JUN-17 |
| MET-DIS-ICP-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3755547 | | | | | | | |
| WG2557811-2 | LCS | TMRM | | | | | | |
| Calcium (Ca)-Dissolved | | | 103.7 | | % | | 80-120 | 24-JUN-17 |
| Magnesium (Mg)-Dissolved | | | 112.1 | | % | | 80-120 | 24-JUN-17 |
| Potassium (K)-Dissolved | | | 106.3 | | % | | 80-120 | 24-JUN-17 |
| Sodium (Na)-Dissolved | | | 103.1 | | % | | 80-120 | 24-JUN-17 |



Quality Control Report

Workorder: L1946182

Report Date: 30-JUN-17

Page 2 of 4

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|--------------|----------|-----------|-------|-----|--------|-----------|
| MET-DIS-ICP-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3755547 | | | | | | | |
| WG2557811-1 | MB | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 24-JUN-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 24-JUN-17 |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 24-JUN-17 |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 24-JUN-17 |
| MET-T-CCMS-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3756343 | | | | | | | |
| WG2557171-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 104.4 | | % | | 80-120 | 26-JUN-17 |
| WG2557171-6 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 106.2 | | % | | 80-120 | 26-JUN-17 |
| WG2557171-1 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 26-JUN-17 |
| WG2557171-5 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 26-JUN-17 |
| Batch | R3756979 | | | | | | | |
| WG2557171-10 | LCS | TMRMM | | | | | | |
| Copper (Cu)-Total | | | 108.5 | | % | | 80-120 | 27-JUN-17 |
| WG2557171-9 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 27-JUN-17 |
| Batch | R3758076 | | | | | | | |
| WG2557171-13 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 98.8 | | % | | 80-120 | 28-JUN-17 |
| WG2557171-12 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 28-JUN-17 |
| NO2-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3756736 | | | | | | | |
| WG2557676-2 | LCS | | | | | | | |
| Nitrite (as N) | | | 102.3 | | % | | 90-110 | 22-JUN-17 |
| WG2557676-1 | MB | | | | | | | |
| Nitrite (as N) | | | <0.010 | | mg/L | | 0.01 | 22-JUN-17 |
| NO3-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3756736 | | | | | | | |
| WG2557676-2 | LCS | | | | | | | |
| Nitrate (as N) | | | 101.0 | | % | | 90-110 | 22-JUN-17 |
| WG2557676-1 | MB | | | | | | | |
| Nitrate (as N) | | | <0.020 | | mg/L | | 0.02 | 22-JUN-17 |



Quality Control Report

Workorder: L1946182

Report Date: 30-JUN-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|--------------|--------|-----------|-------|-----|---------|-----------|
| PH/EC/ALK-CL | | Water | | | | | | |
| Batch | R3754910 | | | | | | | |
| WG2555560-14 | LCS | | | | | | | |
| pH | | | 7.00 | | pH | | 6.9-7.1 | 22-JUN-17 |
| Conductivity (EC) | | | 105.4 | | % | | 90-110 | 22-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | 100.6 | | % | | 85-115 | 22-JUN-17 |
| WG2555560-13 | MB | | | | | | | |
| Conductivity (EC) | | | <2.0 | | uS/cm | | 2 | 22-JUN-17 |
| Bicarbonate (HCO3) | | | <5.0 | | mg/L | | 5 | 22-JUN-17 |
| Carbonate (CO3) | | | <5.0 | | mg/L | | 5 | 22-JUN-17 |
| Hydroxide (OH) | | | <5.0 | | mg/L | | 5 | 22-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | <5.0 | | mg/L | | 5 | 22-JUN-17 |
| SO4-IC-N-CL | | Water | | | | | | |
| Batch | R3756736 | | | | | | | |
| WG2557676-2 | LCS | | | | | | | |
| Sulfate (SO4) | | | 102.0 | | % | | 90-110 | 22-JUN-17 |
| WG2557676-1 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 22-JUN-17 |

Quality Control Report

Workorder: L1946182

Report Date: 30-JUN-17

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To
 Company: Nautilus Environmental
 Contact: Leila Oosterbroek
 Address: #4, 6125 12 St SE
 Calgary, AB T2H 2K1
 Phone: 403-253-7121

Report Format / Distribution
 Select Report Format: PDF EXCEL EDD (DIGITAL)
 Quality Control (QC) Report with Report Yes No
 Criteria on Report - provide details below if box checked
 Select Distribution: EMAIL MAIL FAX
 Email 1 or Fax: leila@nautilusenvironmental.ca
 Email 2: bryon@nautilusenvironmental.ca

Invoice Distribution
 Select Invoice Distribution: EMAIL MAIL FAX
 Email 1 or Fax: abaccounts@nautilusenvironmental.ca
 Email 2: leila@nautilusenvironmental.ca

Oil and Gas Required Fields (client use)
 Approver ID: _____ Cost Center: _____
 GL Account: _____ Routing Code: _____
 Activity Code: _____
 Location: _____

ALS Lab Work Order # (lab use only)

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | C-DIS-ORG-CL (dissolved organic carbon) | ROU-CL (Ca, Mg, Na, SM, Cl, Alk) | MET-T-COMS-1-CL (total copper in water) | MET-D-COMS-1-CL (dissolved copper in water) | FILTER-CL (lab filtered and preserved) | Number of Containers |
|-----------------------------|---|-----------------|--------------|-------------|---|----------------------------------|---|---|--|----------------------|
| 1 | SP1617-029; Lab Control FM - Week 5 | 20160621 | | water | R | R | R | R | R | |
| 2 | SP1617-029; Lab Control HA - Week 5 | | | water | R | R | R | R | R | |
| 3 | SP1617-029; Site Control FM - Week 5 | | | water | R | R | R | R | R | |
| 4 | SP1617-029; Site Control HA - Week 5 | | | water | R | R | R | R | R | |
| 5 | SP1617-029; 5 ug/L Cu - Week 5 | | | water | R | R | R | R | R | |
| 6 | SP1617-029; 10 ug/L Cu - Week 5 | | | water | R | R | R | R | R | |
| 7 | SP1617-029; 20 ug/L Cu - Week 5 | | | water | R | R | R | R | R | |
| 8 | SP1617-029; 40 ug/L Cu - Week 5 | | | water | R | R | R | R | R | |
| 9 | SP1617-029; 80 ug/L Cu - Week 5 | | | water | R | R | R | R | R | |
| 10 | SP1617-029; 160 ug/L Cu - Week 5 | | | water | R | R | R | R | R | |

Drinking Water (DW) Samples (client use)

Are samples taken from a Regulated DW System?
 Yes No

Are samples for human drinking water use?
 Yes No

SHIPMENT RELEASE (client use)
 Released by: [Signature] Date: 20160621 Time: 11:00

INITIAL SHIPMENT RECEPTION (lab use only)
 Received by: KC Date: 21-JUN-17 Time: 12:32pm

Special Instructions / Specify Criteria to add on report (client use)
 ****For total metals, samples have been preserved. For dissolved parameters (DOC, dissolved metals), samples have not been filtered or preserved; please sub-sample and filter/preserve at the lab (SFPL)****

SAMPLE CONDITION AS RECEIVED (lab use only)
 Frozen SIF Observations Yes No
 Ice packs Yes No Custody seal intact Yes No
 Cooling initiated

INITIAL COOLER TEMPERATURES °C: 7.2
 FINAL COOLER TEMPERATURES °C: _____

FINAL SHIPMENT RECEPTION (lab use only)
 Received by: _____ Date: _____ Time: _____

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

L1946182-COFC





Nautilus Environmental
ATTN: Leila Oosterbroek
#4, 6125 - 12 Street SE
Calgary AB T2H 2K1

Date Received: 28-JUN-17
Report Date: 25-JUL-17 15:56 (MT)
Version: FINAL REV. 2

Client Phone: 403-253-7121

Certificate of Analysis

Lab Work Order #: L1950474
Project P.O. #: PO 2016-1190
Job Reference:
C of C Numbers:
Legal Site Desc:

Comments: ADDITIONAL 19-JUL-17 14:21

19-JUL-17

Additional analysis: as per Leila Oosterbroek, additional total + diss Cu analysis on sample - 2, reg-TAT

Nelson Kwan, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|----------|------------|---------|-------|-----------|-----------|----------|
| L1950474-1 SP1617-029; LAB CONTROL HA - WEEK 6 Sampled By: CLIENT on 28-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 04-JUL-17 | R3765443 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | | 04-JUL-17 | R3765545 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.00053 | | 0.00050 | mg/L | | 04-JUL-17 | R3765545 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 79.5 | | 0.50 | mg/L | | 28-JUN-17 | R3758842 |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 04-JUL-17 | R3765443 |
| Calcium (Ca)-Dissolved | 40.9 | | 0.10 | mg/L | | 04-JUL-17 | R3765545 |
| Magnesium (Mg)-Dissolved | 6.57 | | 0.10 | mg/L | | 04-JUL-17 | R3765545 |
| Potassium (K)-Dissolved | 2.65 | | 0.50 | mg/L | | 04-JUL-17 | R3765545 |
| Sodium (Na)-Dissolved | 26.1 | | 1.0 | mg/L | | 04-JUL-17 | R3765545 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | <0.020 | | 0.020 | mg/L | | 28-JUN-17 | R3758842 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 96.9 | | | % | | 05-JUL-17 | |
| TDS (Calculated) | 216 | | | mg/L | | 05-JUL-17 | |
| Hardness (as CaCO3) | 129 | | | mg/L | | 05-JUL-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.076 | | 0.020 | mg/L | | 28-JUN-17 | R3758842 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.076 | | 0.050 | mg/L | | 29-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 28-JUN-17 | R3758842 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 25.9 | | 0.30 | mg/L | | 28-JUN-17 | R3758842 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 8.12 | | 0.10 | pH | | 29-JUN-17 | R3761310 |
| Conductivity (EC) | 435 | | 2.0 | uS/cm | | 29-JUN-17 | R3761310 |
| Bicarbonate (HCO3) | 68.3 | | 5.0 | mg/L | | 29-JUN-17 | R3761310 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 29-JUN-17 | R3761310 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 29-JUN-17 | R3761310 |
| Alkalinity, Total (as CaCO3) | 56.0 | | 5.0 | mg/L | | 29-JUN-17 | R3761310 |
| L1950474-2 SP1617-029; SITE CONTROL HA - WEEK 6 Sampled By: CLIENT on 28-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 21-JUL-17 | R3780246 |
| Copper (Cu)-Dissolved | 0.0128 | | 0.00020 | mg/L | | 21-JUL-17 | R3780316 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.0141 | | 0.00050 | mg/L | | 24-JUL-17 | R3780316 |
| Miscellaneous Parameters | | | | | | | |
| Dissolved Organic Carbon | 34.2 | DLM | 5.0 | mg/L | | 02-JUL-17 | R3760464 |
| Routine Water Analysis | | | | | | | |
| Chloride in Water by IC | | | | | | | |
| Chloride (Cl) | 26.9 | DLHC | 2.5 | mg/L | | 28-JUN-17 | R3758842 |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|--------|------------|---------|-------|-----------|-----------|----------|
| L1950474-2 SP1617-029; SITE CONTROL HA - WEEK 6 Sampled By: CLIENT on 28-JUN-17 Matrix: WATER | | | | | | | |
| Dissolved Metals by ICPOES | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 04-JUL-17 | R3765443 |
| Calcium (Ca)-Dissolved | 25.2 | | 0.10 | mg/L | | 04-JUL-17 | R3765545 |
| Magnesium (Mg)-Dissolved | 7.87 | | 0.10 | mg/L | | 04-JUL-17 | R3765545 |
| Potassium (K)-Dissolved | 2.06 | | 0.50 | mg/L | | 04-JUL-17 | R3765545 |
| Sodium (Na)-Dissolved | 23.4 | | 1.0 | mg/L | | 04-JUL-17 | R3765545 |
| Fluoride in Water by IC | | | | | | | |
| Fluoride (F) | 0.11 | DLHC | 0.10 | mg/L | | 28-JUN-17 | R3758842 |
| Ion Balance Calculation | | | | | | | |
| Ion Balance | 102 | | | % | | 05-JUL-17 | |
| TDS (Calculated) | 161 | | | mg/L | | 05-JUL-17 | |
| Hardness (as CaCO3) | 95.3 | | | mg/L | | 05-JUL-17 | |
| Nitrate in Water by IC | | | | | | | |
| Nitrate (as N) | 0.69 | DLHC | 0.10 | mg/L | | 28-JUN-17 | R3758842 |
| Nitrate+Nitrite | | | | | | | |
| Nitrate and Nitrite (as N) | 0.69 | | 0.11 | mg/L | | 29-JUN-17 | |
| Nitrite in Water by IC | | | | | | | |
| Nitrite (as N) | <0.050 | DLHC | 0.050 | mg/L | | 28-JUN-17 | R3758842 |
| Sulfate in Water by IC | | | | | | | |
| Sulfate (SO4) | 23.8 | DLHC | 1.5 | mg/L | | 28-JUN-17 | R3758842 |
| pH, Conductivity and Total Alkalinity | | | | | | | |
| pH | 7.76 | | 0.10 | pH | | 29-JUN-17 | R3761310 |
| Conductivity (EC) | 292 | | 2.0 | uS/cm | | 29-JUN-17 | R3761310 |
| Bicarbonate (HCO3) | 98.7 | | 5.0 | mg/L | | 29-JUN-17 | R3761310 |
| Carbonate (CO3) | <5.0 | | 5.0 | mg/L | | 29-JUN-17 | R3761310 |
| Hydroxide (OH) | <5.0 | | 5.0 | mg/L | | 29-JUN-17 | R3761310 |
| Alkalinity, Total (as CaCO3) | 80.9 | | 5.0 | mg/L | | 29-JUN-17 | R3761310 |
| L1950474-3 SP1617-029; 5 UG/L CU - WEEK 6 Sampled By: CLIENT on 28-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 04-JUL-17 | R3765443 |
| Copper (Cu)-Dissolved | 0.0183 | | 0.00020 | mg/L | | 04-JUL-17 | R3765545 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.0186 | | 0.00050 | mg/L | | 04-JUL-17 | R3765545 |
| L1950474-4 SP1617-029; 10 UG/L CU - WEEK 6 Sampled By: CLIENT on 28-JUN-17 Matrix: WATER | | | | | | | |
| Individual Dissolved Metal by CCMS | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 04-JUL-17 | R3765443 |
| Copper (Cu)-Dissolved | 0.0229 | | 0.00020 | mg/L | | 04-JUL-17 | R3765545 |
| Individual Total Metal by CCMS | | | | | | | |
| Total Metals in Water by CRC ICPMS | | | | | | | |
| Copper (Cu)-Total | 0.0232 | | 0.00050 | mg/L | | 04-JUL-17 | R3765545 |
| L1950474-5 SP1617-029; 20 UG/L CU - WEEK 6 Sampled By: CLIENT on 28-JUN-17 Matrix: WATER | | | | | | | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---------------|------------|---------|-------|-----------|------------------------|----------------------|
| L1950474-5 SP1617-029; 20 UG/L CU - WEEK 6 Sampled By: CLIENT on 28-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0310 | | 0.00020 | mg/L | | 04-JUL-17 04-JUL-17 | R3765443 R3765545 |
| L1950474-6 SP1617-029; 40 UG/L CU - WEEK 6 Sampled By: CLIENT on 28-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0555 | | 0.00020 | mg/L | | 04-JUL-17 04-JUL-17 | R3765443 R3765545 |
| L1950474-7 SP1617-029; 80 UG/L CU - WEEK 6 Sampled By: CLIENT on 28-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.0841 | DLM | 0.0010 | mg/L | | 04-JUL-17 04-JUL-17 | R3765443 R3765545 |
| L1950474-8 SP1617-029; 160 UG/L CU - WEEK 6 Sampled By: CLIENT on 28-JUN-17 Matrix: WATER Individual Dissolved Metal by CCMS Dissolved Metals in Water by CRC ICPMS Dissolved Metals Filtration Location Copper (Cu)-Dissolved Individual Total Metal by CCMS Total Metals in Water by CRC ICPMS Copper (Cu)-Total | LAB 0.165 | DLM | 0.0010 | mg/L | | 04-JUL-17 04-JUL-17 | R3765443 R3765545 |
| | | | | | | | |

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Qualifiers for Sample Submission Listed:

| Qualifier | Description |
|-----------|---|
| EXTEMP10 | 12.3C (SAME DAY SAMPLING) - Samples Received with temperature >10 Degrees C |
| SFPL | DOC,MET-D - Sample was Filtered and Preserved at the laboratory |

Sample Parameter Qualifier Key:

| Qualifier | Description |
|-----------|--|
| DLHC | Detection Limit Raised: Dilution required due to high concentration of test analyte(s). |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|--------------------------|
| C-DIS-ORG-CL | Water | Dissolved Organic Carbon | APHA 5310 B-Instrumental |
| <p>This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.</p> <p>The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC. TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.</p> | | | |
| CL-IC-N-CL | Water | Chloride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| F-IC-N-CL | Water | Fluoride in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| IONBALANCE-CL | Water | Ion Balance Calculation | APHA 1030E |
| MET-D-CCMS-CL | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |
| <p>Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| MET-DIS-ICP-CL | Water | Dissolved Metals by ICPOES | APHA 3030B/EPA 6010B |
| <p>"This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (APHA Method 3030B) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).</p> | | | |
| MET-T-CCMS-CL | Water | Total Metals in Water by CRC ICPMS | EPA 200.2/6020A (mod) |
| <p>Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.</p> <p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p> | | | |
| N2N3-CALC-CL | Water | Nitrate+Nitrite | CALCULATION |
| NO2-IC-N-CL | Water | Nitrite in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| NO3-IC-N-CL | Water | Nitrate in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |
| PH/EC/ALK-CL | Water | pH, Conductivity and Total Alkalinity | APHA 4500H,2510,2320 |
| <p>All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current</p> | | | |
| SO4-IC-N-CL | Water | Sulfate in Water by IC | EPA 300.1 (mod) |
| <p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---------------|--------|------------------|--------------------|
|---------------|--------|------------------|--------------------|

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1950474

Report Date: 25-JUL-17

Page 1 of 4

Client: Nautilus Environmental
 #4, 6125 - 12 Street SE
 Calgary AB T2H 2K1
 Contact: Leila Oosterbroek

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|-------------|----------|-----------|-------|-----|--------|-----------|
| C-DIS-ORG-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3760464 | | | | | | | |
| WG2561644-2 | LCS | | | | | | | |
| Dissolved Organic Carbon | | | 93.1 | | % | | 80-120 | 02-JUL-17 |
| WG2561644-1 | MB | | | | | | | |
| Dissolved Organic Carbon | | | <1.0 | | mg/L | | 1 | 02-JUL-17 |
| CL-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3758842 | | | | | | | |
| WG2559844-6 | LCS | | | | | | | |
| Chloride (Cl) | | | 100.7 | | % | | 90-110 | 28-JUN-17 |
| WG2559844-5 | MB | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 28-JUN-17 |
| F-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3758842 | | | | | | | |
| WG2559844-6 | LCS | | | | | | | |
| Fluoride (F) | | | 98.6 | | % | | 90-110 | 28-JUN-17 |
| WG2559844-5 | MB | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 28-JUN-17 |
| MET-D-CCMS-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3765545 | | | | | | | |
| WG2563157-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 102.3 | | % | | 80-120 | 04-JUL-17 |
| WG2563157-1 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 04-JUL-17 |
| Batch | R3780316 | | | | | | | |
| WG2576078-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 99.1 | | % | | 80-120 | 21-JUL-17 |
| WG2576078-6 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 102.3 | | % | | 80-120 | 21-JUL-17 |
| WG2576078-9 | LCS | TMRM | | | | | | |
| Copper (Cu)-Dissolved | | | 99.7 | | % | | 80-120 | 21-JUL-17 |
| WG2576078-1 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 21-JUL-17 |
| WG2576078-5 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 21-JUL-17 |
| WG2576078-8 | MB | | | | | | | |
| Copper (Cu)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 21-JUL-17 |
| MET-DIS-ICP-CL | | | | | | | | |
| | Water | | | | | | | |



Quality Control Report

Workorder: L1950474

Report Date: 25-JUL-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|--------------------------|-----------------|-------------|----------|-----------|-------|-----|--------|-----------|
| MET-DIS-ICP-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3765545 | | | | | | | |
| WG2563157-2 | LCS | TMRM | | | | | | |
| Calcium (Ca)-Dissolved | | | 104.5 | | % | | 80-120 | 04-JUL-17 |
| Magnesium (Mg)-Dissolved | | | 102.0 | | % | | 80-120 | 04-JUL-17 |
| Potassium (K)-Dissolved | | | 107.0 | | % | | 80-120 | 04-JUL-17 |
| Sodium (Na)-Dissolved | | | 107.5 | | % | | 80-120 | 04-JUL-17 |
| WG2563157-1 | MB | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 04-JUL-17 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 04-JUL-17 |
| Potassium (K)-Dissolved | | | <0.50 | | mg/L | | 0.5 | 04-JUL-17 |
| Sodium (Na)-Dissolved | | | <1.0 | | mg/L | | 1 | 04-JUL-17 |
| MET-T-CCMS-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3765545 | | | | | | | |
| WG2562509-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 97.3 | | % | | 80-120 | 04-JUL-17 |
| WG2562509-1 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 04-JUL-17 |
| Batch | R3767347 | | | | | | | |
| WG2562509-5 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 101.7 | | % | | 80-120 | 07-JUL-17 |
| WG2562509-4 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 07-JUL-17 |
| Batch | R3780316 | | | | | | | |
| WG2574779-2 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 94.0 | | % | | 80-120 | 21-JUL-17 |
| WG2574779-1 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 21-JUL-17 |
| Batch | R3781287 | | | | | | | |
| WG2574779-5 | LCS | TMRM | | | | | | |
| Copper (Cu)-Total | | | 99.2 | | % | | 80-120 | 24-JUL-17 |
| WG2574779-4 | MB | | | | | | | |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 24-JUL-17 |
| NO2-IC-N-CL | | | | | | | | |
| | Water | | | | | | | |
| Batch | R3758842 | | | | | | | |
| WG2559844-6 | LCS | | | | | | | |
| Nitrite (as N) | | | 103.7 | | % | | 90-110 | 28-JUN-17 |
| WG2559844-5 | MB | | | | | | | |
| Nitrite (as N) | | | <0.010 | | mg/L | | 0.01 | 28-JUN-17 |



Quality Control Report

Workorder: L1950474

Report Date: 25-JUL-17

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| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|------------------------------|-----------------|--------------|--------|-----------|-------|-----|---------|-----------|
| NO3-IC-N-CL | | Water | | | | | | |
| Batch | R3758842 | | | | | | | |
| WG2559844-6 | LCS | | | | | | | |
| Nitrate (as N) | | | 101.4 | | % | | 90-110 | 28-JUN-17 |
| WG2559844-5 | MB | | | | | | | |
| Nitrate (as N) | | | <0.020 | | mg/L | | 0.02 | 28-JUN-17 |
| PH/EC/ALK-CL | | Water | | | | | | |
| Batch | R3761310 | | | | | | | |
| WG2561811-8 | LCS | | | | | | | |
| pH | | | 7.02 | | pH | | 6.9-7.1 | 29-JUN-17 |
| Conductivity (EC) | | | 108.3 | | % | | 90-110 | 29-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | 100.3 | | % | | 85-115 | 29-JUN-17 |
| WG2561811-7 | MB | | | | | | | |
| Conductivity (EC) | | | <2.0 | | uS/cm | | 2 | 29-JUN-17 |
| Bicarbonate (HCO3) | | | <5.0 | | mg/L | | 5 | 29-JUN-17 |
| Carbonate (CO3) | | | <5.0 | | mg/L | | 5 | 29-JUN-17 |
| Hydroxide (OH) | | | <5.0 | | mg/L | | 5 | 29-JUN-17 |
| Alkalinity, Total (as CaCO3) | | | <5.0 | | mg/L | | 5 | 29-JUN-17 |
| SO4-IC-N-CL | | Water | | | | | | |
| Batch | R3758842 | | | | | | | |
| WG2559844-6 | LCS | | | | | | | |
| Sulfate (SO4) | | | 101.5 | | % | | 90-110 | 28-JUN-17 |
| WG2559844-5 | MB | | | | | | | |
| Sulfate (SO4) | | | <0.30 | | mg/L | | 0.3 | 28-JUN-17 |

Quality Control Report

Workorder: L1950474

Report Date: 25-JUL-17

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Legend:

| | |
|-------|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1950474-COCF

COC Number: 14 -

Page ___ of ___

Report To
 Company: Nautilus Environmental
 Contact: Lella Oosterbroek
 Address: #4, 6125 12 St SE
 Calgary, AB T2H 2K1
 Phone: 403-253-7121

Report Format / Distribution
 Select Report Format: PDF EXCEL EDD (DIGITAL)
 Quality Control (QC) Report with Report Yes No
 Criteria on Report - provide details below if box checked
 Select Distribution: EMAIL MAIL FAX
 Email 1 or Fax: lella@nautilusenvironmental.ca
 Email 2: bryon@nautilusenvironmental.ca

Invoice To
 Same as Report To Yes No
 Copy of Invoice with Report Yes No

Company:
 Contact: Lella Oosterbroek
 Email 1 or Fax: abaccounts@nautilusenvironmental.ca
 Email 2: lella@nautilusenvironmental.ca

Project Information
 ALS Quote #: Q55972
 Job #:
 PO / AFE: PO 2016-1190
 L.S.D:
 Approver ID:
 GL Account:
 Activity Code:
 Location:
 ALS Contact: Jesse Eagle
 Date: 2016/10/28
 Time:
 Sample Type: water

Shipping Information
 Shipping Method: Regular Priority Emergency
 Surcharges: 50% surcharge 100% surcharge
 Same day or weekend emergency: Yes No

Analysis Request
 Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Time (hh:mm) | Date (dd-mm-yy) | Sample Type | C-DIS-ORG-CL (dissolved organic carbon) | ROU-CL (Ca, Mg, Na, SO ₄ , Cl, alk) | MET-T-COMS-1-CL (total copper in water) - (F) | MET-D-COMS-1-CL (dissolved copper in water) | Filter-CL (lab filtered and preserved) | Number of Containers |
|-----------------------------|---|--------------|-----------------|-------------|---|--|---|---|--|----------------------|
| 1 | SP1617-029; Lab Control HA - Week 6 | | | water | R | R | R | R | | |
| 2 | SP1617-029; Site Control HA - Week 6 | | | water | R | R | R | R | | |
| 3 | SP1617-029; 5 ug/L Cu - Week 6 | | | water | R | R | R | R | | |
| 4 | SP1617-029; 10 ug/L Cu - Week 6 | | | water | R | R | R | R | | |
| 5 | SP1617-029; 20 ug/L Cu - Week 6 | | | water | R | R | R | R | | |
| 6 | SP1617-029; 40 ug/L Cu - Week 6 | | | water | R | R | R | R | | |
| 7 | SP1617-029; 80 ug/L Cu - Week 6 | | | water | R | R | R | R | | |
| 8 | SP1617-029; 160 ug/L Cu - Week 6 | | | water | R | R | R | R | | |

Shipping and Receipt Information
 SHIPMENT RELEASE (client use)
 Released by: [Signature] Date: 28 Jun 13:00
 INITIAL SHIPMENT RECEPTION (lab use only)
 Received by: KC Date: 28 Jun 13:00
 Special Instructions / Specify Criteria to add on report (client use)
 *****For total metals, samples have been preserved. For dissolved parameters (DOC, dissolved metals), samples have not been filtered or preserved; please sub-sample and filter/preserve at the lab (SPL)*****
 Are samples taken from a Regulated DW System? Yes No
 Are samples for human drinking water use? Yes No
 SAMPLE CONDITION AS RECEIVED (lab use only)
 Frozen: Yes No
 Ice packs: Yes No
 Custody seal intact: Yes No
 Cooling Initiated: Yes No
 INITIAL COOLER TEMPERATURES °C: 12.3
 FINAL COOLER TEMPERATURES °C:
 FINAL SHIPMENT RECEPTION (lab use only)
 Received by:
 Date:
 Time:
 WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy. 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

APPENDIX F – Chain of Custody Forms



4340 Vandever Ave.
San Diego, CA 92120
Phone 858.587.7333
Fax 858.587.3961

COC# 2017-05-09 A

| SAMPLE ID | DATE | TIME | MATRIX | CONTAINER TYPE | NO. OF CONTAINERS | COMMENTS | ANALYSES REQUIRED | | | | | Receipt Temperature (°C) | |
|---|------------------------|--------------------------|--------|--------------------------|-------------------|---|--|----------------------|------------------------------|--------------------------|--|--------------------------|--|
| | | | | | | | 21-d Daphnia magna | 42-d Hyalella azteca | 48-h Brachionus calyciflorus | 32-d Pimephales promelas | | | |
| | | | | | | | X | X | X | X | | | |
| W2 | 2017/05/05 | 15:15 | Water | 200L Barrel | 9 | Please contact Leila for specific analysis required | X | X | X | X | | | |
| W16 | 2017/05/05 | 16:00 | Water | 200L Barrel | 3 | Please contact Leila for specific analysis required | X | X | X | X | | | |
| | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | |
| Report to: Shaun Roberts Company: Minto-Minc Address: PO Box 11, Whitehorse Central PO City/State/Zip: Whitehorse/YT/Y1A 5X9 Contact: Emilie Bouchard/Todd Swenson Phone: 604-759-4659 Email: loddas@mintomine.com/deborah1@mintomine.com | | | | | | | Invoice To: Nautilus Environmental Address: #4, 6125 12 St. SE City/State/Zip: Calgary, AB, T2H 2K1 Contact: Leila Oosterbroek Phone: 403-253-7121 Email: leila@nautilusenvironmental.ca | | | | | | |
| PROJECT INFORMATION | | SAMPLE RECEIPT | | RELINQUISHED BY (CLIENT) | | | RELINQUISHED BY (COURIER) | | | | | | |
| Client: | Nautilus Environmental | Total No. of Containers | | (Signature) | (Time) | (Signature) | (Time) | (Signature) | (Time) | | | | |
| PO No.: | | Received Good Condition? | | (Printed Name) | (Date) | (Printed Name) | (Date) | (Printed Name) | (Date) | | | | |
| Shipped Via: | Manitoulin | Matches Test Schedule? | | (Company) | | (Company) | | (Company) | | | | | |
| SPECIAL INSTRUCTIONS/COMMENTS: CQ/ES 2017/05/12 @ 1500 3 x 200L DRUMS, 6°C NO S/I, GOOD CONDITION | | | | RECEIVED BY (COURIER) | | | RECEIVED BY (LABORATORY) | | | | | | |
| | | | | (Signature) | (Time) | (Signature) | (Time) | (Signature) | (Time) | | | | |
| | | | | (Printed Name) | (Date) | (Printed Name) | (Date) | (Printed Name) | (Date) | | | | |
| | | | | (Company) | | (Company) | | (Company) | | | | | |

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

DISTRIBUTION: WHITE · Nautilus Environmental, COLOR · Originator

END OF REPORT

APPENDIX C
RE-ANALYSIS OF DATA REPORTED FOR
REPRODUCTION IN THE 42-DAY TOXICITY
TEST OF *HYALELLA AZTECA*

APPENDIX C – STATISTICAL RE-ANALYSIS OF THE 42-DAY *HYALELLA AZTECA* REPRODUCTION DATA (AS REPORTED IN APPENDIX B – NAUTILUS 2017)

C1 Background

Verification of the Minto Mine's Water Quality Objective (WQO) for copper in Minto Creek was undertaken on water collected from Minto Creek and the Minto Mine Water Storage Pond (WSP) on May 5th 2017. These waters were mixed in a proportion equivalent to those expected at the Mine's maximum permissible rate of discharge (one part WSP water to three parts Minto Creek water), spiked with copper at nominal concentrations of 5, 10, 20, 40, 80, and 160 µg/L, and tested for toxicity with four test organisms (Appendix B – Nautilus 2017). One of the test endpoints – reproduction of *Hyalella azteca* in a 42-day test – yielded Inhibitory Concentrations (10th, 20th, and 50th percentiles) that were all reported as a "less than" (" $<$ ") values (<14.9 µg/L dissolved copper and <17.5 µg/L total copper; Appendix B – Nautilus 2017).

Inhibitory concentrations associated with the *H. azteca* 42-d reproduction endpoint were generated by Nautilus using the Comprehensive Environmental Toxicity Information System (CETIS) software. Inhibitory concentrations were estimated using a three parameter log-logistic regression model of reproduction (number of young per test organism; $n=8$) on copper concentration (page 154 of Appendix B). The residuals plots (page 155 of Appendix B) show strong heterogeneity of variance in the residuals versus concentration (confirmed by a Levene's test on the residuals of the model using treatment group as a factor; $p < 0.001$), a violation of the assumption of homogeneity of variance required for defensible regression. A data transformation can be used to meet the assumptions of homogeneity of variance. In addition, the laboratory control data set had two unusually large values (30 and 43 young) which have a strong leveraging influence on the laboratory mean value used in the IC_{20} estimate. In comparison, previous testing under clear water conditions yielded a maximum reproductive output of 8 young per female (Minnow 2016) and recent published studies have indicated reproductive output between 0 young per female and 28.4 young per female (Soucek et al. 2016; Ivey et al. 2016).

C2 Approach

To address violation of the assumption of homogeneity of variance, Minnow conducted a regression analysis for the *H. azteca* 42-d toxicity test reproduction endpoint (i.e., number of young per female) versus concentrations of dissolved and total copper. The regressions were conducted by adding a value of 1 to the response variable and then \log_{10} -transforming the



variable to homogenize the variances (confirmed by a Levene's test on the residuals of the model using treatment group as a factor). The following regression models were fit following guidance from Environment Canada (2005):

$$\text{Linear: } Y = \beta_0 + \beta_1 x + \epsilon$$

$$\text{Exponential: } Y = \beta_0 \exp(\beta_1 x) + \epsilon$$

$$\text{Gompertz: } Y = \beta_0 \exp(-\exp(\beta_1 - \beta_2 x)) + \epsilon$$

$$\text{Logistic: } Y = \beta_0 / (1 + \exp(\frac{x - \beta_1}{\beta_2})) + \epsilon$$

Outliers were assessed by comparing Standardized residuals to a cut-off of 3.5 (values based on sample size following formula in Dohoo et al. [2009] for a significance level of 0.05). The model of best fit was determined using Akaike's Information Criteria (AIC). A comparison of AIC values is used to determine which regression model is more likely to be correct (Motulsky and Christopoulos 2004) and is used to compare linear and non-linear models generated with the same response variable. A second order AIC (AIC_C) was used and was calculated as:

$$AIC_C = n \cdot \ln(\widehat{\sigma}^2) + 2K + 2K(K+1)/(n-K-1)$$

where n is the sample size, $\ln()$ is the natural logarithm, $\widehat{\sigma}^2$ is the residual sum of squares from the regression model divided by the sample size, and K is the number of parameters (including the constant and error term) in the model.

The AIC_C is recommended for small sample sizes ($n/K < 40$) and as n gets larger, the last term in the AIC_C formula approaches zero and the AIC_C approaches the general AIC formula (Burnham and Anderson 2002). The AIC_C is used to compare models that were generated with the same response variable data. The model with the smallest AIC_C is more likely to be correct (i.e., it is more likely that the data were generated by the model with the smallest AIC_C). The magnitude of the AIC_C cannot be interpreted and comparisons among AIC_C values can only be made when the values of the response variables are identical. Comparison of AIC_C values is therefore not appropriate for comparing models with different sample sizes (e.g., AIC_C values cannot be compared between models with and without outliers removed).

C3 Results

Inhibitory Concentration (IC) estimates were generated for a 20% decrease in the response variable (no. of young per female) relative to the laboratory control mean and the laboratory control median (Table C1) based on the regression models (Figures C1 and C2). The IC_{20} estimates relative to the laboratory control median remove the influence of the two unusually



large values for the laboratory control group on the estimate of the IC₂₀. The best fit regression model for reproduction and dissolved copper was a linear regression model (Table C1; Figure C1), and the best-fit regression model for reproduction and total copper was also a linear regression model (Table C1; Figure C2). Based on these models, IC₂₀ estimates of 15.9 µg/L dissolved copper and 17.8 µg/L total copper were obtained relative to the laboratory control mean (which was leveraged by two extreme values), and IC₂₀ estimates of 27.6 µg/L dissolved copper and 30.1 µg/L total copper were obtained relative to the laboratory control median. It is noteworthy that there is evidence that the regression models reported in Table C1 do not fit the data based on the lack of fit test (Table C1). This is because the test results (mean reproduction) do not monotonically decrease at each increasing copper concentration (Table C2) as would be expected under an ideal dose-response curve. This results in the estimated means values of all regression models not fitting the observed mean values and suggests that factors other than copper may have influenced the observed responses.

C4 References

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Table C.1: Regression Models for *Hyalella azteca* 42-d Reproduction versus Concentration of Dissolved Copper and Total Copper, and Estimates of IC₂₀ Relative to the Laboratory Control Mean and Median, Minto Turbid Flow, May 5th 2017

| Regression Model | Response Variable Transformation | Predictor Variable | Levene's Test p-value ^a | Coefficient | Coefficient P-value | Lack of Fit Test P-value ^b | n | AIC _c | S | r ² | Regression Coefficients | | | Outliers ^c | IC ₂₀ (µg/L) (Based on the Mean Lab Control) | IC ₂₀ (µg/L) (Based on the Median Lab Control) |
|------------------|----------------------------------|--------------------|------------------------------------|-------------|---------------------|---------------------------------------|--------|------------------|-------|----------------|-------------------------|----------------|----------------|-----------------------|---|---|
| | | | | | | | | | | | b ₀ | b ₁ | b ₂ | | | |
| Linear | log(X+1) | Dissolved Copper | 0.432 | intercept | <0.001 | <0.001 | 64 | - | 0.227 | 0.647 | 1.045 | -0.006 | - | - | 12.8 | 24.8 |
| | | | 0.106 | slope | <0.001 | <0.001 | 63 | -199.9 | 0.198 | 0.720 | 1.066 | -0.006 | - | (1) | 15.9 | 27.6 |
| 0.432 | | | - | - | <0.001 | 64 | - | 0.228 | - | 1.149 | -0.011 | - | - | 15.4 | 22.6 | |
| 0.106 | | | - | - | 0.001 | 63 | -198.3 | 0.200 | - | 1.168 | -0.011 | - | (1) | 17.1 | 24.2 | |
| 0.432 | | | - | - | <0.001 | 64 | - | 0.228 | - | 4.660 | 0.367 | -0.0057 | - | 15.4 | 24.1 | |
| 0.106 | | | - | - | 0.001 | 63 | -198.0 | 0.198 | - | 3.266 | 0.075 | -0.0070 | (1) | 17.6 | 26.7 | |
| 0.432 | | | - | - | <0.001 | 64 | - | 0.229 | - | 2.687 | -22.818 | 66.428 | - | 15.6 | 23.7 | |
| 0.106 | | | - | - | 0.001 | 63 | -197.2 | 0.200 | - | 1.987 | 14.527 | 57.828 | (1) | 17.8 | 26.5 | |
| Linear | log(X+1) | Total Copper | 0.432 | intercept | <0.001 | <0.001 | 64 | - | 0.227 | 0.647 | 1.052 | -0.006 | - | - | 14.6 | 27.1 |
| | | | 0.106 | slope | <0.001 | <0.001 | 63 | -199.9 | 0.198 | 0.720 | 1.073 | -0.006 | - | (1) | 17.8 | 30.1 |
| 0.432 | | | - | - | <0.001 | 64 | - | 0.229 | - | 1.158 | -0.011 | - | - | 17.2 | 24.8 | |
| 0.106 | | | - | - | 0.001 | 63 | -198.0 | 0.201 | - | 1.178 | -0.011 | - | (1) | 18.9 | 26.5 | |
| 0.432 | | | - | - | <0.001 | 64 | - | 0.227 | - | 4.365 | 0.316 | -0.0055 | - | 17.2 | 26.5 | |
| 0.106 | | | - | - | 0.001 | 63 | -198.0 | 0.198 | - | 3.183 | 0.045 | -0.0067 | (1) | 19.5 | 29.2 | |
| 0.432 | | | - | - | <0.001 | 64 | - | 0.230 | - | 2.545 | -16.512 | 68.949 | - | 17.4 | 26.1 | |
| 0.106 | | | - | - | 0.001 | 63 | -197.0 | 0.200 | - | 1.964 | 17.736 | 60.658 | (1) | 19.8 | 29.0 | |

Model with smallest AIC_c (best fit).

^a Levene's test for homogeneity of variances performed on the model residuals with copper treatment group as the factor. Values > 0.05 indicate within-treatment residual variances are not significantly different.

^b P-value < α (0.05) implies that the model does not fit the data (the mean values at each copper treatment are not well estimated by the regression model).

^c Outliers identified as observations with Standardized residuals greater than 3.5 (based on α = 0.05; Dohoo et al. 2009).

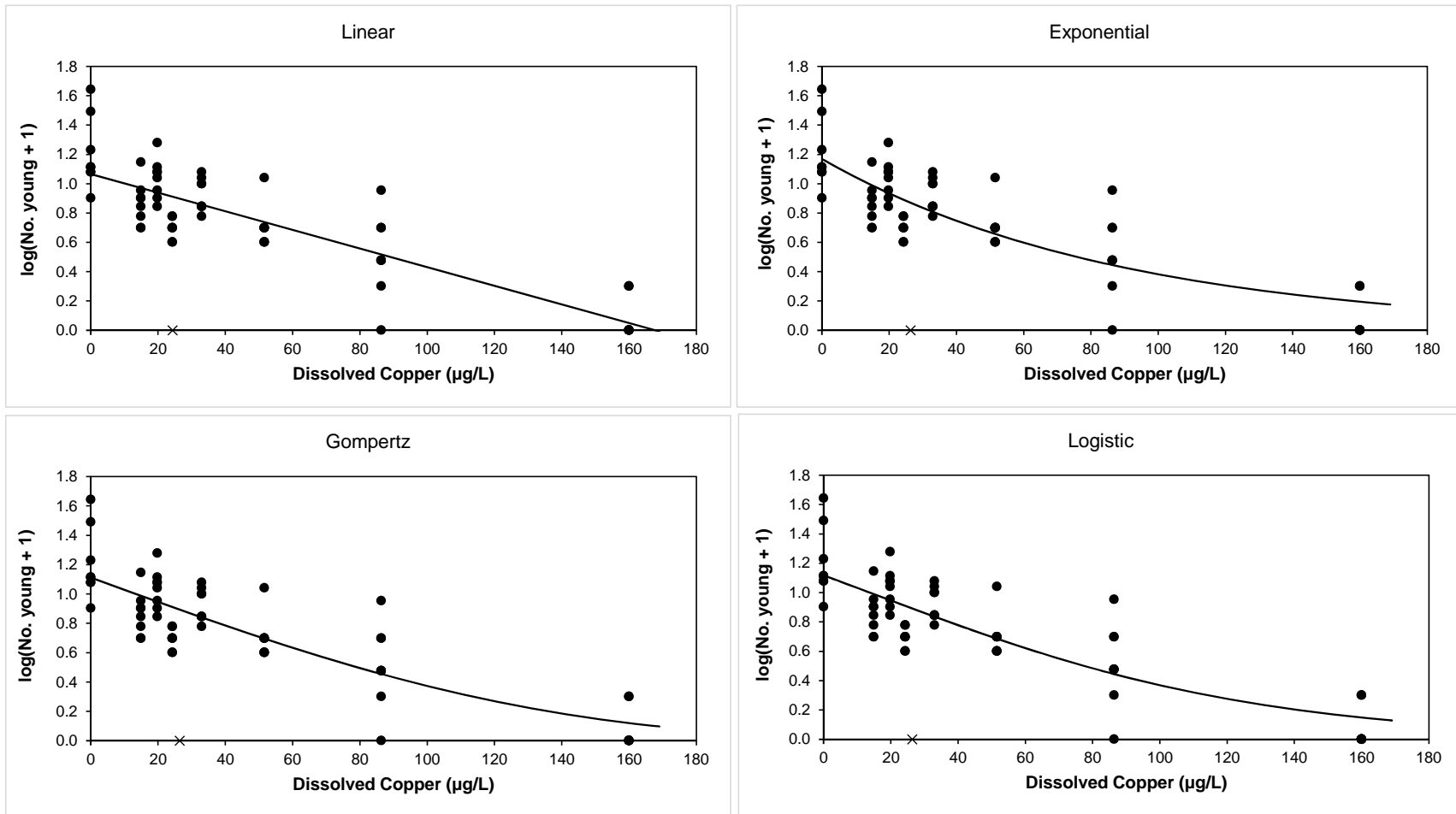


Figure C.1: Scatterplots and Regression Models for *Hyalella azteca* 42-d Reproduction versus Concentration of Dissolved Copper, Minto Turbid Flow, May 5th 2017

Notes: Outliers removed from analysis denoted by an x.

Solid border indicates model with the best fit (lowest AIC_c value as reported in Table C.1).

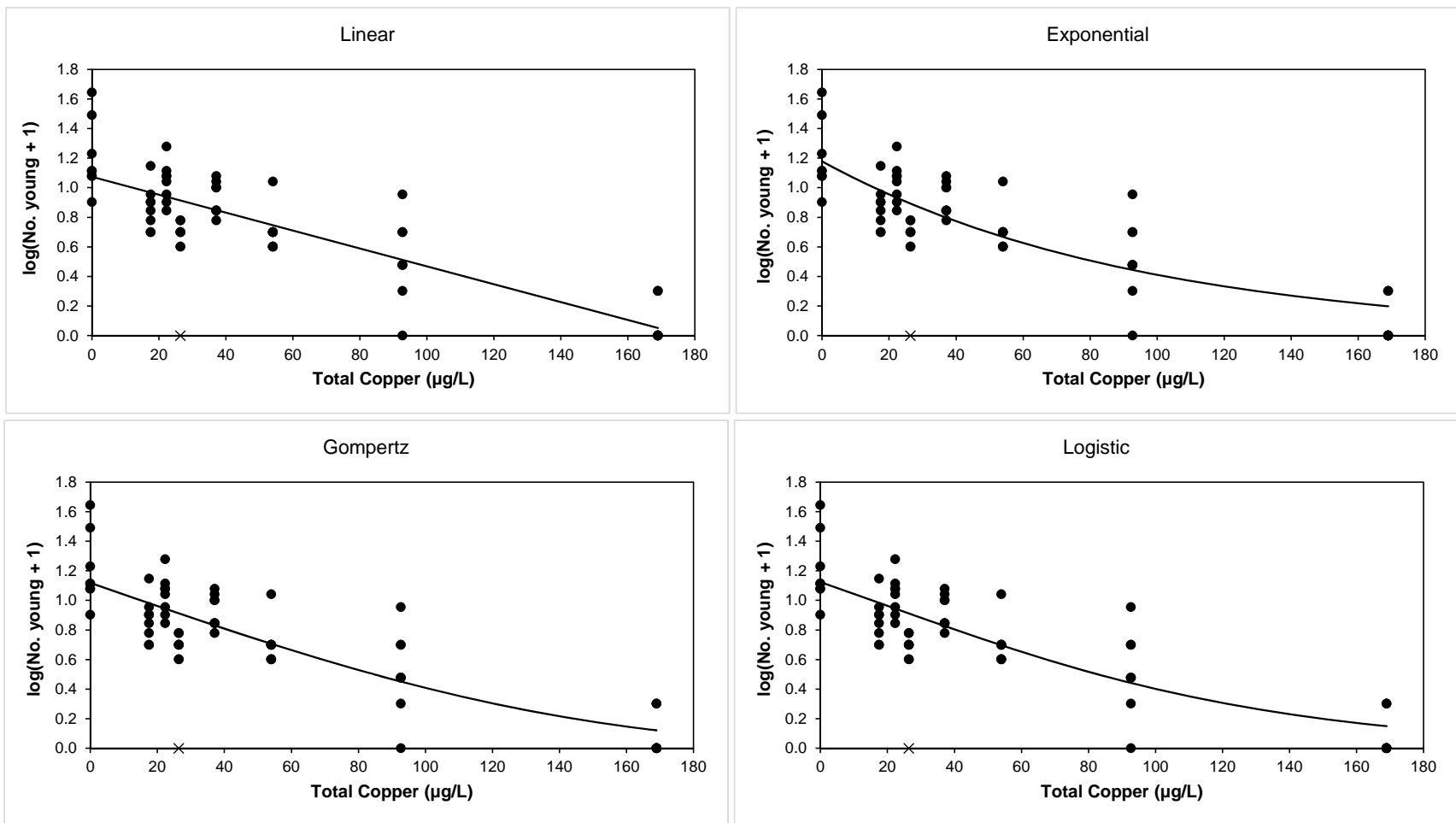



Figure C.2: Scatterplots and Regression Models for *Hyalella azteca* 42-d Reproduction versus Concentration of Total Copper, Minto Turbid Flow, May 5th 2017

Notes: Outliers removed from analysis denoted by an x.

Solid border indicates model with the best fit (lowest AIC_c value as reported in Table C.1).

Table C.2: Mean *Hyalella azteca* 42-d Reproduction by Treatment Group of Concentration Copper, Minto Turbid Flow, May 5th 2017

| Treatment Group | Total Copper (µg/L) | Dissolved Copper (µg/L) | Mean Reproduction | Mean Reproduction (outlier removed) |
|-----------------|---------------------|-------------------------|-------------------|-------------------------------------|
| Lab Control | 0 | 0 | 17.8 | 17.8 |
| Site Control | 17.5 | 14.9 | 6.8 | 6.8 |
| 5 | 22.3 | 19.8 | 10.4 | 10.4 |
| 10 | 26.4 | 24.3 | 3.5 | 4.0 |
| 20 | 37.1 | 33 | 7.8 | 7.8 |
| 40 | 54 | 51.6 | 4.4 | 4.4 |
| 80 | 92.7 | 86.4 | 2.9 | 2.9 |
| 160 | 169 | 160 | 0.25 | 0.25 |

 Mean value exceeds the mean value of a treatment with lower copper concentration.

Appendix N – Waste Rock Verification Program Results

2017 Waste Rock Verification Results

| Waste Dump Name | Sample ID | Date Sampled | Northing | Easting | Elevation | Cu% | %C(Tot) | %S(Tot) | NP | AP | NP/AP | Pass/Fail |
|-----------------|------------------|--------------|-------------|------------|-----------|-------|---------|---------|---------|---------|---------|-----------|
| MPD | WRV-MPD -1701-01 | 26-Jun-17 | 6944787.938 | 384547.75 | 807.63 | 0.005 | 0.227 | 0.001 | 18.9091 | 0.03125 | 605.091 | Pass |
| MPD | WRV-MPD -1701-02 | 26-Jun-17 | 6944772.445 | 384554.95 | 807.987 | 0.005 | 0.246 | 0.012 | 20.4918 | 0.375 | 54.645 | Pass |
| MPD | WRV-MPD -1701-03 | 26-Jun-17 | 6944753.22 | 384566.109 | 807.296 | 0.020 | 0.174 | 0.020 | 14.4942 | 0.625 | 23.191 | Pass |
| MPD | WRV-MPD -1702-01 | 26-Jun-17 | 6944696.09 | 384589.044 | 818.288 | 0.413 | 0.196 | 0.019 | 16.3268 | 0.59375 | 27.498 | Pass |
| MPD | WRV-MPD -1702-02 | 26-Jun-17 | 6944711.829 | 384574.674 | 819.219 | 0.005 | 0.224 | 0.007 | 18.6592 | 0.21875 | 85.299 | Pass |
| MPD | WRV-MPD -1702-03 | 26-Jun-17 | 6944731.386 | 384558.801 | 818.667 | 0.019 | 0.309 | 0.016 | 25.7397 | 0.5 | 51.479 | Pass |
| MPD | WRV-MPD -1702-04 | 26-Jun-17 | 6944741.505 | 384551.475 | 818.523 | 0.040 | 0.192 | 0.014 | 15.9936 | 0.4375 | 36.557 | Pass |
| MPD | WRV-MPD -1703-01 | 26-Jun-17 | 6944701.304 | 384682.671 | 818.038 | 0.034 | 0.179 | 0.014 | 14.9107 | 0.4375 | 34.082 | Pass |
| MPD | WRV-MPD -1703-02 | 26-Jun-17 | 6944697.004 | 384669.599 | 819.345 | 0.135 | 0.114 | 0.016 | 9.4962 | 0.5 | 18.992 | Pass |
| MPD | WRV-MPD -1703-03 | 26-Jun-17 | 6944691.672 | 384649.13 | 821.97 | 0.020 | 0.293 | 0.013 | 24.4069 | 0.40625 | 60.079 | Pass |
| MPD | WRV-MPD -1703-04 | 26-Jun-17 | 6944685.996 | 384630.553 | 824.323 | 0.654 | 0.195 | 0.026 | 16.2435 | 0.8125 | 19.992 | Pass |
| MPD | WRV-MPD -1703-05 | 26-Jun-17 | 6944672.579 | 384614.041 | 826.418 | 0.178 | 0.223 | 0.127 | 18.5759 | 3.96875 | 4.681 | Pass |
| MPD | WRV-MPD -1704-01 | 26-Jun-17 | 6944807.332 | 384495.904 | 824.469 | 0.041 | 0.245 | 0.012 | 20.4085 | 0.375 | 54.423 | Pass |
| MPD | WRV-MPD -1704-02 | 26-Jun-17 | 6944777.923 | 384511.547 | 824.763 | 0.010 | 0.129 | 0.009 | 10.7457 | 0.28125 | 38.207 | Pass |
| MPD | WRV-MPD -1704-03 | 26-Jun-17 | 6944751.699 | 384525.276 | 823.784 | 0.005 | 0.247 | 0.005 | 20.5751 | 0.15625 | 131.681 | Pass |
| MPD | WRV-MPD -1704-04 | 26-Jun-17 | 6944720.604 | 384541.704 | 823.312 | 0.015 | 0.186 | 0.006 | 15.4938 | 0.1875 | 82.634 | Pass |
| 118 | WRV-118 -1704-01 | 26-Jun-17 | 6944209.631 | 384936.971 | 862.212 | 0.189 | 0.245 | 0.003 | 20.4085 | 0.09375 | 217.691 | Pass |
| 118 | WRV-118 -1704-02 | 26-Jun-17 | 6944221.947 | 384924.93 | 862.666 | 0.095 | 0.200 | 0.003 | 16.6600 | 0.09375 | 177.707 | Pass |
| 118 | WRV-118 -1704-03 | 26-Jun-17 | 6944228.677 | 384914.711 | 863.3 | 0.099 | 0.238 | 0.004 | 19.8254 | 0.125 | 158.603 | Pass |
| 118 | WRV-118 -1704-04 | 26-Jun-17 | 6944220.32 | 384905.519 | 863.154 | 0.112 | 0.175 | 0.003 | 14.5775 | 0.09375 | 155.493 | Pass |
| 118 | WRV-118 -1704-05 | 26-Jun-17 | 6944214.404 | 384915.654 | 862.706 | 0.138 | 0.168 | 0.003 | 13.9944 | 0.09375 | 149.274 | Pass |

| Waste Dump Name | Sample ID | Date Sampled | Northing | Easting | Elevation | Cu% | %C(Tot) | %S(Tot) | NP | AP | NP/AP | Pass/Fail |
|-----------------|------------------|--------------|-------------|------------|-----------|-------|---------|---------|---------|---------|---------|-----------|
| MPD | WRV-MPD -1705-01 | 26-Jun-17 | 6944794.791 | 384475.559 | 833.185 | 0.067 | 0.332 | 0.039 | 27.6556 | 1.21875 | 22.692 | Pass |
| MPD | WRV-MPD -1705-02 | 26-Jun-17 | 6944771.33 | 384484.61 | 832.465 | 0.106 | 0.599 | 0.016 | 49.8967 | 0.5 | 99.793 | Pass |
| MPD | WRV-MPD -1705-03 | 26-Jun-17 | 6944742.875 | 384484.852 | 832.158 | 0.027 | 0.455 | 0.017 | 37.9015 | 0.53125 | 71.344 | Pass |
| MPD | WRV-MPD -1705-04 | 26-Jun-17 | 6944724.736 | 384496.087 | 832.056 | 0.029 | 0.404 | 0.023 | 33.6532 | 0.71875 | 46.822 | Pass |
| MPD | WRV-MPD -1705-05 | 26-Jun-17 | 6944706.419 | 384507.841 | 832.144 | 0.108 | 0.499 | 0.016 | 41.5667 | 0.5 | 83.133 | Pass |
| 118 | WRV-118 -1705-01 | 26-Jun-17 | 6944191.816 | 384889.943 | 867.851 | 0.105 | 0.371 | 0.002 | 30.9043 | 0.0625 | 494.469 | Pass |
| 118 | WRV-118 -1705-02 | 26-Jun-17 | 6944208.883 | 384875.397 | 868.366 | 0.074 | 0.504 | 0.013 | 41.9832 | 0.40625 | 103.343 | Pass |
| 118 | WRV-118 -1705-03 | 26-Jun-17 | 6944219.162 | 384856.972 | 868.634 | 0.176 | 0.045 | 0.001 | 3.7485 | 0.03125 | 119.952 | Pass |
| 118 | WRV-118 -1705-04 | 26-Jun-17 | 6944229.054 | 384830.789 | 868.985 | 0.030 | 0.041 | 0.004 | 3.4153 | 0.125 | 27.322 | Pass |
| 118 | WRV-118 -1705-05 | 26-Jun-17 | 6944205.392 | 384827.104 | 869.268 | 0.068 | 0.050 | 0.007 | 4.1650 | 0.21875 | 19.040 | Pass |
| 118 | WRV-118 -1705-06 | 26-Jun-17 | 6944196.083 | 384850.184 | 868.97 | 0.105 | 0.381 | 0.005 | 31.7373 | 0.15625 | 203.119 | Pass |
| MPD | WRV-MPD -1706-01 | 26-Jun-17 | 6944846.987 | 384369.079 | 838.186 | 0.227 | 0.301 | 0.022 | 25.0733 | 0.6875 | 36.470 | Pass |
| MPD | WRV-MPD -1706-02 | 26-Jun-17 | 6944830.377 | 384375.593 | 838.299 | 0.324 | 0.301 | 0.145 | 25.0733 | 4.53125 | 5.533 | Pass |
| MPD | WRV-MPD -1706-03 | 26-Jun-17 | 6944801.932 | 384387.587 | 838.51 | 0.170 | 0.136 | 0.031 | 11.3288 | 0.96875 | 11.694 | Pass |
| MPD | WRV-MPD -1706-04 | 26-Jun-17 | 6944786.125 | 384393.805 | 838.561 | 0.080 | 0.130 | 0.033 | 10.8290 | 1.03125 | 10.501 | Pass |
| MPD | WRV-MPD -1706-05 | 26-Jun-17 | 6944766.07 | 384402.059 | 838.679 | 0.112 | 0.132 | 0.022 | 10.9956 | 0.6875 | 15.994 | Pass |
| MPD | WRV-MPD -1706-06 | 26-Jun-17 | 6944752.143 | 384407.304 | 838.882 | 0.428 | 0.310 | 0.299 | 25.8230 | 9.34375 | 2.764 | Fail |
| 118 | WRV-118 -1706-01 | 26-Jun-17 | 6944130.391 | 384851.08 | 872.821 | 0.201 | 0.079 | 0.006 | 6.5807 | 0.1875 | 35.097 | Pass |
| 118 | WRV-118 -1706-02 | 26-Jun-17 | 6944122.238 | 384826.223 | 872.724 | 0.090 | 0.023 | 0.008 | 1.9159 | 0.25 | 7.664 | Pass |
| 118 | WRV-118 -1706-03 | 26-Jun-17 | 6944130.589 | 384803.952 | 872.621 | 0.213 | 0.055 | 0.002 | 4.5815 | 0.0625 | 73.304 | Pass |
| 118 | WRV-118 -1706-04 | 26-Jun-17 | 6944118.281 | 384742.793 | 874.621 | 0.181 | 0.083 | 0.023 | 6.9139 | 0.71875 | 9.619 | Pass |
| 118 | WRV-118 -1706-05 | 26-Jun-17 | 6944157.68 | 384738.272 | 873.229 | 0.040 | 0.011 | 0.003 | 0.9163 | 0.09375 | 9.774 | Pass |

| Waste Dump Name | Sample ID | Date Sampled | Northing | Easting | Elevation | Cu% | %C(Tot) | %S(Tot) | NP | AP | NP/AP | Pass/Fail |
|-----------------|------------------|--------------|-------------|------------|-----------|-------|---------|---------|---------|---------|---------|-----------|
| 118 | WRV-118 -1706-06 | 26-Jun-17 | 6944201.912 | 384773.796 | 871.724 | 0.016 | 0.018 | 0.006 | 1.4994 | 0.1875 | 7.997 | Pass |
| 118 | WRV-118 -1706-07 | 26-Jun-17 | 6944178.152 | 384810.796 | 871.877 | 0.167 | 0.195 | 0.007 | 16.2435 | 0.21875 | 74.256 | Pass |
| 118 | WRV-118 -1706-08 | 26-Jun-17 | 6944171.26 | 384836.096 | 871.746 | 0.086 | 0.165 | 0.001 | 13.7445 | 0.03125 | 439.824 | Pass |
| 118 | WRV-118 -1706-09 | 26-Jun-17 | 6944166.938 | 384860.876 | 872.044 | 0.100 | 0.143 | 0.007 | 11.9119 | 0.21875 | 54.454 | Pass |
| 118 | WRV-118 -1706-10 | 26-Jun-17 | 6944219.277 | 384804.946 | 870.582 | 0.005 | 0.011 | 0.005 | 0.9163 | 0.15625 | 5.864 | Pass |
| MPD | WRV-MPD -1707-01 | 24-Jul-17 | 6944806.419 | 384403.615 | 848.628 | 0.371 | 0.433 | 0.147 | 36.0689 | 4.59375 | 7.852 | Pass |
| MPD | WRV-MPD -1707-02 | 24-Jul-17 | 6944794.476 | 384388.82 | 848.597 | 0.180 | 0.352 | 0.071 | 29.3216 | 2.21875 | 13.215 | Pass |
| MPD | WRV-MPD -1707-03 | 24-Jul-17 | 6944781.787 | 384373.527 | 848.563 | 0.223 | 0.528 | 0.132 | 43.9824 | 4.125 | 10.662 | Pass |
| MPD | WRV-MPD -1707-04 | 24-Jul-17 | 6944758.481 | 384375.871 | 848.193 | 0.228 | 0.563 | 0.087 | 46.8979 | 2.71875 | 17.250 | Pass |
| MPD | WRV-MPD -1707-05 | 24-Jul-17 | 6944770.6 | 384394.804 | 848.419 | 0.215 | 0.615 | 0.111 | 51.2295 | 3.46875 | 14.769 | Pass |
| MPD | WRV-MPD -1707-06 | 24-Jul-17 | 6944781.363 | 384415.137 | 847.867 | 0.589 | 0.471 | 0.120 | 39.2343 | 3.75 | 10.462 | Pass |
| MPD | WRV-MPD -1707-07 | 24-Jul-17 | 6944762.027 | 384425.628 | 847.629 | 0.802 | 0.491 | 0.135 | 40.9003 | 4.21875 | 9.695 | Pass |
| MPD | WRV-MPD -1707-08 | 24-Jul-17 | 6944749.424 | 384407.155 | 848.029 | 0.215 | 0.487 | 0.226 | 40.5671 | 7.0625 | 5.744 | Pass |
| MPD | WRV-MPD -1707-09 | 24-Jul-17 | 6944737.617 | 384427.135 | 847.456 | 0.443 | 0.481 | 0.186 | 40.0673 | 5.8125 | 6.893 | Pass |
| MPD | WRV-MPD -1707-10 | 24-Jul-17 | 6944723.467 | 384446.267 | 845.282 | 0.479 | 0.360 | 0.201 | 29.9880 | 6.28125 | 4.774 | Pass |
| MPD | WRV-MPD -1708-01 | 20-Aug-17 | 6944761.407 | 384358.959 | 847.677 | 0.261 | 0.684 | 0.134 | 56.9772 | 4.1875 | 13.606 | Pass |
| MPD | WRV-MPD -1708-02 | 20-Aug-17 | 6944775.979 | 384339.405 | 847.476 | 0.210 | 0.457 | 0.119 | 38.0681 | 3.71875 | 10.237 | Pass |
| MPD | WRV-MPD -1708-03 | 20-Aug-17 | 6944787.039 | 384321.443 | 847.547 | 0.152 | 0.396 | 0.104 | 32.9868 | 3.25 | 10.150 | Pass |
| MPD | WRV-MPD -1708-04 | 20-Aug-17 | 6944721.626 | 384366.802 | 843.467 | 0.233 | 0.759 | 0.114 | 63.2247 | 3.5625 | 17.747 | Pass |
| MPD | WRV-MPD -1708-05 | 20-Aug-17 | 6944705.415 | 384357.541 | 843.767 | 0.084 | 0.309 | 0.070 | 25.7397 | 2.1875 | 11.767 | Pass |
| MPD | WRV-MPD -1708-06 | 20-Aug-17 | 6944694.436 | 384384.856 | 843.031 | 0.018 | 0.160 | 0.008 | 13.3280 | 0.25 | 53.312 | Pass |
| MPD | WRV-MPD -1708-07 | 20-Aug-17 | 6944714.482 | 384398.702 | 842.524 | 0.330 | 0.473 | 0.146 | 39.4009 | 4.5625 | 8.636 | Pass |

| Waste Dump Name | Sample ID | Date Sampled | Northing | Easting | Elevation | Cu% | %C(Tot) | %S(Tot) | NP | AP | NP/AP | Pass/Fail |
|-----------------|-------------------|--------------|-------------|------------|-----------|-------|---------|---------|---------|------------|---------|-----------|
| MPD | WRV-MPD -1708-08 | 20-Aug-17 | 6944704.841 | 384425.722 | 841.605 | 0.197 | 0.449 | 0.092 | 37.4017 | 2.875 | 13.009 | Pass |
| MPD | WRV-MPD -1708-09 | 20-Aug-17 | 6944680.4 | 384422.516 | 841.404 | 0.051 | 0.303 | 0.045 | 25.2399 | 1.40625 | 17.948 | Pass |
| MPD | WRV-MPD -1708-10 | 20-Aug-17 | 6944668.316 | 384443.501 | 841.083 | 0.150 | 0.311 | 0.054 | 25.9063 | 1.6875 | 15.352 | Pass |
| MPD | WRV-MPD -1708-11 | 20-Aug-17 | 6944687.257 | 384456.752 | 840.96 | 0.245 | 0.137 | 0.045 | 11.4121 | 1.40625 | 8.115 | Pass |
| MPD | WRV-MPD -1709-01 | 11-Dec-17 | 6944672.821 | 384507.812 | 836.789 | 0.185 | 0.283 | 0.025 | 23.5739 | 0.78125 | 30.175 | Pass |
| MPD | WRV-MPD -1709-02 | 11-Dec-17 | 6944680.995 | 384499.257 | 836.702 | 0.015 | 0.056 | 0.002 | 4.6648 | 0.0625 | 74.637 | Pass |
| MPD | WRV-MPD -1709-03 | 11-Dec-17 | 6944698.028 | 384495.946 | 837.232 | 0.011 | 0.020 | 0.001 | 1.6660 | 0.03125 | 53.312 | Pass |
| MPD | WRV-MPD -1709-04 | 11-Dec-17 | 6944689.85 | 384510.086 | 837.377 | 0.023 | 0.063 | 0.002 | 5.2479 | 0.0625 | 83.966 | Pass |
| MPD | WRV-MPD -1709-05 | 11-Dec-17 | 6944679.098 | 384521.98 | 837.953 | 0.030 | 0.069 | 0.001 | 5.7477 | 0.03125 | 183.926 | Pass |
| MPD | WRV-MPD -1709-06 | 11-Dec-17 | 6944670.574 | 384537.969 | 837.494 | 0.087 | 0.406 | 0.054 | 33.8198 | 1.6875 | 20.041 | Pass |
| MPD | WRV-MPD -1709-07 | 11-Dec-17 | 6944667.295 | 384552.194 | 837.136 | 0.133 | 0.452 | 0.118 | 37.6516 | 3.6875 | 10.211 | Pass |
| MPD | WRV-MPD -1709-08 | 11-Dec-17 | 6944666.192 | 384525.43 | 837.081 | 0.089 | 0.367 | 0.071 | 30.5711 | 2.21875 | 13.779 | Pass |
| MPD | WRV-MPD -1710-01 | 11-Dec-17 | 6944898.968 | 384383.839 | 836.789 | 0.156 | 0.456 | 0.019 | 37.9971 | 0.582682 | 65.211 | Pass |
| MPD | WRV-MPD -1710-02 | 11-Dec-17 | 6944910.346 | 384368.009 | 836.702 | 0.136 | 0.293 | 0.089 | 24.3886 | 2.78860931 | 8.746 | Pass |
| MPD | WRV-MPD -1710-03 | 11-Dec-17 | 6944922.4 | 384351.228 | 837.232 | 0.106 | 0.315 | 0.082 | 26.2051 | 2.55381232 | 10.261 | Pass |
| MPD | WRV-MPD -1710-04 | 11-Dec-17 | 6944930.282 | 384331.731 | 837.377 | 0.098 | 0.216 | 0.021 | 17.9650 | 0.64102374 | 28.025 | Pass |
| MPD | WRV-MPD -1710-05 | 11-Dec-17 | 6944939.313 | 384312.082 | 837.953 | 0.037 | 0.208 | 0.002 | 17.3110 | 0.0684374 | 252.946 | Pass |
| MPD | WRV-MPD -1710-06 | 11-Dec-17 | 6944918.955 | 384301.192 | 837.494 | 0.083 | 0.149 | 0.007 | 12.3824 | 0.22420889 | 55.227 | Pass |
| MPD | WRV-MPD -1710-07 | 11-Dec-17 | 6944908.433 | 384317.719 | 837.136 | 0.242 | 0.167 | 0.008 | 13.9232 | 0.23689361 | 58.774 | Pass |
| MPD | WRV-MPD -1710-08 | 11-Dec-17 | 6944893.23 | 384333.305 | 837.081 | 0.060 | 0.240 | 0.003 | 20.0137 | 0.08421188 | 237.659 | Pass |
| MPD | WRV-MPD -1710-09 | 11-Dec-17 | 6944876.392 | 384364.284 | 836.775 | 0.322 | 0.233 | 0.153 | 19.4362 | 4.79367411 | 4.055 | Pass |
| MWDW | WRV-MWDW -1711-01 | 11-Dec-17 | 6944910.197 | 383959.65 | 868.352 | 0.340 | 0.123 | 0.011 | 10.2693 | 0.34433101 | 29.824 | Pass |

| Waste Dump Name | Sample ID | Date Sampled | Northing | Easting | Elevation | Cu% | %C(Tot) | %S(Tot) | NP | AP | NP/AP | Pass/Fail |
|-----------------|-------------------|--------------|-------------|------------|-----------|-------|---------|---------|---------|------------|---------|-----------|
| MWDW | WRV-MWDW -1711-02 | 11-Dec-17 | 6944916.832 | 383939.256 | 869.805 | 0.380 | 0.092 | 0.021 | 7.6452 | 0.65715861 | 11.634 | Pass |
| MWDW | WRV-MWDW -1711-03 | 11-Dec-17 | 6944924.181 | 383918.498 | 871.463 | 0.308 | 0.081 | 0.011 | 6.7745 | 0.35655082 | 19.000 | Pass |
| MWDW | WRV-MWDW -1711-04 | 11-Dec-17 | 6944935.272 | 383898.634 | 872.973 | 0.321 | 0.076 | 0.019 | 6.3150 | 0.5976044 | 10.567 | Pass |
| MWDW | WRV-MWDW -1711-05 | 11-Dec-17 | 6944949.327 | 383881.073 | 875.098 | 0.304 | 0.095 | 0.025 | 7.8917 | 0.78817391 | 10.013 | Pass |
| MWDW | WRV-MWDW -1711-06 | 11-Dec-17 | 6944962.548 | 383864.426 | 877.148 | 0.554 | 0.144 | 0.028 | 11.9973 | 0.87883989 | 13.651 | Pass |
| MPD | WRV-MPD-1711-01 | 11-Dec-17 | 6944580.077 | 384410.496 | 853.16 | 0.044 | 0.081 | 0.001 | 6.7136 | 0.01652677 | 406.223 | Pass |
| MPD | WRV-MPD-1711-02 | 11-Dec-17 | 6944580.303 | 384432.681 | 853.162 | 0.096 | 0.041 | 0.014 | 3.4048 | 0.43952286 | 7.747 | Pass |
| MPD | WRV-MPD-1711-03 | 11-Dec-17 | 6944583.145 | 384461.986 | 853.7 | 0.702 | 0.131 | 0.058 | 10.9127 | 1.80275706 | 6.053 | Pass |
| MPD | WRV-MPD-1711-04 | 11-Dec-17 | 6944578.443 | 384485.653 | 854.084 | 0.640 | 0.061 | 0.002 | 5.1045 | 0.04729576 | 107.926 | Pass |
| MPD | WRV-MPD-1711-05 | 11-Dec-17 | 6944581.528 | 384509.465 | 854.467 | 0.690 | 0.066 | 0.004 | 5.4880 | 0.10954581 | 50.098 | Pass |
| MPD | WRV-MPD-1711-06 | 11-Dec-17 | 6944600.546 | 384489.873 | 853.512 | 0.585 | 0.056 | 0.001 | 4.6461 | 0.02561255 | 181.397 | Pass |
| MPD | WRV-MPD-1711-07 | 11-Dec-17 | 6944615.291 | 384467.032 | 852.477 | 0.277 | 0.339 | 0.009 | 28.2365 | 0.28862006 | 97.833 | Pass |
| MPD | WRV-MPD-1711-08 | 11-Dec-17 | 6944616.293 | 384444.443 | 852.375 | 0.321 | 0.151 | 0.008 | 12.5533 | 0.2367733 | 53.018 | Pass |
| MPD | WRV-MPD-1711-09 | 11-Dec-17 | 6944605.776 | 384424.564 | 852.797 | 0.139 | 0.194 | 0.003 | 16.1602 | 0.09375 | 172.375 | Pass |

Appendix O – ABA Report 2017 GMP Annual Report



Minto Mine
Water Licence QZ14-031 & Quartz Mining Licence QML-0001
2017 Annual Report
Geochemical Monitoring Report

Prepared by:
Minto Explorations Ltd.
Minto Mine
March 2018

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Appendix A: Sample Location Images

Appendix B: 2017 Modified NP Method (MEND 1991) ABA Results for Waste Rock and Overburden

Appendix C: ALS Minerals Raw Lab Results

Appendix D: 2017 Modified NP Method (MEND 1991) ABA Results for Tailings

1 Geochemical Monitoring Program Objectives

This report is submitted to meet requirements under Minto Explorations Ltd., (a subsidiary of Capstone Mining Corporation), Minto Mine (Minto) Type “A” Water Licence QZ14-031-1 (WUL) and Quartz Mining Licence QML-0001.

The WUL specifically addresses the requirement in clause 95 which states *“The Licensee shall implement the updated Geochemical Monitoring Program, including the Waste Rock Verification Program, and the results from this program are to be included in the Annual Report.”*

The QML addresses the requirement in Schedule D – Annual Reporting Requirements, under the Environmental Monitoring section, subsection a) which states *“a summary of the programs undertaken for environmental monitoring and surveillance as outlined in the Environmental Monitoring, Surveillance and Reporting Plan”*.

Details regarding the Geochemical Monitoring Program can be found in Minto’s Environmental Monitoring, Surveillance and Reporting Plan (EMSRP) that was approved by the Yukon Water Board and Yukon Government, Energy Mines and Resources Branch on October 4th, 2016 and December 13th, 2016 respectively. In general, the Geochemical Monitoring Program is comprised of the following components:

- The Acid Base Accounting (ABA) Program, the primary focus of this document;
- The Waste Rock Management Verification Program; and
- Low Grade and Oxide Ore Metals Leaching Characterization Program (currently not implemented).

The objective of the ABA Program is to determine the Neutralization Potential Ratio, otherwise referred to as the NPR (Neutralizing Potential divided by Acid Potential [NP/AP]) for overburden and waste rock. An NPR value of 3 or greater generally indicates non-acid generating material. During 2017, 265 waste rock and overburden samples were collected and analyzed from the Area 2 Stage 3 Pit, and another 19 samples of waste rock was sampled from the Minto East and Area 2 underground development.

A separate, parallel ABA program was administered to determine the NPR of the tailings solids. During 2017, 15 Tailing samples were collected and analyzed. A sample was analyzed for each month except January 2017. April 2017 had one composition and one supplementary tailing sample collected on April 10th and May 2017 had 2 separate tailings sample. June composition was not a mixture but rather a weekly tailings sample. The third and fourth quarter months were sampled as per scheduled.

The objective of the Waste Rock Management Verification Program is to verify that the on-site waste rock segregation system is performing as expected. The results of the Waste Rock Management Verification Program are available in a separate report and will therefore not be discussed further in this document.

There are currently no details or results for the Low Grade and Oxide Ore Metals Leaching Characterization Program. The leach pad structures were built in August 2017, and ore was added in November 2017 and January 2018. Results from this program are expected in 2018 and will not be discussed further in this document.

2 ABA Program - Waste Rock and Overburden

2.1 Internal Frequency of Sampling – On-site Analysis

On-site total carbon (C(T)) and total sulphur (S(T)) analysis are carried out on drill cuttings from every blast hole. Samples are collected for grade control purposes, and a portion of each sample is sent for S(T) and total carbon C(T) analyses at the on-site laboratory.

2.2 External Frequency of Sampling

External laboratory analysis were completed for composites samples from open pit mining. A sample of drill cuttings was collected from waste blasts with a frequency of approximately one sample for every seven holes drilled. Composite samples from each waste class for each blast are formed from approximately 4-5 individual samples.

External analysis were also carried out for underground ABA samples. The sampling procedure assembles a composite sample every 3300 tonnes (equivalent to approximately 50 m of development) using a grab sample or wall chipping technique.

2.3 Sample Preparation

All composite samples were reduced to 1-2 kg in mass using a riffle splitter. The resulting split sample was labeled according to the ABA Program sample naming standards and shipped to an accredited laboratory. The labeling methodology was consistent with the Mine Environmental ABA Database throughout the reporting period.

2.4 Test Work and Evaluation

Internal samples are analyzed for S(T) and C(T) using an Eltra CS-800 inducition furnace with infrared detectors. The resultant S(T) and C(T) data are converted to equivalent acid and neutralization potential and ultimately, NP:AP ratios are calculated. The calculated NP:AP ratios are used for characterization and segregation of waste rock on-site. This data is used for internal classification and waste rock segregation only, therefore, the results of that program will not be reported in this report.

In 2017, ALS Minerals conducted ABA analysis using the MEND (1991) Modified NP method as detailed in the EMSRP for all external samples. Reported results were entered into the Mine Environmental ABA Database. Waste rock and overburden composite samples were also analyzed for total metals for the entire duration of the reporting period.

For the reporting period, the results obtained from ALS were compared against past results found in the Mine Environmental ABA Database and the results are presented in Section 2.5. Sulphide sulphur ($S(S^{-2})$) results from ALS Minerals were calculated using the difference between total sulphur and sulphate sulphur (HCl Leach). In the event that the $S(S^{-2})$ value was zero or negative, the detection limit of <0.01% was used. The acid potential (AP) results from ALS Mineral were calculated using the calculated $S(S^{-2})$ value.

2.5 Discussion

Blasts are numbered by bench (denoted by the toe elevation) and by the sequential blast number for that bench (e.g. 784-01; 784 being the toe elevation of the bench and 01 being the first blast of the bench). Images depicting the location of all surface samples collecting during the reporting period are provided in Appendix A.

The primary lithology of the deposit is granodiorite. The granodiorite is divided into sub-units and classified as equigranular granodiorite (eG), porphyroblastic granodiorite (pG), and foliated granodiorite (fG). Locally, very highly-weathered granodiorite near the surface is described as residuum, and surface materials comprised of organics and soil is termed overburden. Other minor lithological units are described as pegmatite (Peg), Andesite (And) and Aplite (Ap).

2.6 Results

The 304 samples collected in the reporting period were analyzed by ALS Minerals and results were reported according to the Modified NP method (MEND 1991). In the reporting period, the NPR values ranged from 0.67 to 208.0 with a mean NP/mean AP of 41.09 and a median of 28.80. A summary of the results for ABA analysis are attached as Appendix B. Additionally, the ALS raw lab result files are provided in Appendix C.

2.6.1 NPR

The 2017 NPR results are compared to the results from 2014-2016 in Table 1, below.

Table 1. NPR Results Summary for 2014 to 2017.

| NPR Values | | | | |
|---|---------------|---------------|---------------------|--------------|
| Period Ending | Minimum (NPR) | Maximum (NPR) | (Mean NP)/(Mean AP) | Median (NPR) |
| 2014 (January to December, 2014) | 0.60 | 167.20 | 5.31 | 23.80 |
| 2015 (January to December, 2015) | -6.10 | 102.10 | 5.08 | 18.70 |
| 2016 (January to December, 2016) | 0.80 | 134.40 | 14.49 | 35.20 |
| 2017 (January to December, 2017) | 0.67 | 208.0 | 15.26 | 28.80 |

During the reporting period, 33 samples returned NPR values below the threshold of 3.0. Of the 33 samples with a NPR value less than 3:

- 17 were found to have an increased sulphide sulphur content (and therefore AP) consequently decreasing the NPR;

And of the remaining samples:

- 5 samples represented material classified as NAG (or waste);
- 7 samples represented material that was placed in the SAT dump;
- 4 samples represented material that was placed in the overburden;

All waste rock and overburden was dispatched based on Minto's *Waste Rock and Overburden Management Plan*.

2.6.2 Paste pH

The paste pH results for 2017 were between 7.50 and 9.20 with a mean value of 8.50 and a median value of 8.50. The paste pH results for 2017 are compared to 2014-2016 and displayed in Table 2, below.

Table 2. Paste pH Results Summary for 2014 to 2017.

| Paste pH from SGS (2014-2016) and from ALS (2016-2017) | | | | |
|---|---------------------|---------------------|------------------|--------------------|
| Period Ending | Minimum (pH) | Maximum (pH) | Mean (pH) | Median (pH) |
| 2014 (January to December, 2014) | 6.44 | 9.43 | 8.56 | 8.66 |
| 2015 (January to December, 2015) | 5.23 | 9.47 | 8.70 | 8.78 |
| 2016 (January to December, 2016) | 7.61 | 9.39 | 8.75 | 8.77 |
| 2017 (January to December, 2017) | 7.50 | 9.20 | 8.50 | 8.50 |

The results from 2017 are comparable to previous years results.

2.6.3 Sulphide Sulphur

The sulphide sulphur content $S(S^{2-})$ results for 2017 ranged from <0.01 to 1.38%, with a mean value of 0.082% and a median value of 0.03% as summarized and compared with 2014-2016 values in Table 3.

Table 3. Sulphide Sulphur Results Summary for 2014 to 2017

| Sulphide-Sulphur % from SGS (2014-2016) and from ALS (2016-2017) | | | | |
|---|---|---|--------------------------------------|--|
| Period Ending | Minimum ($S(S^{2-})$) | Maximum ($S(S^{2-})$) | Mean ($S(S^{2-})$) | Median ($S(S^{2-})$) |
| 2014 (January to December, 2014) | 0.01 | 3.26 | 0.12 | 0.02 |
| 2015 (January to December, 2015) | <0.01 | 1.09 | 0.09 | 0.02 |
| 2016 (January to December, 2016) | <0.01 | 0.75 | 0.05 | 0.02 |
| 2017 (January to December, 2017) | <0.01 | 1.38 | 0.082 | 0.03 |

A total of 21 samples exceeded the sulphide sulphur threshold for construction rock of 0.3% during 2017. Furthermore, 17 samples also had a NPR of less than 3 and therefore represented SAT material. The 4 remaining samples had an NPR greater than 3 and exceeded the sulphide sulphur threshold (2 MEUG and 2 A2S3).

Figure 1, below, is a plot of sulphide sulphur versus (vs) NPR for all samples analyzed during 2017. Figure 1 illustrates that 21 samples had sulphide sulphur content greater than 0.3% and 33 samples had a NPR threshold of less than 3.

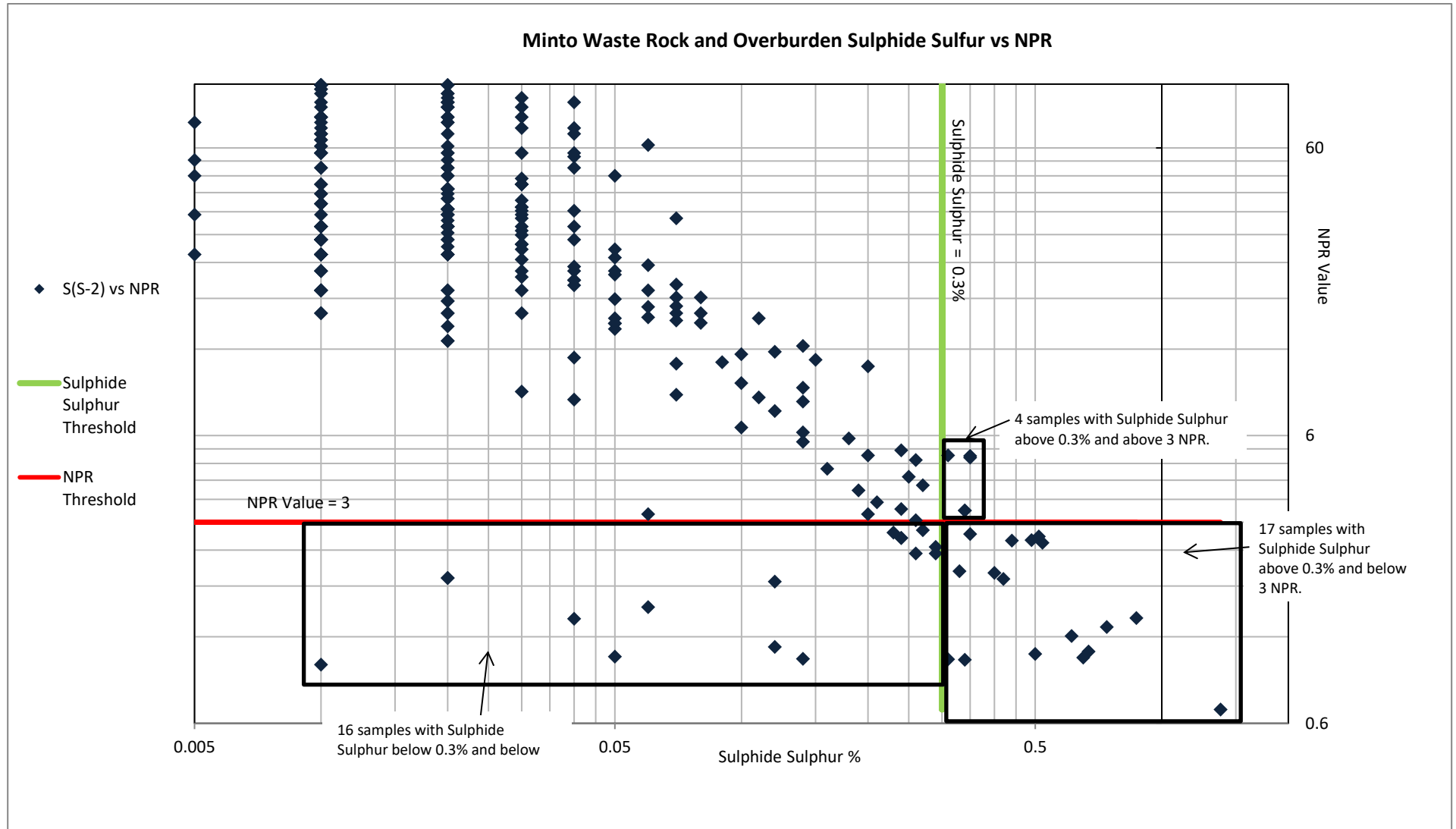


Figure 1. Minto Waste Rock and Overburden Sulphide Sulfur vs NPR, 2017

3 Tailings

3.1 Frequency of Sampling and Sample Preparation

Minto collects a weekly sample of final tailings. The weekly samples have been filtered and dried in the onsite lab and then combined into a monthly sample which is then riffled down to produce a 1-2 kg composite. Samples are labelled according to the labeling protocol established in the Mine Environmental ABA Database.

3.2 Test work and Evaluation

Mirroring the waste rock and overburden analysis, ALS Minerals conducted ABA analysis using the MEND (1991) Modified NP method as detailed in the EMSRP. Reported results were entered into the Mine Environmental ABA Database. Monthly tailings composite samples were also analyzed for total metals for the 11 months of available samples.

3.3 Results

The results from the ALS Minerals laboratory analyses indicate that 2017 tailings samples were within the threshold of NPR greater than 4 and contain lower than 0.3% sulphide sulphur content as presented in Figure 2, below. The tailings results are summarized in Appendix D and the raw lab results are presented in Appendix C.

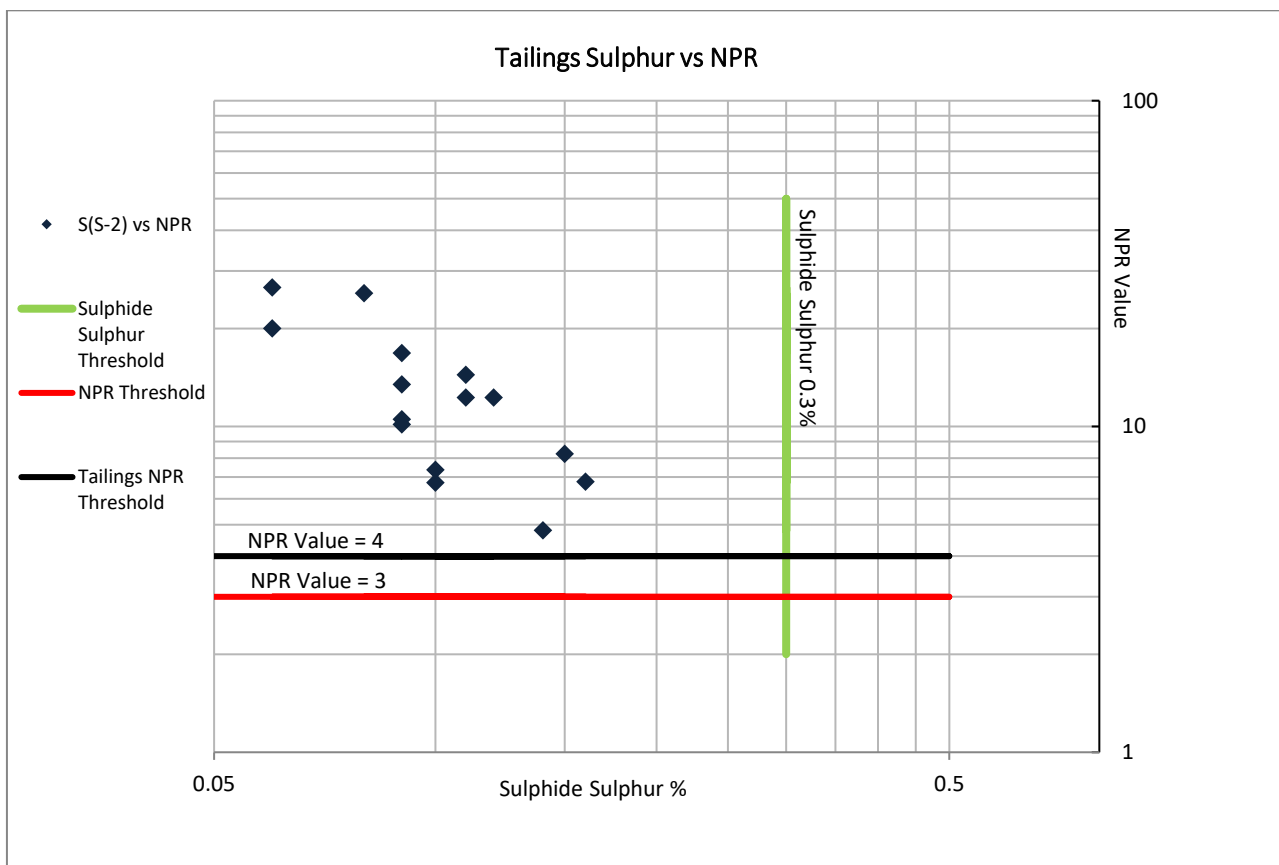


Figure 2. Tailings Sulphide Sulphur vs NPR, 2017

4 Conclusion

The results displayed in this report combined with the previous reporting periods are the foundation for the Mine Environmental ABA Database. Overburden and waste rock development will continue through the subsequent phases of mining and milling and will be sampled, analyzed and reported as required by the WUL and QML and in accordance with the EMSRP.

5 References

MEND. (1991). *Mine Environment Neutral Drainage Program: Acid Rock Drainage Prediction Manual, MEND Project 1.16.1 (b)*. Prepared by Coastech Research Inc., North Vancouver, B.C. March 1991.

Appendix A: Sample Location Images

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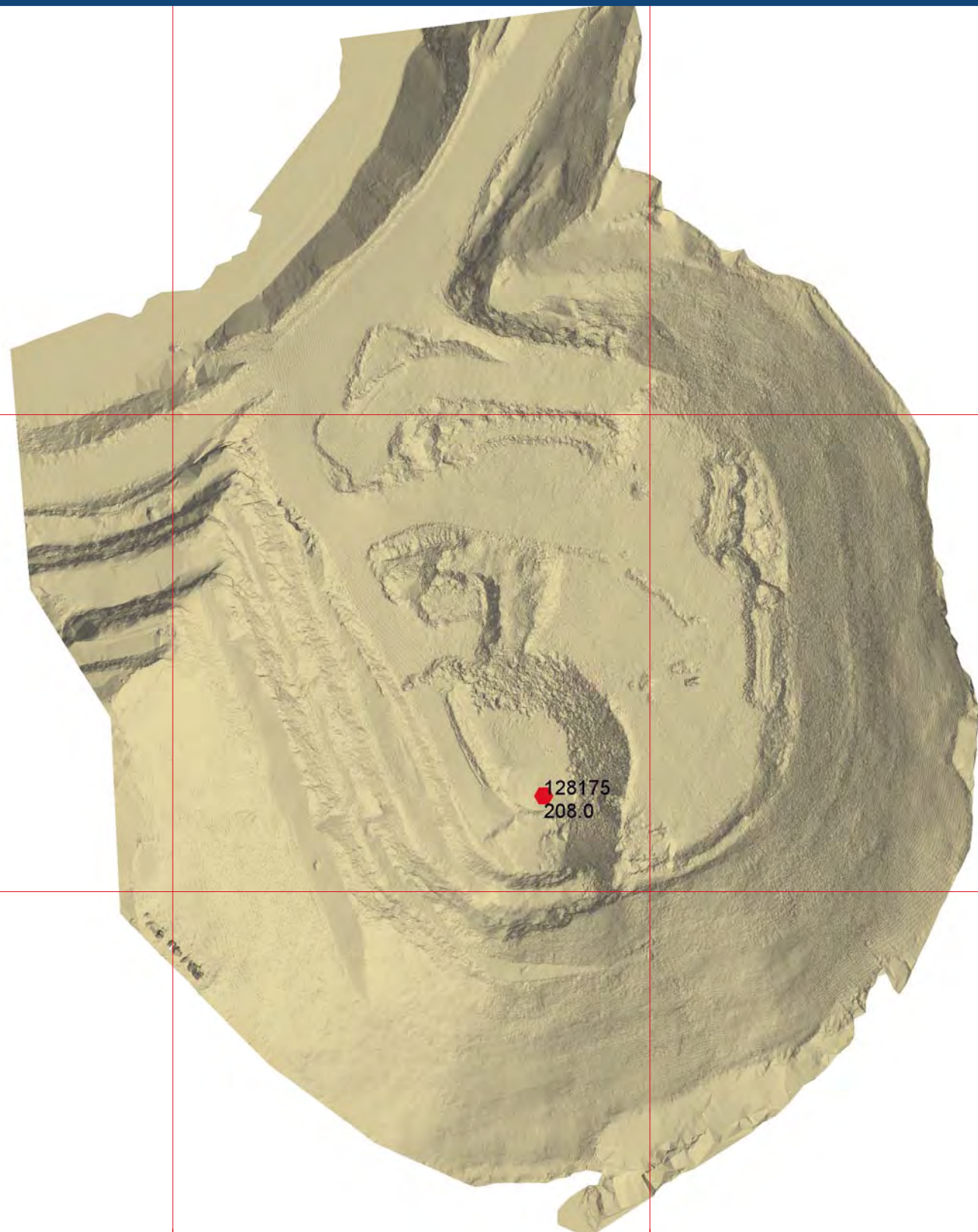
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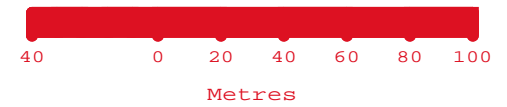
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| DATE: 24-Feb-2018 | DRAWN BY: MS |



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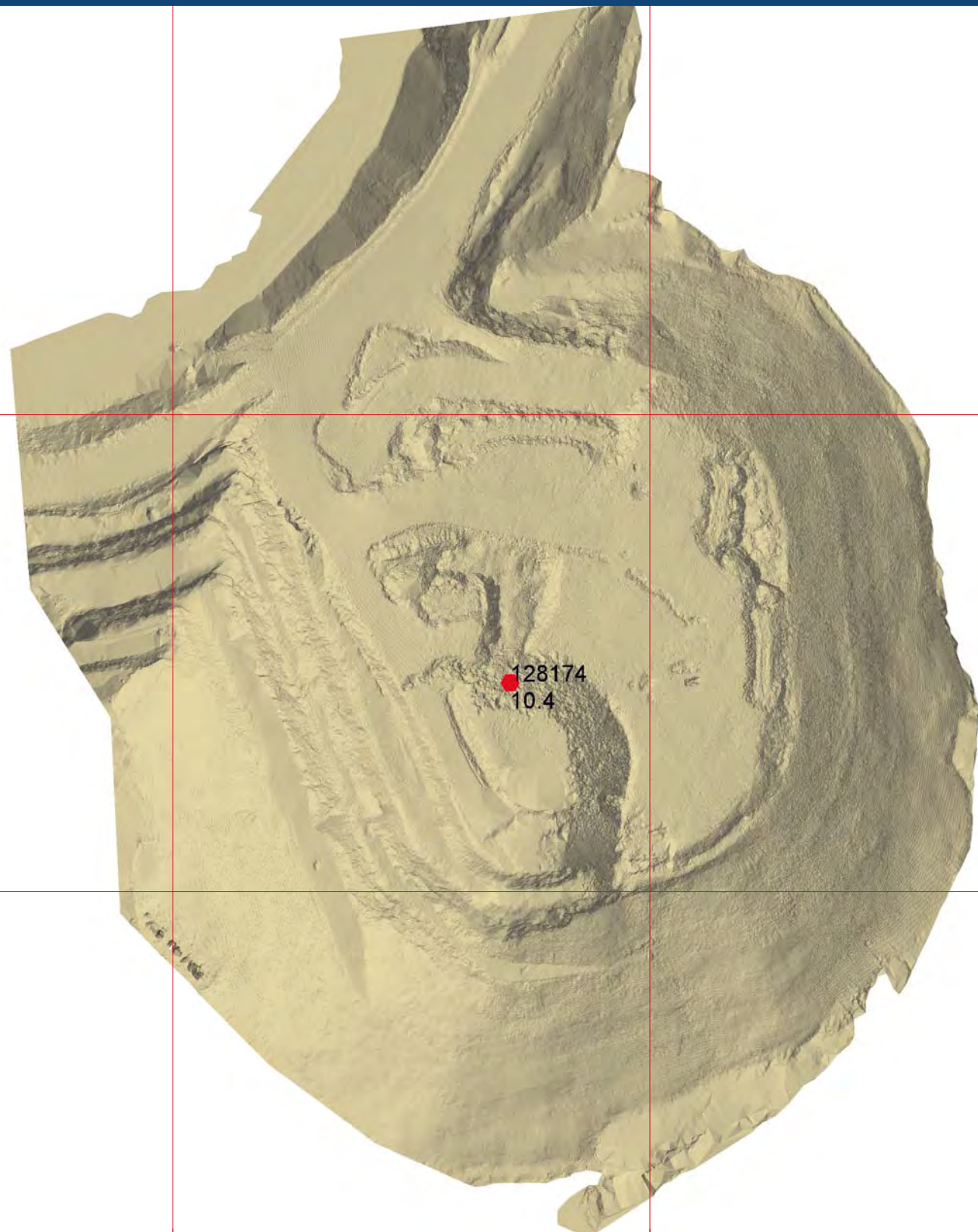
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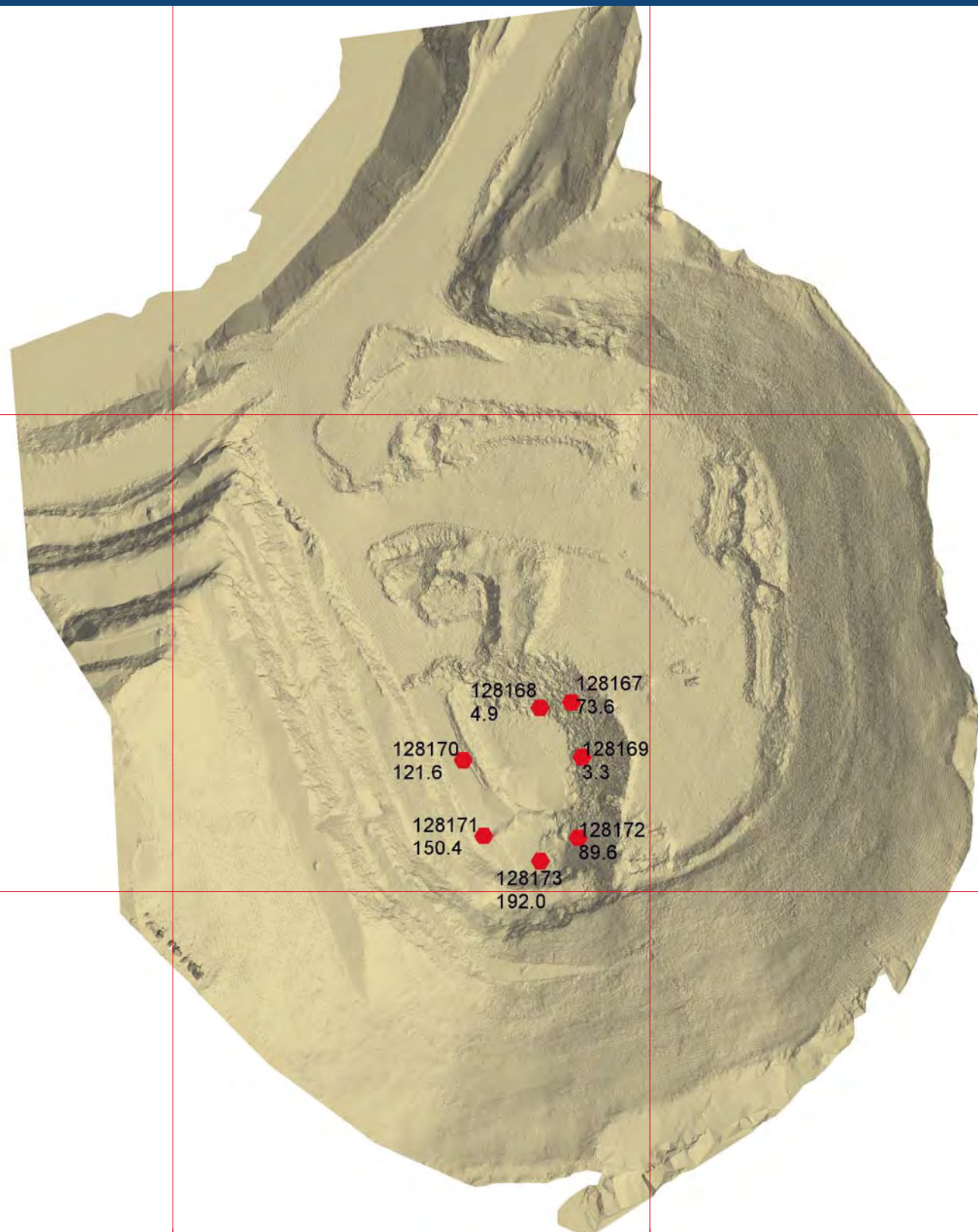
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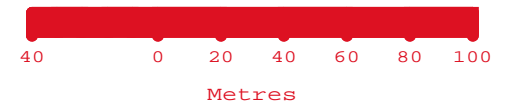
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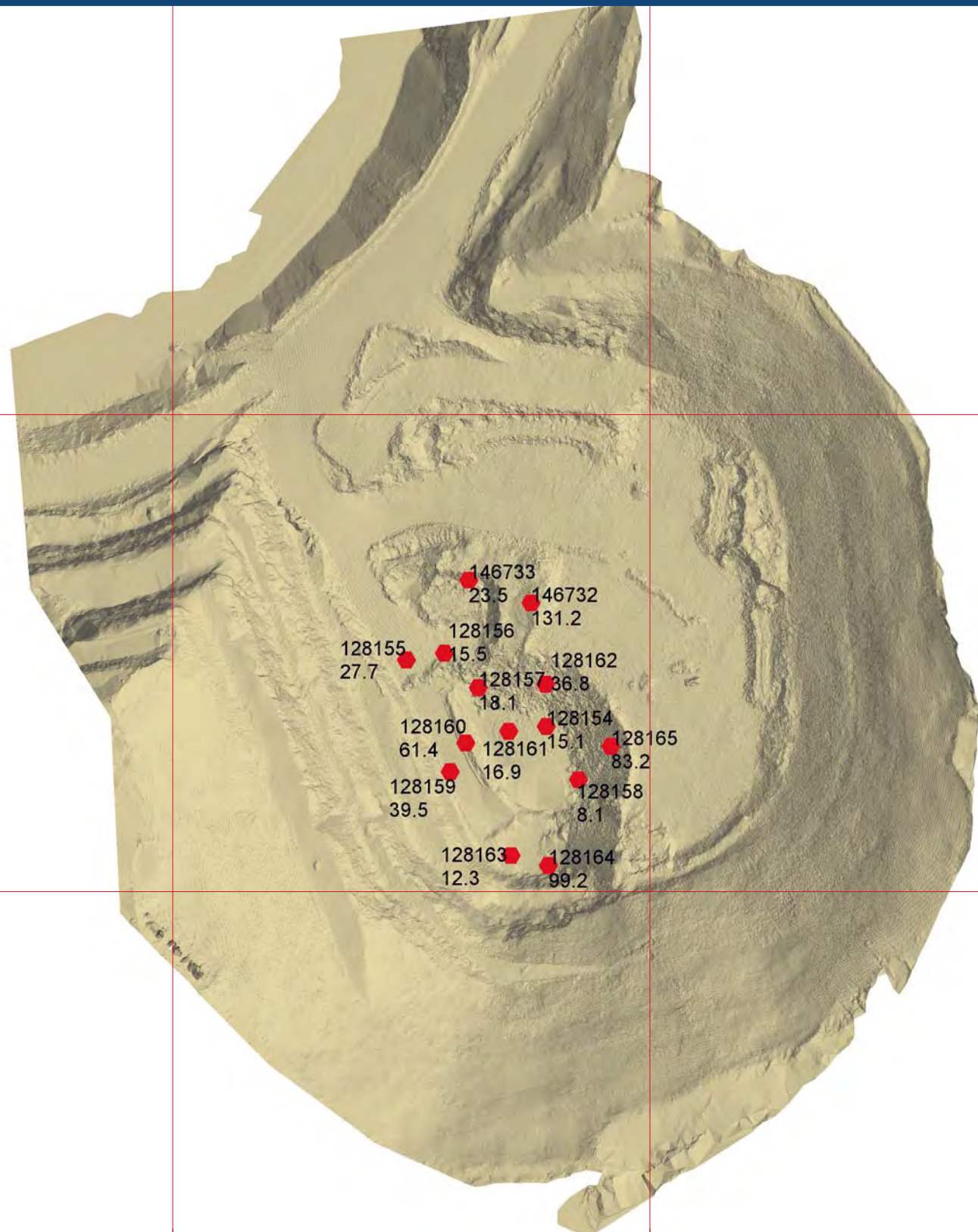
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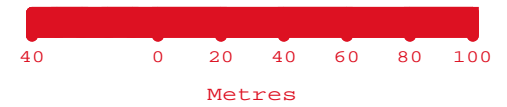
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A2S3/S3ext ABA Loc. 763 elev.

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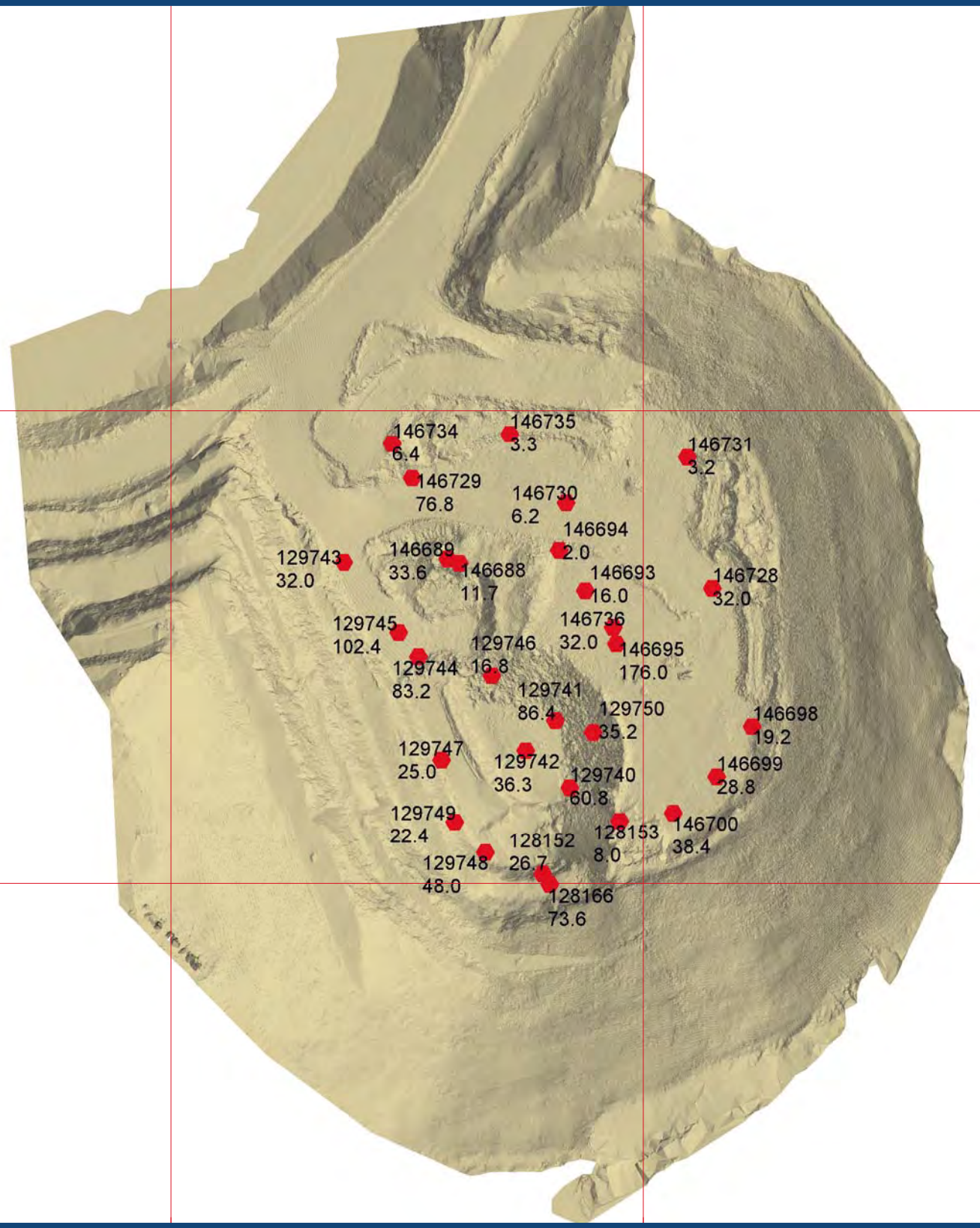
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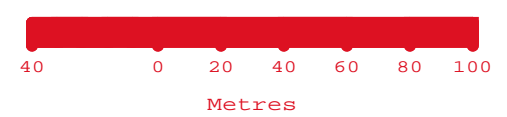
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A2S3/S3ext ABA Loc. 769 elev.

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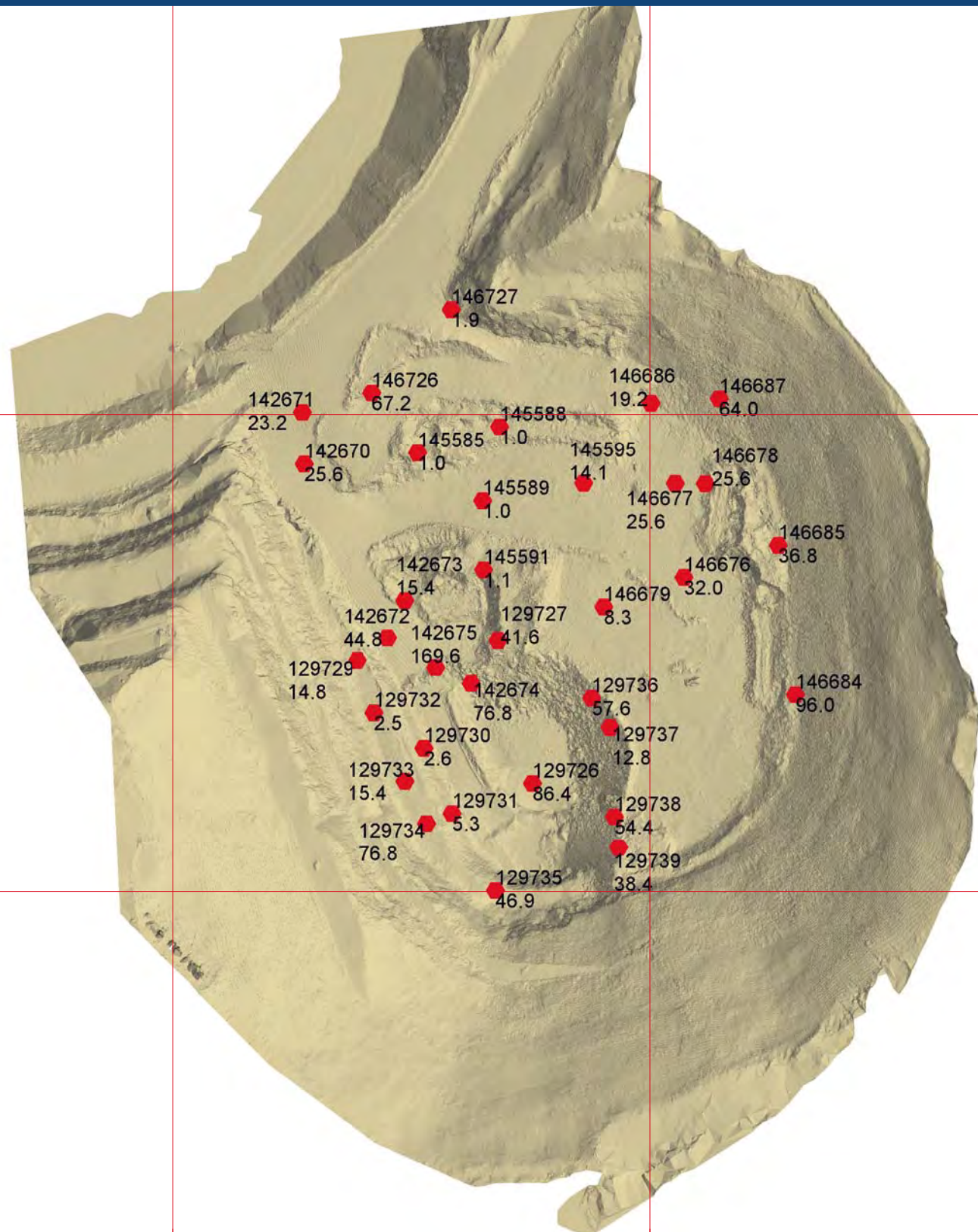
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DATE:
24-Feb-2018

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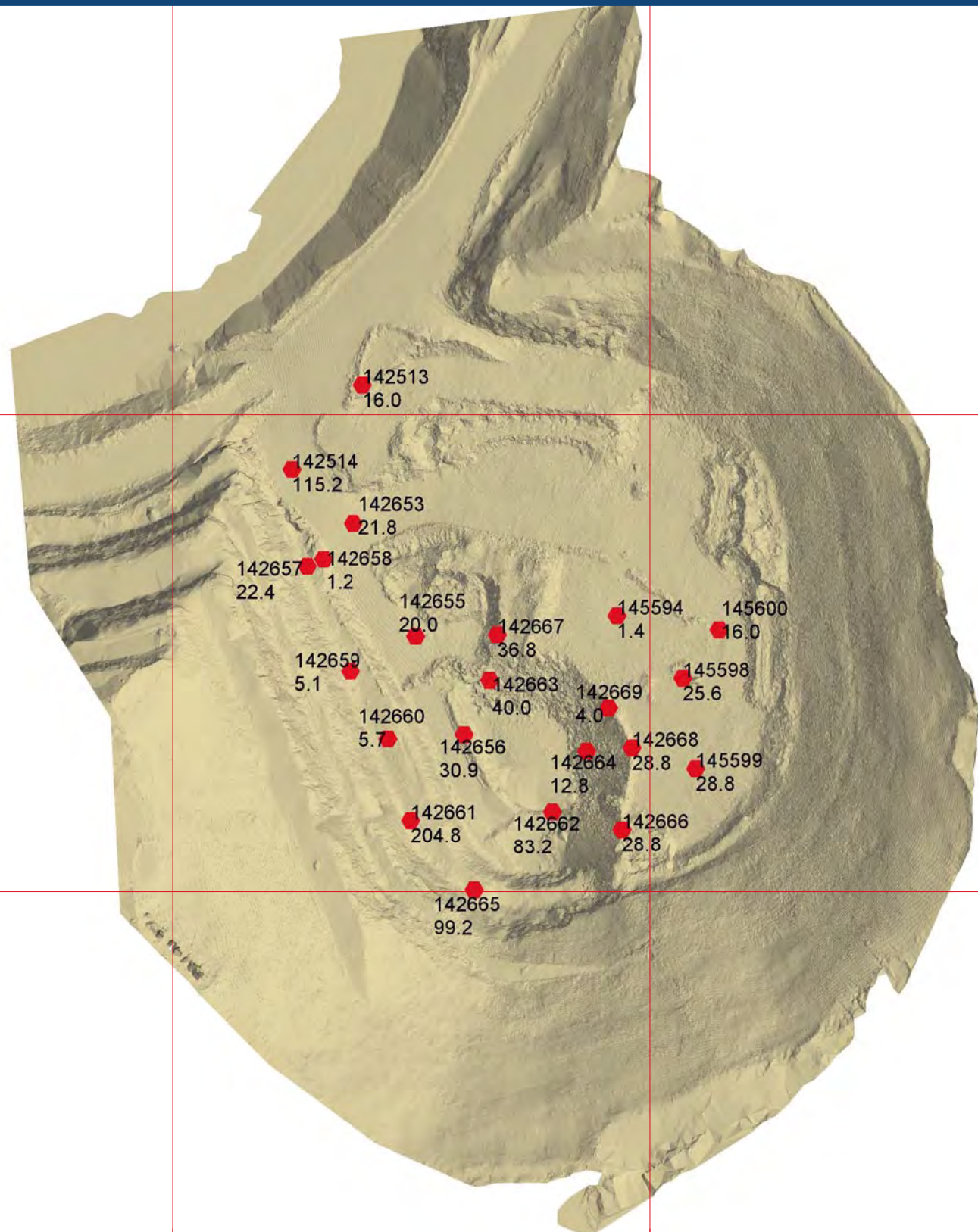
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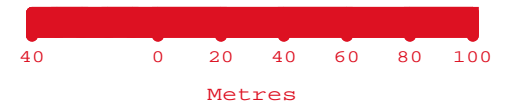
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A2S3/S3ext ABA Loc. 781 elev.

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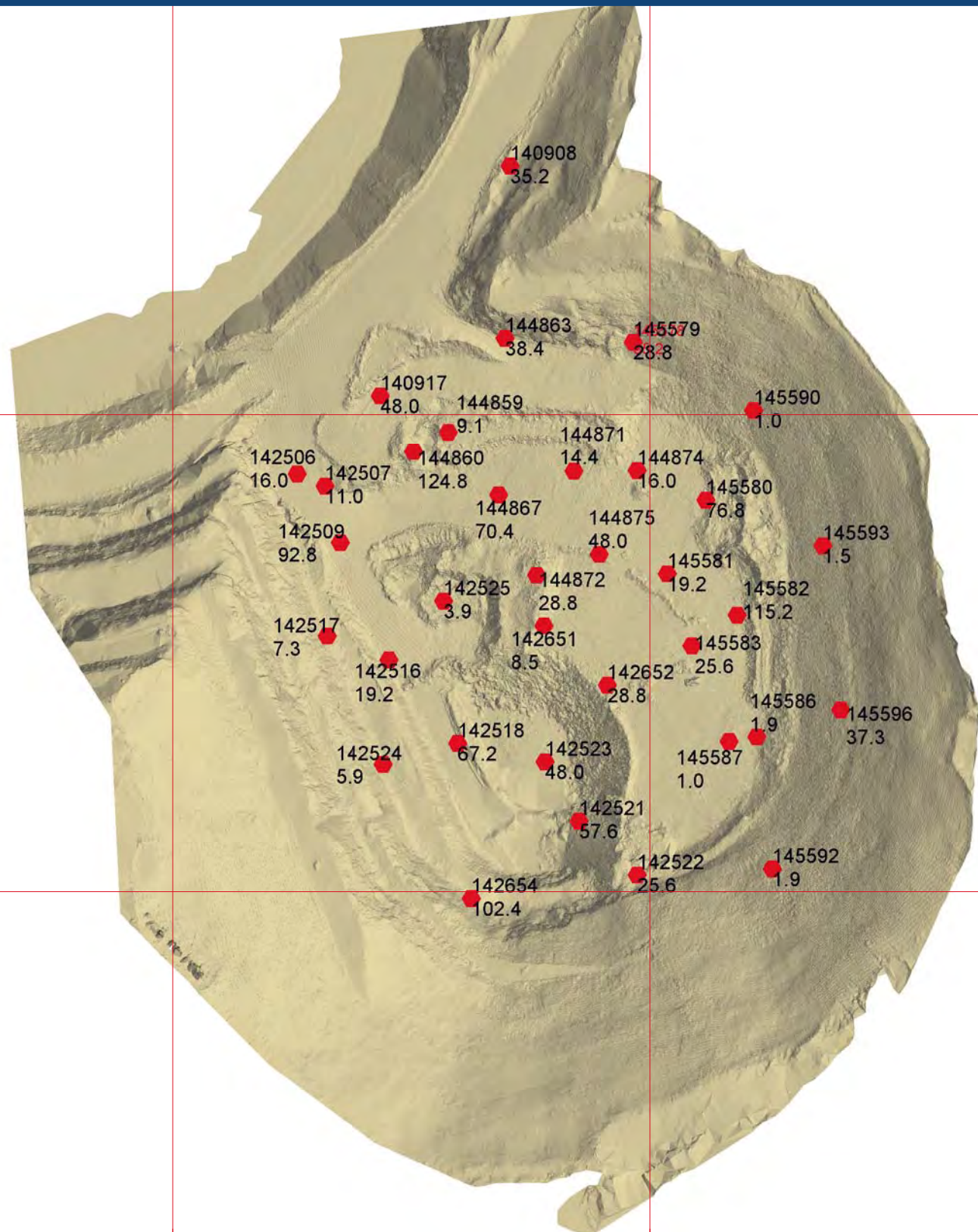
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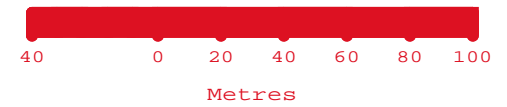
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A2S3/S3ext ABA Loc. 787 elev.

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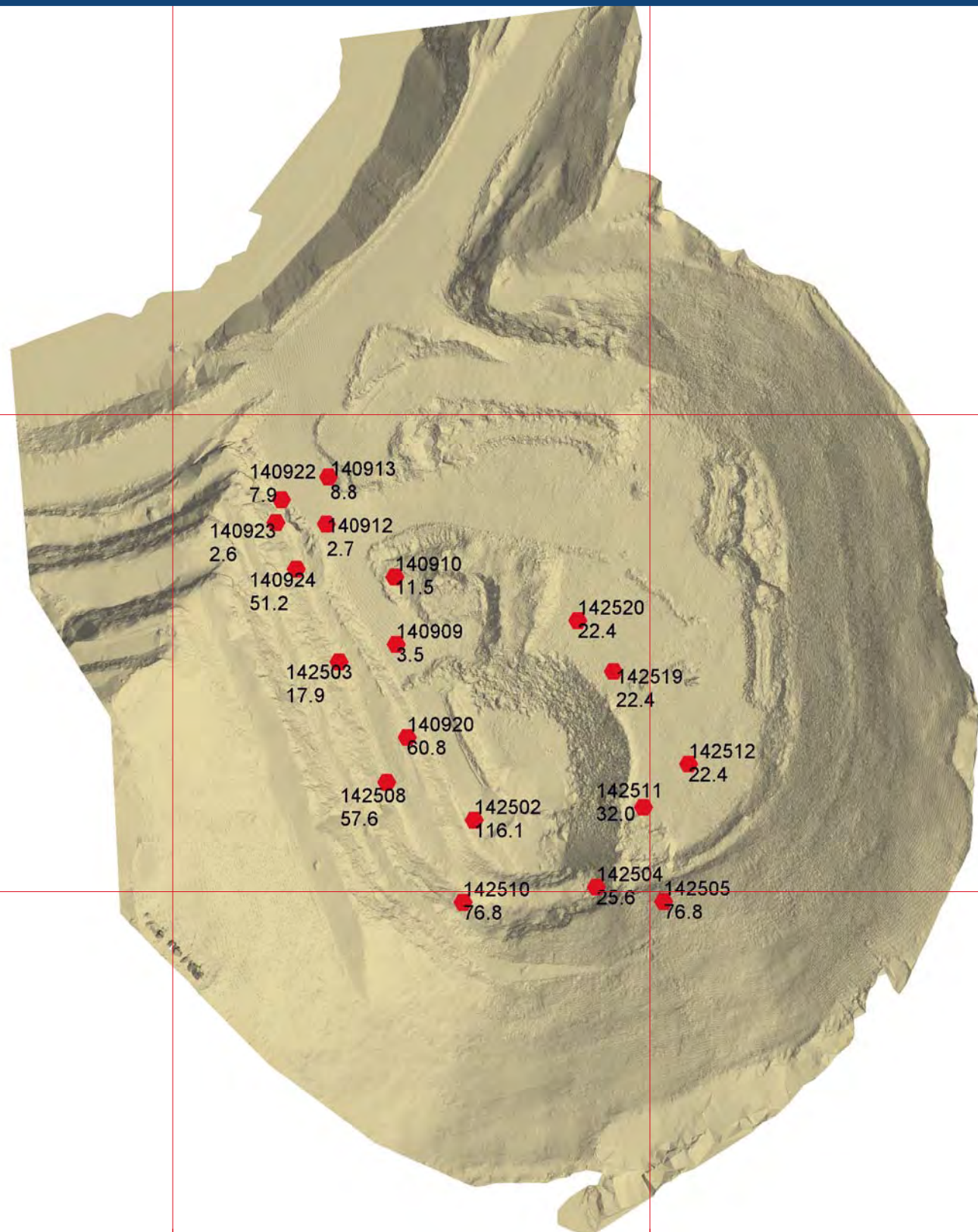
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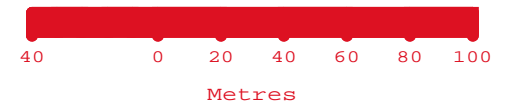
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A2S3/S3ext ABA Loc. 793 elev.

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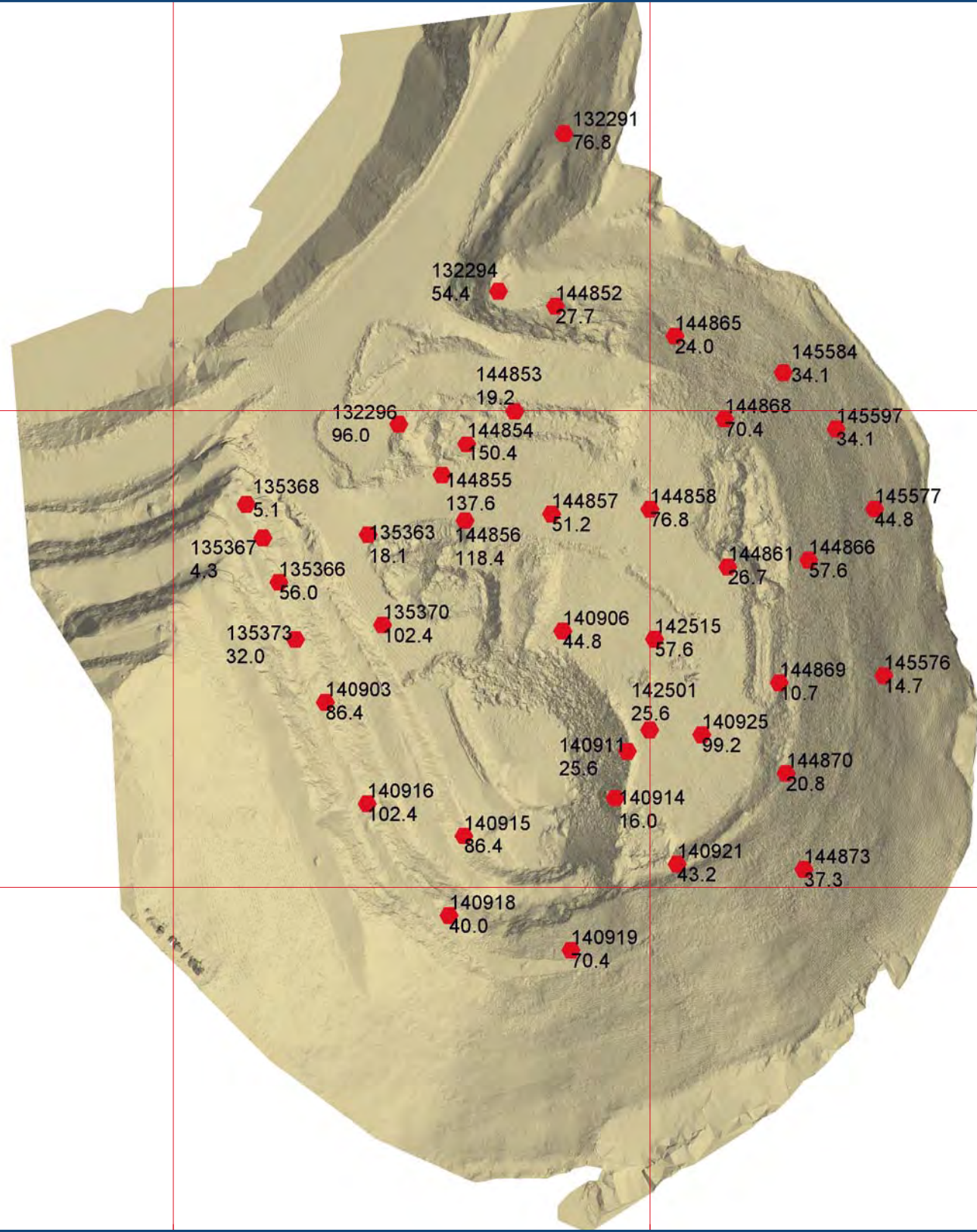
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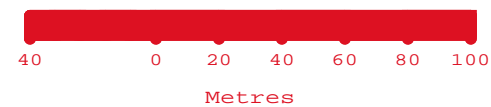
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24-Feb-2018

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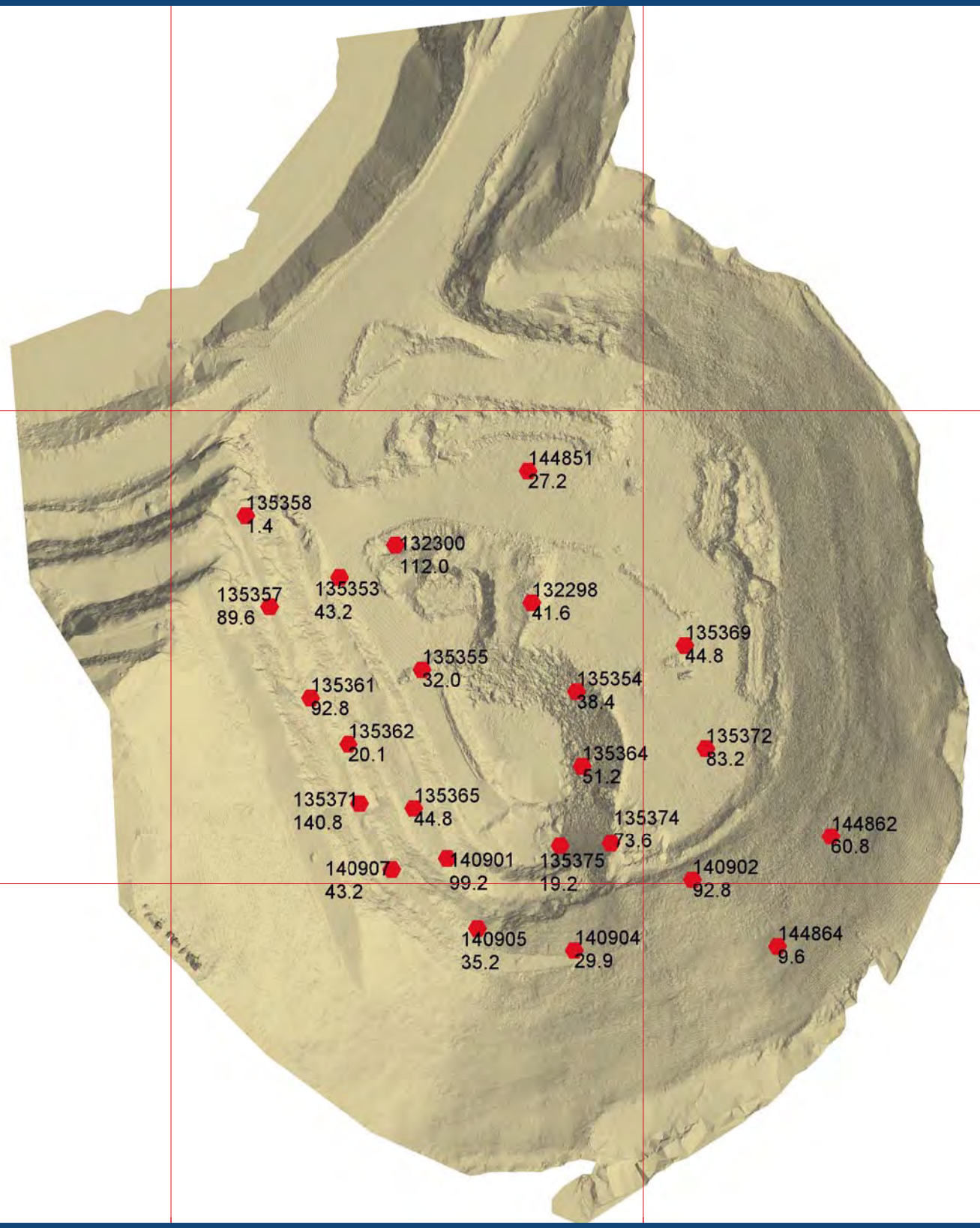
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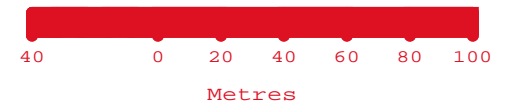
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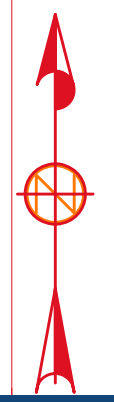
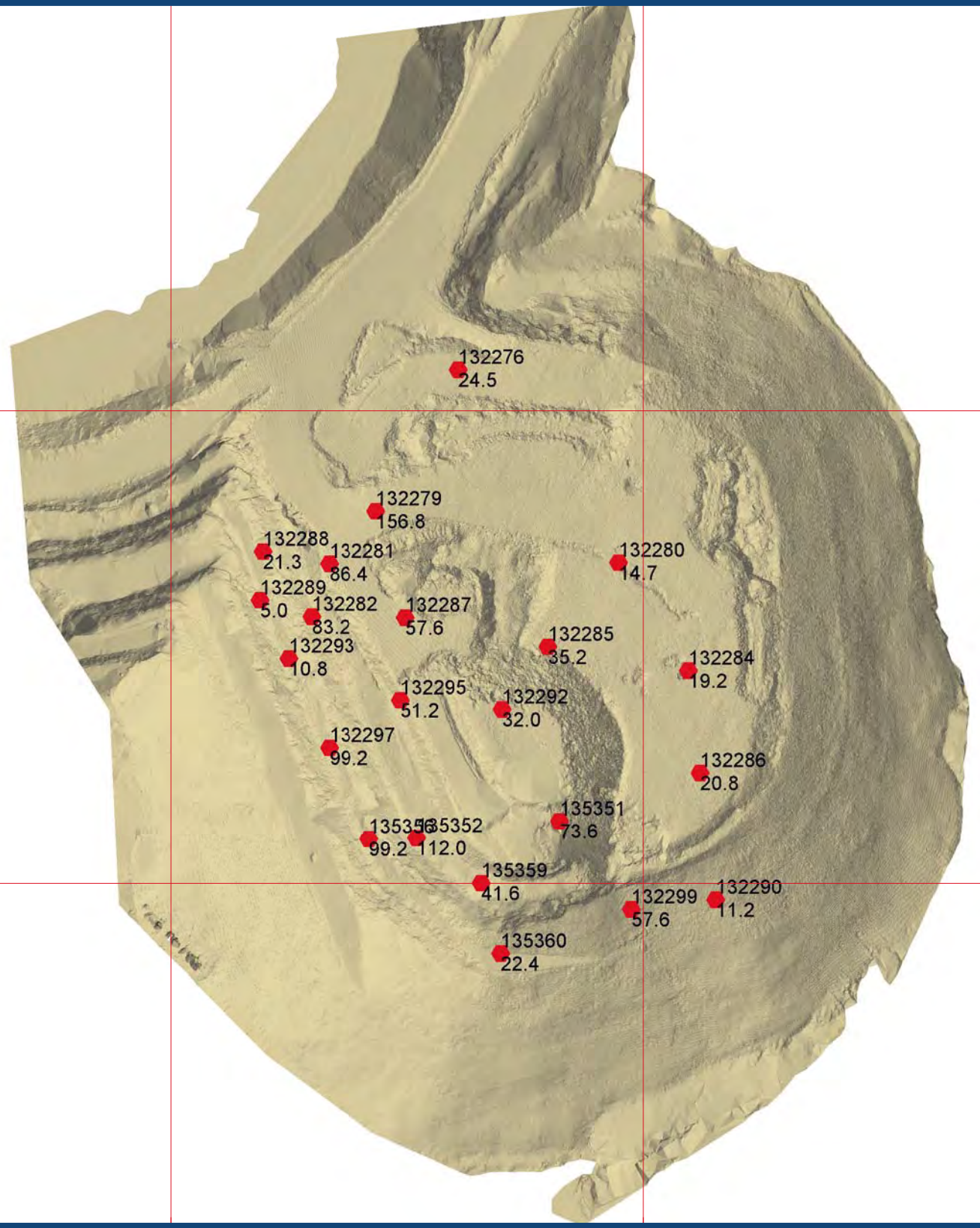
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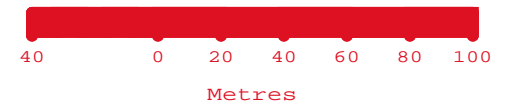
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A2S3/S3ext ABA Loc. 811 elev.

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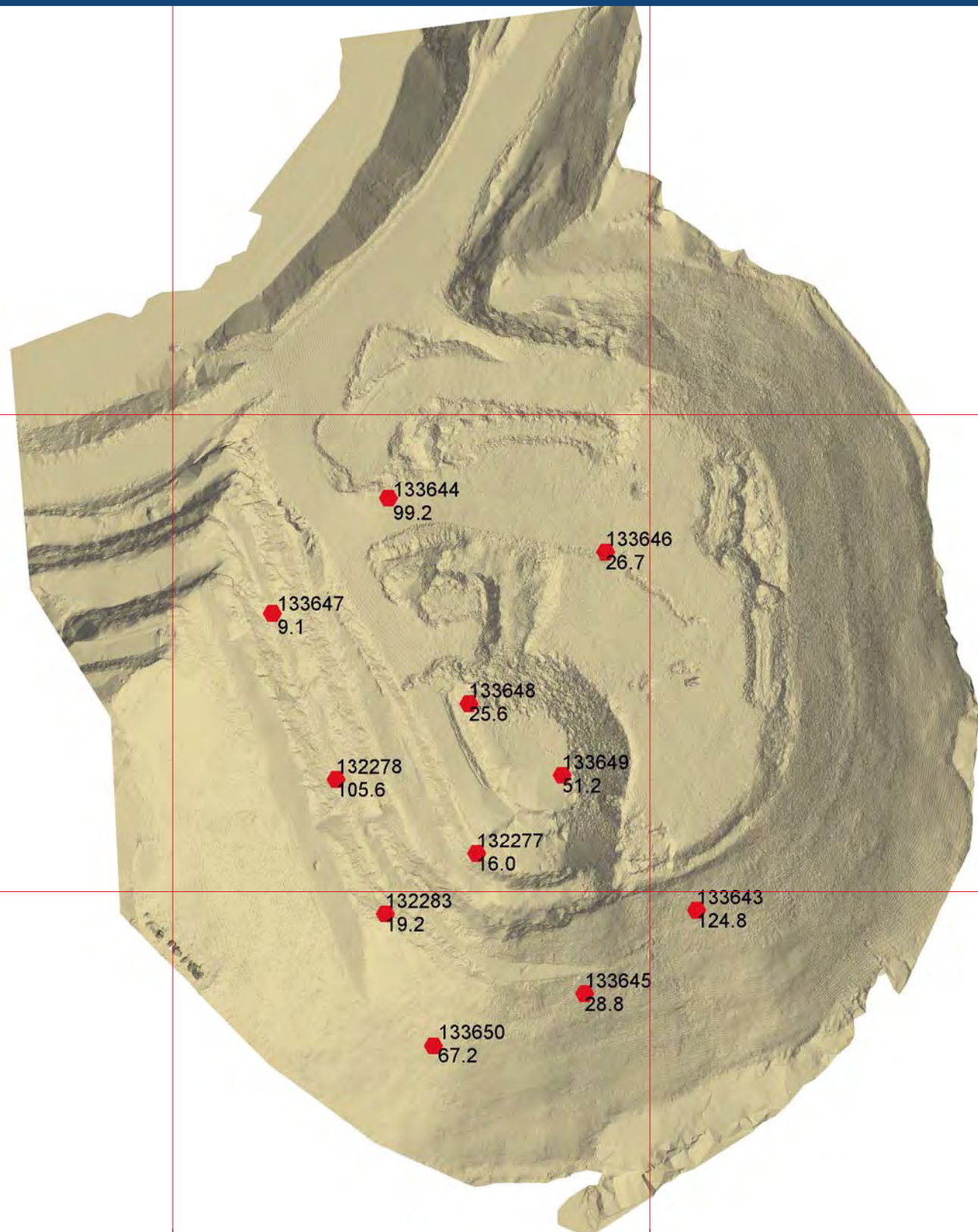
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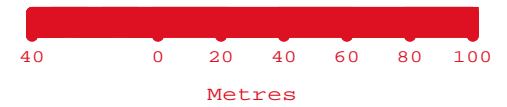
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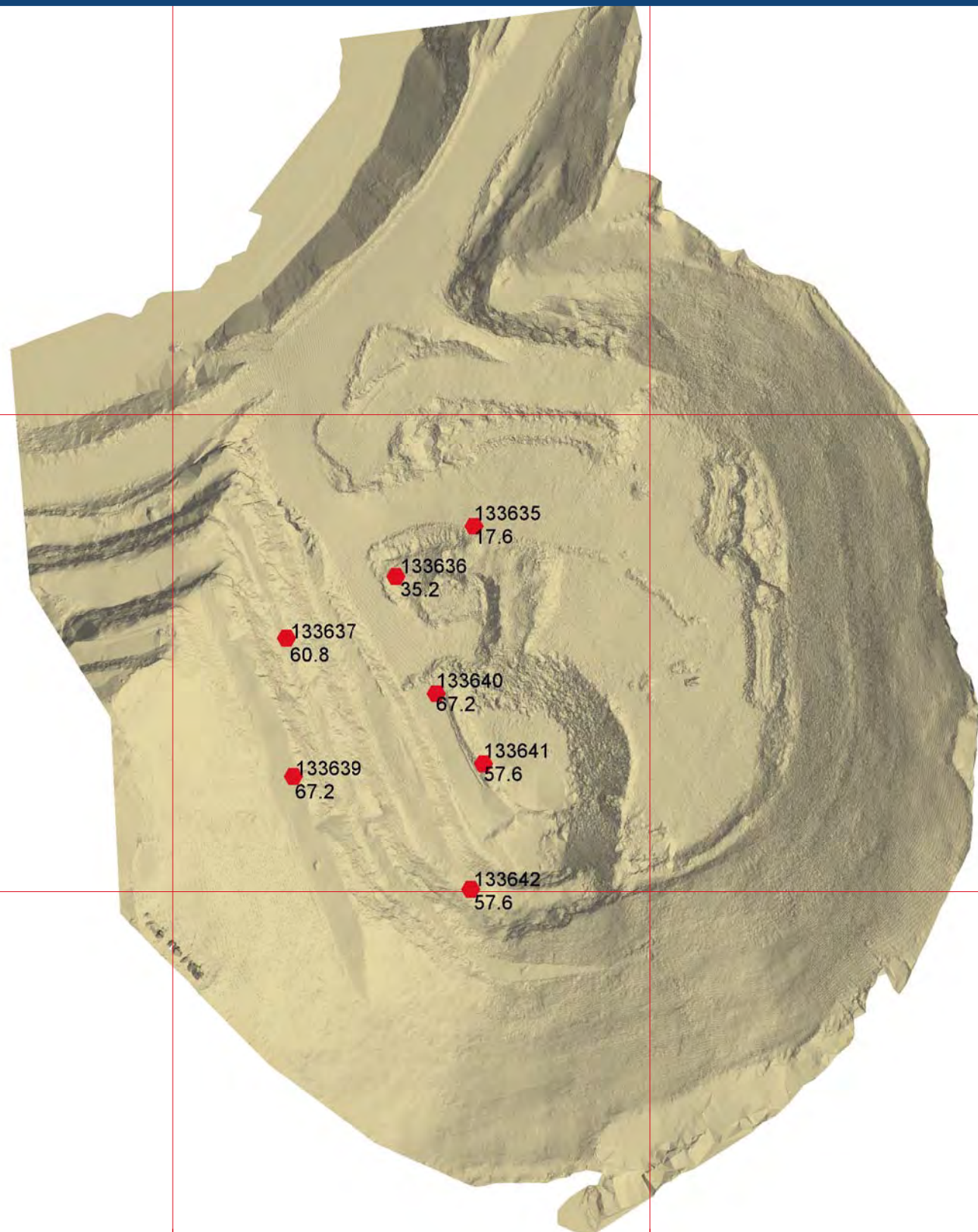
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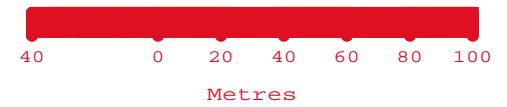
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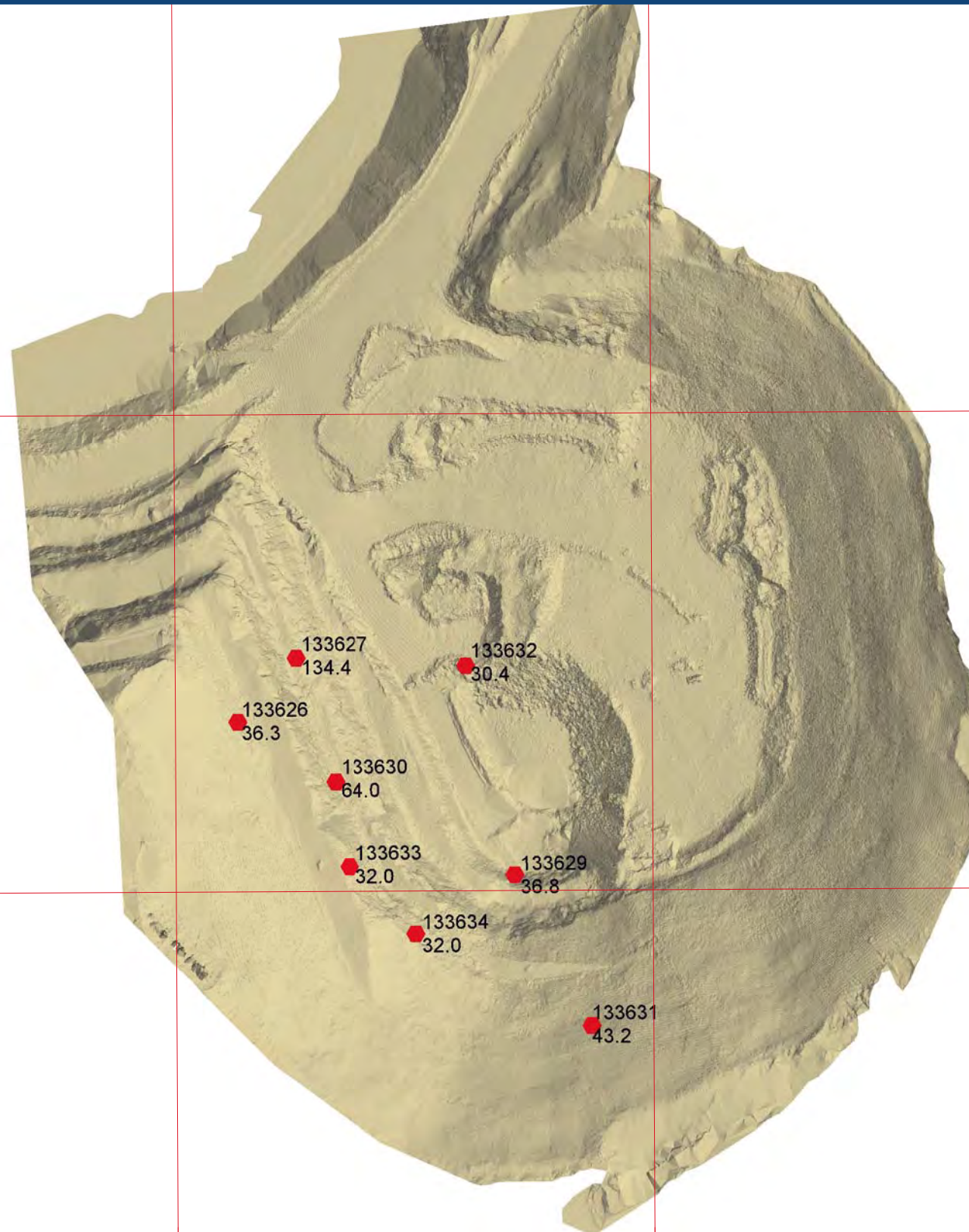
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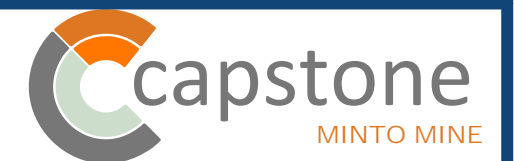
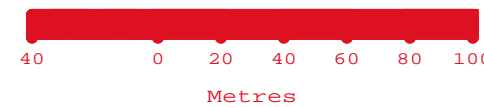
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A2S3/S3ext ABA Loc. 829 elev.

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24-Feb-2018

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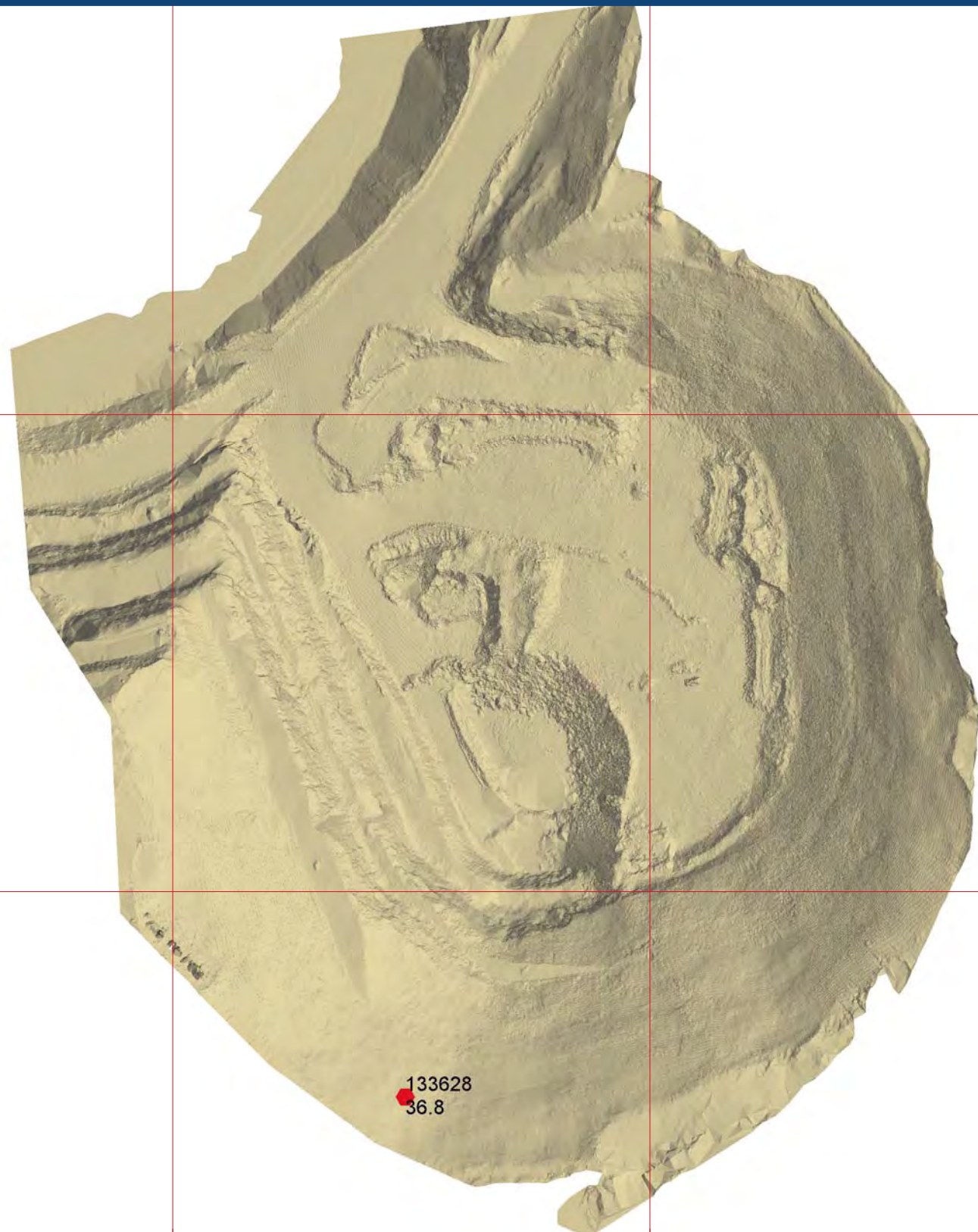
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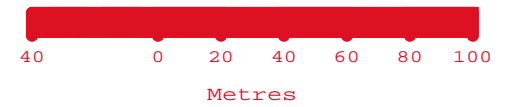
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| A2S3/S3ext ABA Loc. 841 elev. | |
| DATE: 24-Feb-2018 | DRAWN BY: MS |



Appendix B: 2017 Modified NP Method (MEND 1991) ABA Results for Waste Rock and Overburden

| Appendix B. Summary A2S3 and A2S4 Pits ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|---|--------|---------------|------------|-------|-------|-------|---------------------|---------------------|------------------------------|-----|-------------|----------|
| Sample Date | ABA ID | Sample Source | Waste Type | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | | | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 1/23/2017 | 133627 | A2S3 | NAG | 8.6 | 0.15 | <0.01 | 0.01 | <0.01 | 0.3125 | 21 | 134.40 | 21 |
| 1/26/2017 | 133628 | A2S3 | NAG | 8.3 | 0.18 | 0.02 | 0.02 | <0.01 | 0.3125 | 22 | 36.80 | 23 |
| 1/26/2017 | 133626 | A2S3 | NAG | 8.3 | 0.33 | 0.03 | 0.01 | 0.02 | 0.625 | 33 | 36.27 | 34 |
| 1/27/2017 | 133629 | A2S3 | NAG | 8.2 | 0.2 | 0.02 | 0.02 | <0.01 | 0.3125 | 22 | 36.80 | 23 |
| 1/30/2017 | 133630 | A2S3 | NAG | 8 | 0.15 | 0.01 | <0.01 | 0.01 | 0.3125 | 20 | 64.00 | 20 |
| 2/1/2017 | 133631 | A2S3 | NAG | 8.3 | 0.23 | 0.02 | 0.02 | <0.01 | 0.3125 | 26 | 43.20 | 27 |
| 2/1/2017 | 133632 | A2S3 | NAG | 7.9 | 0.17 | 0.02 | 0.01 | 0.01 | 0.3125 | 18 | 30.40 | 19 |
| 2/3/2017 | 133633 | A2S3 | NAG | 8.1 | 0.16 | 0.02 | <0.01 | 0.02 | 0.625 | 19 | 32.00 | 20 |
| 2/5/2017 | 133634 | A2S3 | NAG | 8.2 | 0.16 | 0.02 | <0.01 | 0.02 | 0.625 | 19 | 32.00 | 20 |
| 2/9/2017 | 133636 | A2S3 | NAG | 8.7 | <0.05 | <0.01 | <0.01 | <0.01 | 0.3125 | 11 | 35.20 | 11 |
| 2/9/2017 | 133635 | A2S3 | NAG | 8 | 0.07 | 0.02 | <0.01 | 0.02 | 0.625 | 10 | 17.60 | 11 |
| 2/11/2017 | 133637 | A2S3 | NAG | 8.6 | 0.13 | 0.01 | <0.01 | 0.01 | 0.3125 | 19 | 60.80 | 19 |
| 2/18/2017 | 133640 | A2S3 | NAG | 7.9 | 0.19 | 0.01 | 0.01 | <0.01 | 0.3125 | 21 | 67.20 | 21 |
| 2/18/2017 | 133639 | A2S3 | NAG | 8.2 | 0.48 | 0.04 | 0.02 | 0.02 | 0.625 | 41 | 67.20 | 42 |
| 2/23/2017 | 133641 | A2S3 | NAG | 7.9 | 0.19 | 0.01 | 0.01 | <0.01 | 0.3125 | 18 | 57.60 | 18 |
| 2/27/2017 | 133642 | A2S3 | NAG | 7.8 | 0.17 | 0.02 | 0.02 | <0.01 | 0.3125 | 17 | 57.60 | 18 |
| 3/4/2017 | 133643 | A2S3 | NAG | 8.2 | 0.47 | 0.02 | 0.03 | <0.01 | 0.3125 | 38 | 124.80 | 39 |
| 3/9/2017 | 133644 | A2S3 | NAG | 8.6 | 0.29 | 0.01 | 0.02 | <0.01 | 0.3125 | 31 | 99.20 | 31 |
| 3/12/2017 | 133645 | A2S3 | NAG | 7.5 | 0.21 | 0.04 | 0.02 | 0.02 | 0.625 | 17 | 28.80 | 18 |
| 3/14/2017 | 133646 | A2S3 | NAG | 7.8 | 0.3 | 0.05 | 0.02 | 0.03 | 0.9375 | 23 | 26.67 | 25 |
| 3/16/2017 | 133647 | A2S3 | SAT | 8.5 | 0.19 | 0.1 | 0.03 | 0.07 | 2.1875 | 17 | 9.14 | 20 |
| 3/17/2017 | 133648 | A2S3 | NAG | 8.3 | 0.14 | 0.02 | <0.01 | 0.02 | 0.625 | 15 | 25.60 | 16 |
| 3/20/2017 | 133649 | A2S3 | NAG | 7.9 | 0.14 | 0.02 | 0.03 | <0.01 | 0.3125 | 15 | 51.20 | 16 |
| 3/24/2017 | 132276 | A2S3 | NAG | 8.1 | 0.24 | 0.03 | <0.01 | 0.03 | 0.9375 | 22 | 24.53 | 23 |
| 3/26/2017 | 133650 | A2S3 | NAG | 7.9 | 0.22 | 0.02 | 0.02 | <0.01 | 0.3125 | 20 | 67.20 | 21 |
| 3/27/2017 | 132277 | A2S3 | NAG | 8.1 | 0.07 | 0.02 | <0.01 | 0.02 | 0.625 | 9 | 16.00 | 10 |
| 3/28/2017 | 132278 | A2S3 | NAG | 8.5 | 0.32 | 0.01 | <0.01 | 0.01 | 0.3125 | 33 | 105.60 | 33 |

| Appendix B. Summary A2S3 and A2S4 Pits ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|---|--------|---------------|------------|-------|------|------|---------------------|---------------------|------------------------------|-----|-------------|----------|
| Sample Date | ABA ID | Sample Source | Waste Type | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | | | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 3/29/2017 | 132279 | A2S3 | NAG | 8.5 | 0.52 | 0.01 | 0.02 | <0.01 | 0.3125 | 49 | 156.80 | 49 |
| 3/31/2017 | 132280 | A2S3 | NAG | 8 | 0.27 | 0.05 | <0.01 | 0.05 | 1.5625 | 21 | 14.72 | 23 |
| 4/2/2017 | 132282 | A2S3 | NAG | 8.8 | 0.25 | 0.02 | 0.04 | <0.01 | 0.3125 | 25 | 83.20 | 26 |
| 4/2/2017 | 132283 | A2S3 | NAG | 8.5 | 0.11 | 0.02 | <0.01 | 0.02 | 0.625 | 11 | 19.20 | 12 |
| 4/2/2017 | 132281 | A2S3 | NAG | 8.7 | 0.23 | 0.04 | 0.04 | <0.01 | 0.3125 | 26 | 86.40 | 27 |
| 4/3/2017 | 132284 | A2S3 | NAG | 7.9 | 0.15 | 0.03 | <0.01 | 0.03 | 0.9375 | 17 | 19.20 | 18 |
| 4/4/2017 | 132285 | A2S3 | NAG | 8.2 | 0.06 | 0.02 | 0.01 | 0.01 | 0.3125 | 10 | 35.20 | 11 |
| 4/6/2017 | 132286 | A2S3 | NAG | 8 | 0.28 | 0.04 | <0.01 | 0.04 | 1.25 | 25 | 20.80 | 26 |
| 4/7/2017 | 132287 | A2S3 | NAG | 8.5 | 0.13 | 0.02 | 0.02 | <0.01 | 0.3125 | 17 | 57.60 | 18 |
| 4/7/2017 | 132289 | A2S3 | NAG | 8.4 | 0.69 | 0.35 | <0.01 | 0.35 | 10.9375 | 44 | 5.03 | 55 |
| 4/7/2017 | 132288 | A2S3 | NAG | 8.6 | 0.19 | 0.03 | <0.01 | 0.03 | 0.9375 | 19 | 21.33 | 20 |
| 4/8/2017 | 132290 | A2S3 | NAG | 7.9 | 0.16 | 0.04 | <0.01 | 0.04 | 1.25 | 13 | 11.20 | 14 |
| 4/12/2017 | 132291 | A2S3 | NAG | 7.9 | 0.22 | 0.03 | 0.02 | 0.01 | 0.3125 | 23 | 76.80 | 24 |
| 4/12/2017 | 132293 | A2S3 | NAG | 8.6 | 0.26 | 0.09 | 0.01 | 0.08 | 2.5 | 24 | 10.80 | 27 |
| 4/13/2017 | 132294 | A2S3 | NAG | 8.2 | 0.13 | 0.02 | 0.02 | <0.01 | 0.3125 | 16 | 54.40 | 17 |
| 4/14/2017 | 132295 | A2S3 | NAG | 8.8 | 0.1 | 0.02 | 0.03 | <0.01 | 0.3125 | 15 | 51.20 | 16 |
| 4/14/2017 | 132292 | A2S3 | NAG | 8.2 | 0.05 | 0.01 | 0.03 | <0.01 | 0.3125 | 10 | 32.00 | 10 |
| 4/15/2017 | 132297 | A2S3 | NAG | 8.5 | 0.29 | 0.01 | 0.02 | <0.01 | 0.3125 | 31 | 99.20 | 31 |
| 4/15/2017 | 132296 | A2S3 | NAG | 8.7 | 0.3 | 0.01 | 0.02 | <0.01 | 0.3125 | 30 | 96.00 | 30 |
| 4/16/2017 | 132298 | A2S3 | NAG | 8.5 | 0.07 | 0.01 | <0.01 | 0.01 | 0.3125 | 13 | 41.60 | 13 |
| 4/17/2017 | 132299 | A2S3 | NAG | 7.8 | 0.2 | 0.04 | 0.04 | <0.01 | 0.3125 | 17 | 57.60 | 18 |
| 4/18/2017 | 132300 | A2S3 | NAG | 8.5 | 0.34 | 0.01 | 0.02 | <0.01 | 0.3125 | 35 | 112.00 | 35 |
| 4/19/2017 | 135352 | A2S3 | NAG | 8.8 | 0.36 | 0.01 | <0.01 | 0.01 | 0.3125 | 35 | 112.00 | 35 |
| 4/19/2017 | 135351 | A2S3 | NAG | 8.1 | 0.22 | 0.02 | 0.02 | <0.01 | 0.3125 | 22 | 73.60 | 23 |
| 4/20/2017 | 135353 | A2S3 | NAG | 8.5 | 0.24 | 0.02 | <0.01 | 0.02 | 0.625 | 26 | 43.20 | 27 |
| 4/21/2017 | 135354 | A2S3 | NAG | 8.2 | 0.06 | 0.01 | 0.02 | <0.01 | 0.3125 | 12 | 38.40 | 12 |
| 4/21/2017 | 135355 | A2S3 | NAG | 8.6 | 0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 10 | 32.00 | 10 |

| Appendix B. Summary A2S3 and A2S4 Pits ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|---|--------|---------------|------------|-------|-------|------|---------------------|---------------------|------------------------------|-----|-------------|----------|
| Sample Date | ABA ID | Sample Source | Waste Type | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | | | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 4/23/2017 | 135356 | A2S3 | NAG | 8.6 | 0.33 | 0.02 | 0.01 | 0.01 | 0.3125 | 30 | 99.20 | 31 |
| 4/24/2017 | 135357 | A2S3 | SAT | 8.7 | 0.27 | 0.02 | 0.01 | 0.01 | 0.3125 | 27 | 89.60 | 28 |
| 4/24/2017 | 135358 | A2S3 | SAT | 8.5 | 0.41 | 0.87 | 0.02 | 0.85 | 26.5625 | 10 | 1.39 | 37 |
| 4/26/2017 | 135361 | A2S3 | CGW | 8.8 | 0.23 | 0.01 | 0.01 | <0.01 | 0.3125 | 29 | 92.80 | 29 |
| 4/26/2017 | 135359 | A2S3 | NAG | 7.8 | 0.3 | 0.01 | <0.01 | 0.01 | 0.3125 | 13 | 41.60 | 13 |
| 4/26/2017 | 135362 | A2S3 | NAG | 8.4 | 0.43 | 0.07 | <0.01 | 0.07 | 2.1875 | 42 | 20.11 | 44 |
| 4/26/2017 | 135360 | A2S3 | NAG | 8.1 | 0.19 | 0.03 | <0.01 | 0.03 | 0.9375 | 20 | 22.40 | 21 |
| 4/28/2017 | 135363 | A2S3 | NAG | 8.6 | 0.33 | 0.07 | 0.01 | 0.06 | 1.875 | 32 | 18.13 | 34 |
| 4/29/2017 | 135364 | A2S3 | NAG | 8.3 | 0.13 | 0.01 | 0.02 | <0.01 | 0.3125 | 16 | 51.20 | 16 |
| 4/29/2017 | 135365 | A2S3 | NAG | 8.7 | 0.43 | 0.01 | 0.01 | <0.01 | 0.3125 | 14 | 44.80 | 14 |
| 4/30/2017 | 135366 | A2S3 | NAG | 8.7 | 0.32 | 0.04 | 0.02 | 0.02 | 0.625 | 34 | 56.00 | 35 |
| 4/30/2017 | 135367 | A2S3 | SAT | 8.7 | 0.39 | 0.25 | 0.02 | 0.23 | 7.1875 | 23 | 4.31 | 31 |
| 4/30/2017 | 135368 | A2S3 | NAG | 8.5 | 0.54 | 0.35 | 0.03 | 0.32 | 10 | 40 | 5.10 | 51 |
| 5/2/2017 | 135370 | A2S3 | NAG | 8.6 | 0.3 | 0.03 | 0.02 | 0.01 | 0.3125 | 31 | 102.40 | 32 |
| 5/2/2017 | 135371 | A2S3 | NAG | 8.7 | 0.5 | 0.01 | 0.01 | <0.01 | 0.3125 | 44 | 140.80 | 44 |
| 5/2/2017 | 135369 | A2S3 | NAG | 7.9 | 0.27 | 0.03 | 0.01 | 0.02 | 0.625 | 27 | 44.80 | 28 |
| 5/3/2017 | 135372 | A2S3 | NAG | 8 | 0.23 | 0.03 | 0.03 | <0.01 | 0.3125 | 25 | 83.20 | 26 |
| 5/4/2017 | 135373 | A2S3 | NAG | 8.8 | 0.26 | 0.04 | 0.01 | 0.03 | 0.9375 | 29 | 32.00 | 30 |
| 5/5/2017 | 140902 | A2S3 | NAG | 8.2 | 0.26 | 0.02 | 0.04 | <0.01 | 0.3125 | 28 | 92.80 | 29 |
| 5/5/2017 | 135374 | A2S3 | NAG | 8.3 | 0.21 | 0.02 | 0.03 | <0.01 | 0.3125 | 22 | 73.60 | 23 |
| 5/5/2017 | 135375 | A2S3 | NAG | 8.2 | <0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 6 | 19.20 | 6 |
| 5/5/2017 | 140901 | A2S3 | NAG | 8.7 | 0.25 | 0.01 | <0.01 | 0.01 | 0.3125 | 31 | 99.20 | 31 |
| 5/6/2017 | 140903 | A2S3 | NAG | 8.7 | 0.23 | 0.02 | 0.01 | 0.01 | 0.3125 | 26 | 86.40 | 27 |
| 5/8/2017 | 140904 | A2S3 | NAG | 8.3 | 0.27 | 0.03 | <0.01 | 0.03 | 0.9375 | 27 | 29.87 | 28 |
| 5/8/2017 | 140905 | A2S3 | NAG | 8.5 | 0.08 | 0.01 | <0.01 | 0.01 | 0.3125 | 11 | 35.20 | 11 |
| 5/9/2017 | 140906 | A2S3 | NAG | 8.5 | 0.07 | 0.01 | 0.02 | <0.01 | 0.3125 | 14 | 44.80 | 14 |
| 5/10/2017 | 140907 | A2S3 | NAG | 8.6 | 0.27 | 0.02 | <0.01 | 0.02 | 0.625 | 26 | 43.20 | 27 |

| Appendix B. Summary A2S3 and A2S4 Pits ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|---|--------|---------------|------------|-------|-------|-------|---------------------|---------------------|------------------------------|-----|-------------|----------|
| Sample Date | ABA ID | Sample Source | Waste Type | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | | | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 5/11/2017 | 140908 | A2S3 | NAG | 8.4 | 0.16 | 0.03 | 0.01 | 0.02 | 0.625 | 21 | 35.20 | 22 |
| 5/12/2017 | 140910 | A2S3 | NAG | 8.7 | 0.36 | 0.1 | <0.01 | 0.1 | 3.125 | 33 | 11.52 | 36 |
| 5/12/2017 | 140909 | A2S3 | SAT | 8.8 | 0.14 | 0.21 | 0.01 | 0.2 | 6.25 | 15 | 3.52 | 22 |
| 5/13/2017 | 140911 | A2S3 | NAG | 8 | 0.1 | 0.01 | 0.01 | <0.01 | 0.3125 | 8 | 25.60 | 8 |
| 5/14/2017 | 140913 | A2S3 | NAG | 8.8 | 0.35 | 0.14 | 0.02 | 0.12 | 3.75 | 29 | 8.80 | 33 |
| 5/14/2017 | 140912 | A2S3 | SAT | 8.4 | 0.52 | 0.51 | 0.02 | 0.49 | 15.3125 | 25 | 2.68 | 41 |
| 5/15/2017 | 140914 | A2S3 | NAG | 8.3 | 0.05 | 0.02 | <0.01 | 0.02 | 0.625 | 9 | 16.00 | 10 |
| 5/15/2017 | 140915 | A2S3 | NAG | 8.3 | 0.27 | 0.02 | 0.02 | <0.01 | 0.3125 | 26 | 86.40 | 27 |
| 5/16/2017 | 140916 | A2S3 | NAG | 8.7 | 0.31 | 0.02 | 0.01 | 0.01 | 0.3125 | 31 | 102.40 | 32 |
| 5/17/2017 | 140917 | A2S3 | NAG | 8.4 | 0.3 | 0.05 | 0.03 | 0.02 | 0.625 | 28 | 48.00 | 30 |
| 5/18/2017 | 140921 | A2S3 | NAG | 8.5 | 0.29 | 0.02 | <0.01 | 0.02 | 0.625 | 26 | 43.20 | 27 |
| 5/18/2017 | 140918 | A2S3 | NAG | 8.5 | 0.26 | 0.02 | <0.01 | 0.02 | 0.625 | 24 | 40.00 | 25 |
| 5/21/2017 | 140919 | A2S3 | NAG | 8.2 | 0.22 | 0.03 | 0.02 | 0.01 | 0.3125 | 21 | 70.40 | 22 |
| 5/22/2017 | 140920 | A2S3 | NAG | 8.9 | 0.11 | 0.02 | 0.02 | <0.01 | 0.3125 | 18 | 60.80 | 19 |
| 5/24/2017 | 140923 | A2S3 | SAT | 8.6 | 0.38 | 0.44 | 0.02 | 0.42 | 13.125 | 20 | 2.59 | 34 |
| 5/24/2017 | 140924 | A2S3 | NAG | 8.8 | 0.34 | 0.04 | 0.02 | 0.02 | 0.625 | 31 | 51.20 | 32 |
| 5/24/2017 | 140922 | A2S3 | NAG | 8.6 | 0.39 | 0.14 | 0.01 | 0.13 | 4.0625 | 28 | 7.88 | 32 |
| 5/25/2017 | 140925 | A2S3 | NAG | 8.3 | 0.31 | 0.02 | 0.02 | <0.01 | 0.3125 | 30 | 99.20 | 31 |
| 5/25/2017 | 142501 | A2S3 | NAG | 8.1 | 0.06 | 0.01 | 0.01 | <0.01 | 0.3125 | 8 | 25.60 | 8 |
| 5/26/2017 | 142503 | A2S3 | NAG | 8.6 | 0.24 | 0.05 | <0.01 | 0.05 | 1.5625 | 26 | 17.90 | 28 |
| 5/27/2017 | 142502 | A2S3 | NAG | 8.4 | 0.38 | <0.01 | 0.01 | <0.01 | 0.31 | 36 | 116.10 | 36 |
| 5/29/2017 | 142506 | A2S3 | NAG | 8.7 | 0.42 | 0.07 | <0.01 | 0.07 | 2.1875 | 33 | 16.00 | 35 |
| 5/29/2017 | 142504 | A2S3 | NAG | 8.2 | <0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 8 | 25.60 | 8 |
| 5/29/2017 | 142505 | A2S3 | NAG | 8.4 | 0.21 | 0.02 | 0.02 | <0.01 | 0.3125 | 23 | 76.80 | 24 |
| 5/29/2017 | 142507 | A2S3 | SAT | 8.5 | 0.65 | 0.15 | <0.01 | 0.15 | 4.375 | 43 | 11.00 | 48 |
| 5/30/2017 | 142508 | A2S3 | NAG | 8.5 | 0.36 | 0.03 | 0.01 | 0.02 | 0.625 | 35 | 57.60 | 36 |
| 5/31/2017 | 142509 | A2S3 | NAG | 8.8 | 0.24 | 0.02 | 0.01 | 0.01 | 0.3125 | 28 | 92.80 | 29 |

| Appendix B. Summary A2S3 and A2S4 Pits ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|---|--------|---------------|------------|-------|-------|-------|---------------------|---------------------|------------------------------|-----|-------------|----------|
| Sample Date | ABA ID | Sample Source | Waste Type | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | | | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 6/1/2017 | 142510 | A2S3 | NAG | 8.5 | 0.21 | 0.01 | <0.01 | 0.01 | 0.3125 | 24 | 76.80 | 24 |
| 6/2/2017 | 142513 | A2S3 | NAG | 8.6 | 0.47 | 0.08 | <0.01 | 0.08 | 2.5 | 38 | 16.00 | 40 |
| 6/2/2017 | 142511 | A2S3 | NAG | 8.2 | <0.05 | 0.01 | 0.01 | <0.01 | 0.3125 | 10 | 32.00 | 10 |
| 6/2/2017 | 142512 | A2S3 | NAG | 8.2 | 0.08 | 0.01 | 0.01 | <0.01 | 0.3125 | 7 | 22.40 | 7 |
| 6/4/2017 | 142514 | A2S3 | NAG | 8.7 | 0.37 | 0.1 | <0.01 | 0.01 | 0.3125 | 33 | 115.20 | 36 |
| 6/6/2017 | 142517 | A2S3 | SAT | 8.9 | 0.22 | 0.12 | <0.01 | 0.12 | 3.4375 | 21 | 7.30 | 25 |
| 6/6/2017 | 142516 | A2S3 | NAG | 8.9 | 0.34 | 0.06 | 0.01 | 0.05 | 1.5625 | 28 | 19.20 | 30 |
| 6/6/2017 | 142515 | A2S3 | NAG | 8.3 | 0.14 | 0.01 | <0.01 | 0.01 | 0.3125 | 18 | 57.60 | 18 |
| 6/7/2017 | 142518 | A2S3 | NAG | 8.7 | 0.19 | 0.01 | <0.01 | 0.01 | 0.3125 | 21 | 67.20 | 21 |
| 6/8/2017 | 142519 | A2S3 | NAG | 8.2 | <0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 7 | 22.40 | 7 |
| 6/9/2017 | 142520 | A2S3 | NAG | 8.2 | 0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 7 | 22.40 | 7 |
| 6/11/2017 | 142522 | A2S3 | NAG | 8.2 | <0.05 | <0.01 | <0.01 | <0.01 | 0.3125 | 8 | 25.60 | 8 |
| 6/11/2017 | 142521 | A2S3 | NAG | 8.3 | 0.12 | 0.01 | <0.01 | 0.01 | 0.3125 | 18 | 57.60 | 18 |
| 6/12/2017 | 142523 | A2S3 | NAG | 8.5 | 0.10 | <0.01 | <0.01 | <0.01 | 0.3125 | 15 | 48.00 | 15 |
| 6/14/2017 | 142524 | A2S3 | SAT | 8.5 | 0.38 | 0.18 | <0.01 | 0.18 | 5.625 | 27 | 5.87 | 33 |
| 6/14/2017 | 142525 | A2S3 | NAG | 8.5 | 0.25 | 0.19 | <0.01 | 0.19 | 5.9375 | 17 | 3.87 | 23 |
| 6/15/2017 | 142651 | A2S3 | NAG | 8.3 | <0.05 | 0.03 | <0.01 | 0.03 | 0.9375 | 7 | 8.53 | 8 |
| 6/16/2017 | 142652 | A2S3 | NAG | 8.3 | 0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 9 | 28.80 | 9 |
| 6/18/2017 | 142653 | A2S3 | NAG | 8.5 | 0.41 | 0.05 | <0.01 | 0.05 | 1.5625 | 32 | 21.76 | 34 |
| 6/19/2017 | 142654 | A2S3 | NAG | 8.4 | 0.34 | 0.01 | 0.03 | <0.01 | 0.3125 | 32 | 102.40 | 32 |
| 6/20/2017 | 142655 | A2S3 | NAG | 8.5 | 0.23 | 0.04 | <0.01 | 0.04 | 1.25 | 24 | 20.00 | 25 |
| 6/21/2017 | 142656 | A2S3 | NAG | 8.5 | 0.33 | 0.03 | <0.01 | 0.03 | 0.9375 | 28 | 30.93 | 29 |
| 6/24/2017 | 142657 | A2S3 | NAG | 8.7 | 0.29 | 0.04 | <0.01 | 0.04 | 1.25 | 27 | 22.40 | 28 |
| 6/24/2017 | 142658 | A2S3 | SAT | 8.6 | 0.19 | 0.61 | <0.01 | 0.61 | 19.0625 | 4 | 1.21 | 23 |
| 6/25/2017 | 142659 | A2S3 | NAG | 8.5 | 0.38 | 0.20 | <0.01 | 0.2 | 6.25 | 26 | 5.12 | 32 |
| 6/26/2017 | 142660 | A2S3 | NAG | 8.7 | 0.27 | 0.14 | <0.01 | 0.14 | 4.375 | 21 | 5.71 | 25 |
| 6/26/2017 | 142661 | A2S3 | NAG | 8.5 | 0.69 | 0.01 | <0.01 | 0.01 | 0.3125 | 64 | 204.80 | 64 |

| Appendix B. Summary A2S3 and A2S4 Pits ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|---|--------|---------------|------------|-------|-------|-------|---------------------|---------------------|------------------------------|-----|-------------|----------|
| Sample Date | ABA ID | Sample Source | Waste Type | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | | | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 6/28/2017 | 142664 | A2S3 | NAG | 8.6 | 0.05 | 0.02 | <0.01 | 0.02 | 0.625 | 7 | 12.80 | 8 |
| 6/28/2017 | 142662 | A2S3 | NAG | 8.4 | 0.2 | 0.01 | <0.01 | 0.01 | 0.3125 | 26 | 83.20 | 26 |
| 6/28/2017 | 142663 | A2S3 | NAG | 8.6 | 0.2 | 0.02 | <0.01 | 0.02 | 0.625 | 24 | 40.00 | 25 |
| 6/28/2017 | 142665 | A2S3 | NAG | 8.4 | 0.3 | 0.01 | <0.01 | 0.01 | 0.3125 | 31 | 99.20 | 31 |
| 6/30/2017 | 142666 | A2S3 | NAG | 8.5 | <0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 9 | 28.80 | 9 |
| 7/2/2017 | 142667 | A2S3 | NAG | 8.8 | 0.2 | 0.02 | <0.01 | 0.02 | 0.625 | 22 | 36.80 | 23 |
| 7/2/2017 | 142668 | A2S3 | NAG | 8.3 | <0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 9 | 28.80 | 9 |
| 7/2/2017 | 142669 | A2S3 | NAG | 8.3 | 0.29 | 0.27 | <0.01 | 0.27 | 8.4375 | 26 | 4.03 | 34 |
| 7/4/2017 | 142671 | A2S3 | NAG | 8.7 | 0.35 | 0.04 | <0.01 | 0.04 | 1.25 | 28 | 23.20 | 29 |
| 7/4/2017 | 142670 | A2S3 | CGW | 8.8 | <0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 8 | 25.60 | 8 |
| 7/6/2017 | 142672 | A2S3 | CGW | 9.1 | 0.27 | 0.03 | 0.01 | 0.02 | 0.625 | 27 | 44.80 | 28 |
| 7/6/2017 | 142673 | A2S3 | NAG | 9 | 0.23 | 0.05 | <0.01 | 0.05 | 1.5625 | 22 | 15.36 | 24 |
| 7/7/2017 | 142674 | A2S3 | NAG | 9.1 | 0.22 | 0.02 | 0.02 | <0.01 | 0.3125 | 23 | 76.80 | 24 |
| 7/7/2017 | 142675 | A2S3 | CGW | 8.7 | 0.56 | 0.01 | 0.02 | <0.01 | 0.3125 | 53 | 169.60 | 53 |
| 7/12/2017 | 129726 | A2S3 | NAG | 8.7 | 0.25 | 0.02 | 0.02 | <0.01 | 0.3125 | 26 | 86.40 | 27 |
| 7/14/2017 | 142728 | A2S3 | SAT | 9.1 | 0.13 | 0.5 | 0.01 | 0.49 | 15.3125 | 0.4 | 1.04 | 16 |
| 7/14/2017 | 129729 | A2S3 | NAG | 9.2 | 0.43 | 0.08 | <0.01 | 0.08 | 2.5 | 35 | 14.80 | 37 |
| 7/15/2017 | 129727 | A2S3 | NAG | 9.1 | 0.28 | 0.02 | <0.01 | 0.02 | 0.625 | 25 | 41.60 | 26 |
| 7/16/2017 | 129736 | A2S3 | NAG | 9 | 0.17 | 0.01 | 0.01 | <0.01 | 0.3125 | 18 | 57.60 | 18 |
| 7/16/2017 | 129738 | A2S3 | NAG | 8.9 | 0.11 | <0.01 | <0.01 | <0.01 | 0.3125 | 17 | 54.40 | 17 |
| 7/16/2017 | 129737 | A2S3 | CGW | 8.8 | <0.05 | 0.02 | <0.01 | 0.02 | 0.625 | 7 | 12.80 | 8 |
| 7/17/2017 | 129734 | A2S3 | CGW | 9 | 0.23 | 0.01 | <0.01 | 0.01 | 0.3125 | 24 | 76.80 | 24 |
| 7/17/2017 | 129732 | A2S3 | SAT | 8.8 | 0.68 | 0.52 | 0.03 | 0.49 | 15.3125 | 23 | 2.55 | 39 |
| 7/17/2017 | 129733 | A2S3 | NAG | 8.8 | 0.74 | 0.11 | 0.01 | 0.1 | 3.125 | 45 | 15.36 | 48 |
| 7/17/2017 | 129730 | A2S3 | SAT | 8.9 | 0.56 | 0.49 | 0.01 | 0.48 | 15 | 24 | 2.60 | 39 |
| 7/17/2017 | 129731 | A2S3 | NAG | 9.1 | 0.59 | 0.24 | 0.03 | 0.21 | 6.5625 | 28 | 5.33 | 35 |
| 7/19/2017 | 129735 | A2S3 | NAG | 8.7 | 0.48 | 0.03 | <0.01 | 0.03 | 0.9375 | 43 | 46.93 | 44 |

| Appendix B. Summary A2S3 and A2S4 Pits ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|---|--------|---------------|------------|-------|-------|------|---------------------|---------------------|------------------------------|-----|-------------|----------|
| Sample Date | ABA ID | Sample Source | Waste Type | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | | | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 7/23/2017 | 129739 | A2S3 | NAG | 9 | 0.07 | 0.01 | <0.01 | 0.01 | 0.3125 | 12 | 38.40 | 12 |
| 7/25/2017 | 129741 | A2S3 | CGW | 8.7 | 0.28 | 0.01 | 0.01 | <0.01 | 0.3125 | 27 | 86.40 | 27 |
| 7/25/2017 | 129742 | A2S3 | NAG | 8.7 | 0.47 | 0.04 | 0.01 | 0.03 | 0.9375 | 33 | 36.27 | 34 |
| 7/27/2017 | 129740 | A2S3 | NAG | 8.7 | 0.15 | 0.01 | 0.01 | <0.01 | 0.3125 | 19 | 60.80 | 19 |
| 7/29/2017 | 129743 | A2S3 | NAG | 8.8 | 0.15 | 0.03 | 0.01 | 0.02 | 0.625 | 19 | 32.00 | 20 |
| 7/30/2017 | 129745 | A2S3 | CGW | 8.8 | 0.3 | 0.01 | <0.01 | 0.01 | 0.3125 | 32 | 102.40 | 32 |
| 7/30/2017 | 129744 | A2S3 | NAG | 9 | 0.23 | 0.02 | 0.03 | <0.01 | 0.3125 | 25 | 83.20 | 26 |
| 7/31/2017 | 129746 | A2S3 | NAG | 8.9 | 0.19 | 0.06 | 0.02 | 0.04 | 1.25 | 19 | 16.80 | 21 |
| 8/3/2017 | 129747 | A2S3 | NAG | 9.2 | 0.52 | 0.05 | <0.01 | 0.05 | 1.5625 | 37 | 24.96 | 39 |
| 8/4/2017 | 129749 | A2S3 | CGW | 8.9 | 0.35 | 0.05 | 0.01 | 0.04 | 1.25 | 26 | 22.40 | 28 |
| 8/4/2017 | 129748 | A2S3 | NAG | 8.9 | 0.38 | 0.02 | <0.01 | 0.02 | 0.625 | 29 | 48.00 | 30 |
| 8/5/2017 | 129750 | A2S3 | NAG | 8.9 | 0.19 | 0.02 | <0.01 | 0.02 | 0.625 | 21 | 35.20 | 22 |
| 8/5/2017 | 129751 | A2S3 | CGW | 8.9 | <0.05 | 0.02 | <0.01 | 0.02 | 0.625 | 10 | 17.60 | 11 |
| 8/6/2017 | 128153 | A2S3 | NAG | 9.1 | 0.06 | 0.04 | <0.01 | 0.04 | 1.25 | 9 | 8.00 | 10 |
| 8/6/2017 | 128152 | A2S3 | NAG | 8.7 | 0.25 | 0.03 | <0.01 | 0.03 | 0.9375 | 24 | 26.67 | 25 |
| 8/10/2017 | 128157 | A2S3 | SAT | 8.7 | 0.36 | 0.08 | 0.02 | 0.06 | 1.875 | 32 | 18.13 | 34 |
| 8/10/2017 | 128156 | A2S3 | NAG | 9.1 | 0.28 | 0.06 | <0.01 | 0.06 | 1.875 | 27 | 15.47 | 29 |
| 8/10/2017 | 128155 | A2S3 | CGW | 9.1 | 0.24 | 0.03 | <0.01 | 0.03 | 0.9375 | 25 | 27.73 | 26 |
| 8/10/2017 | 128154 | A2S3 | CGW | 8.8 | 0.34 | 0.07 | <0.01 | 0.07 | 2.1875 | 31 | 15.09 | 33 |
| 8/11/2017 | 128158 | A2S3 | NAG | 9.1 | 0.33 | 0.11 | <0.01 | 0.11 | 3.4375 | 25 | 8.15 | 28 |
| 8/14/2017 | 128159 | A2S3 | NAG | 9 | 0.51 | 0.03 | <0.01 | 0.03 | 0.9375 | 36 | 39.47 | 37 |
| 8/14/2017 | 128160 | A2S3 | NAG | 8.9 | 1.29 | 0.06 | 0.01 | 0.05 | 1.5625 | 94 | 61.44 | 96 |
| 8/14/2017 | 128161 | A2S3 | NAG | 8.8 | 0.4 | 0.07 | <0.01 | 0.07 | 2.1875 | 35 | 16.91 | 37 |
| 8/15/2017 | 128162 | A2S3 | NAG | 9 | 0.23 | 0.02 | <0.01 | 0.02 | 0.625 | 22 | 36.80 | 23 |
| 8/16/2017 | 128165 | A2S3 | NAG | 8.6 | 0.27 | 0.02 | 0.02 | <0.01 | 0.3125 | 25 | 83.20 | 26 |
| 8/16/2017 | 128164 | A2S3 | NAG | 9 | 0.33 | 0.01 | 0.01 | <0.01 | 0.3125 | 31 | 99.20 | 31 |
| 8/16/2017 | 128163 | A2S3 | NAG | 8.7 | 0.84 | 0.14 | 0.01 | 0.13 | 4.0625 | 46 | 12.31 | 50 |

| Appendix B. Summary A2S3 and A2S4 Pits ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|---|--------|---------------|------------|-------|------|-------|---------------------|---------------------|------------------------------|------|-------------|----------|
| Sample Date | ABA ID | Sample Source | Waste Type | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | | | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 8/19/2017 | 128166 | A2S3 | NAG | 8.6 | 0.22 | <0.01 | 0.02 | <0.01 | 0.3125 | 23 | 73.60 | 23 |
| 8/20/2017 | 128167 | A2S3 | NAG | 9 | 0.24 | 0.01 | 0.01 | <0.01 | 0.3125 | 23 | 73.60 | 23 |
| 8/20/2017 | 128168 | A2S3 | NAG | 8.6 | 0.51 | 0.26 | 0.02 | 0.24 | 7.5 | 29 | 4.93 | 37 |
| 8/21/2017 | 128169 | A2S3 | NAG | 8.7 | 0.47 | 0.34 | 0.01 | 0.33 | 10.3125 | 23 | 3.30 | 34 |
| 8/24/2017 | 128171 | A2S3 | CGW | 8.7 | 0.93 | 0.03 | 0.02 | 0.01 | 0.3125 | 46 | 150.40 | 47 |
| 8/24/2017 | 128170 | A2S3 | CGW | 8.8 | 0.67 | 0.05 | 0.04 | 0.01 | 0.3125 | 36 | 121.60 | 38 |
| 8/25/2017 | 128173 | A2S3 | CGW | 8.8 | 1.02 | 0.01 | 0.01 | <0.01 | 0.3125 | 60 | 192.00 | 60 |
| 8/25/2017 | 128172 | A2S3 | NAG | 9 | 0.38 | 0.03 | 0.02 | 0.01 | 0.3125 | 27 | 89.60 | 28 |
| 8/30/2017 | 128174 | A2S3 | SAT | 9 | 1.04 | 0.2 | 0.01 | 0.19 | 5.9375 | 56 | 10.44 | 62 |
| 9/6/2017 | 128175 | A2S3 | NAG | 8.9 | 0.96 | 0.02 | 0.01 | 0.01 | 0.3125 | 64 | 208.00 | 65 |
| 9/10/2017 | 144851 | A2S3 | NAG | 8.8 | 0.13 | 0.02 | <0.01 | 0.02 | 0.625 | 16 | 27.20 | 17 |
| 9/20/2017 | 144852 | A2S3 | CGW | 8.5 | 0.25 | 0.03 | <0.01 | 0.03 | 0.9375 | 25 | 27.73 | 26 |
| 9/23/2017 | 144855 | A2S3 | CGW | 8.8 | 0.44 | 0.01 | <0.01 | 0.01 | 0.3125 | 43 | 137.60 | 43 |
| 9/23/2017 | 144853 | A2S3 | CGW | 9.2 | 0.06 | 0.02 | <0.01 | 0.02 | 0.625 | 11 | 19.20 | 12 |
| 9/23/2017 | 144854 | A2S3 | NAG | 8.9 | 0.51 | 0.01 | <0.01 | 0.01 | 0.3125 | 47 | 150.40 | 47 |
| 9/25/2017 | 144856 | A2S3 | NAG | 9 | 0.34 | 0.01 | <0.01 | 0.01 | 0.3125 | 37 | 118.40 | 37 |
| 9/25/2017 | 144857 | A2S3 | CGW | 8.7 | 0.1 | 0.01 | <0.01 | 0.01 | 0.3125 | 16 | 51.20 | 16 |
| 9/30/2017 | 144858 | A2S3 | OVV | 8.2 | 0.22 | 0.02 | 0.03 | <0.01 | 0.3125 | 23 | 76.80 | 24 |
| 10/3/2017 | 144860 | A2S3 | CGW | 8.8 | 0.44 | 0.01 | <0.01 | 0.01 | 0.3125 | 39 | 124.80 | 39 |
| 10/3/2017 | 144859 | A2S3 | NAG | 8.9 | 0.19 | 0.1 | 0.03 | 0.07 | 2.1875 | 17 | 9.14 | 20 |
| 10/7/2017 | 144861 | A2S3 | OVV | 7.9 | 0.31 | 0.05 | 0.02 | 0.03 | 0.9375 | 23 | 26.67 | 25 |
| 10/9/2017 | 144862 | A2S3 | OVV | 7.8 | 0.22 | 0.04 | 0.03 | 0.01 | 0.3125 | 18 | 60.80 | 19 |
| 10/10/2017 | 144863 | A2S3 | NAG | 8.6 | 0.08 | 0.02 | 0.01 | 0.01 | 0.3125 | 11 | 38.40 | 12 |
| 10/12/2017 | 144864 | A2S3 | OVV | 7.5 | 0.19 | 0.05 | 0.01 | 0.04 | 1.25 | 10 | 9.60 | 12 |
| 10/14/2017 | 144865 | A2S3 | OVV | 7.9 | 0.3 | 0.05 | 0.01 | 0.04 | 1.25 | 28 | 24.00 | 30 |
| 10/15/2017 | 144866 | A2S3 | OVV | 7.7 | 0.2 | 0.04 | 0.03 | 0.01 | 0.3125 | 17 | 57.60 | 18 |
| 10/16/2017 | 144867 | A2S3 | NAG | 8.6 | 0.19 | 0.01 | <0.01 | 0.01 | 0.3125 | 70.4 | 70.40 | 22 |

| Appendix B. Summary A2S3 and A2S4 Pits ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|---|--------|---------------|------------|-------|-------|------|---------------------|---------------------|------------------------------|-------|-------------|----------|
| Sample Date | ABA ID | Sample Source | Waste Type | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | | | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 10/18/2017 | 144868 | A2S3 | OVB | 8 | 0.23 | 0.04 | 0.05 | <0.01 | 0.3125 | 18.4 | 70.40 | 22 |
| 10/19/2017 | 144869 | A2S3 | OVB | 7.9 | 0.24 | 0.07 | 0.01 | 0.06 | 1.875 | 10.06 | 10.67 | 20 |
| 10/21/2017 | 144870 | A2S3 | OVB | 8.2 | 0.28 | 0.04 | <0.01 | 0.04 | 1.25 | 21.6 | 20.80 | 26 |
| 10/22/2017 | 144872 | A2S3 | NAG | 8.6 | 0.15 | 0.02 | <0.01 | 0.02 | 0.625 | 30.4 | 28.80 | 18 |
| 10/22/2017 | 144871 | A2S3 | CGW | 8.5 | <0.05 | 0.02 | <0.01 | 0.02 | 0.625 | 16 | 14.40 | 9 |
| 10/24/2017 | 144874 | A2S3 | OVB/Waste | 8.5 | <0.05 | 0.01 | 0.03 | <0.01 | 0.3125 | 16 | 16.00 | 5 |
| 10/24/2017 | 144875 | A2S3 | CGW | 8.8 | 0.1 | 0.02 | 0.01 | 0.01 | 0.3125 | 25.6 | 48.00 | 15 |
| 10/25/2017 | 144873 | A2S3 | OVB | 8.5 | 0.36 | 0.03 | <0.01 | 0.03 | 0.9375 | 38.4 | 37.33 | 35 |
| 10/27/2017 | 145576 | A2S3 | OVB | 7.9 | 0.27 | 0.05 | <0.01 | 0.05 | 1.5625 | 21 | 14.72 | 23 |
| 10/27/2017 | 145577 | A2S3 | OVB | 8.1 | 0.44 | 0.03 | <0.01 | 0.03 | 0.9375 | 41 | 44.80 | 42 |
| 10/29/2017 | 145578 | A2S3 | OVB | 8.3 | 0.2 | 0.02 | <0.01 | 0.02 | 0.625 | 21 | 35.20 | 22 |
| 10/29/2017 | 145579 | A2S3 | NAG | 8.3 | <0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 9 | 28.80 | 9 |
| 10/30/2017 | 145580 | A2S3 | OVB/Waste | 8.4 | 0.22 | 0.01 | <0.01 | 0.01 | 0.3125 | 24 | 76.80 | 24 |
| 10/30/2017 | 145581 | A2S3 | NAG | 8.2 | <0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 6 | 19.20 | 6 |
| 11/1/2017 | 145582 | A2S3 | OVB/Waste | 8.4 | 0.36 | 0.02 | 0.01 | 0.01 | 0.3125 | 35 | 115.20 | 36 |
| 11/1/2017 | 145583 | A2S3 | NAG | 8.3 | <0.05 | 0.01 | 0.01 | <0.01 | 0.3125 | 8 | 25.60 | 8 |
| 11/2/2017 | 145587 | A2S3 | NAG | 8.1 | 0.15 | 0.01 | 0.01 | <0.01 | 0.3125 | 12 | 0.96 | 0.3 |
| 11/2/2017 | 145586 | A2S3 | OVB/Waste | 8.4 | 0.35 | 0.02 | 0.02 | <0.01 | 0.3125 | 32 | 1.92 | 0.6 |
| 11/4/2017 | 145584 | A2S3 | OVB | 8.2 | 0.29 | 0.03 | <0.01 | 0.03 | 0.9375 | 31 | 34.13 | 32 |
| 11/5/2017 | 145592 | A2S3 | OVB | 8.3 | 0.38 | 0.02 | 0.01 | 0.01 | 0.3125 | 35 | 1.92 | 0.6 |
| 11/5/2017 | 145585 | A2S3 | NAG | 8.6 | 0.66 | 0.31 | <0.01 | 0.31 | 9.6875 | 38 | 1.00 | 9.7 |
| 11/6/2017 | 145589 | A2S3 | NAG | 8.6 | 0.7 | 0.34 | <0.01 | 0.34 | 10.625 | 46 | 1.00 | 10.6 |
| 11/6/2017 | 145588 | A2S3 | NAG | 8.5 | 0.62 | 0.14 | <0.01 | 0.14 | 4.375 | 39 | 1.01 | 4.4 |
| 11/9/2017 | 145596 | A2S3 | OVB | 8.1 | 0.39 | 0.03 | <0.01 | 0.03 | 0.9375 | 34 | 37.33 | 35 |
| 11/11/2017 | 145590 | A2S3 | OVB | 8 | 0.35 | 0.05 | <0.01 | 0.05 | 1.5625 | 31 | 1.02 | 1.6 |
| 11/13/2017 | 145591 | A2S3 | NAG | 8.6 | 0.44 | 0.12 | 0.01 | 0.11 | 3.4375 | 33 | 1.11 | 3.8 |
| 11/14/2017 | 145594 | A2S3 | NAG | 8.3 | 0.09 | 0.04 | 0.01 | 0.03 | 0.9375 | 11 | 1.39 | 1.3 |

| Appendix B. Summary A2S3 and A2S4 Pits ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|---|--------|---------------|------------|-------|-------|------|---------------------|---------------------|------------------------------|-------|-------------|----------|
| Sample Date | ABA ID | Sample Source | Waste Type | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | | | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 11/17/2017 | 145593 | A2S3 | OVB | 7.7 | 0.34 | 0.06 | 0.02 | 0.04 | 1.25 | 28 | 1.52 | 1.9 |
| 11/19/2017 | 145595 | A2S3 | NAG | 8.5 | 0.24 | 0.05 | <0.01 | 0.05 | 1.5625 | 20 | 14.08 | 22 |
| 11/23/2017 | 145597 | A2S3 | OVB | 7.9 | 0.26 | 0.07 | 0.04 | 0.03 | 0.9375 | 30 | 34.13 | 32 |
| 11/24/2017 | 146677 | A2S3 | NAG | 8.3 | <0.05 | 0.02 | 0.01 | 0.01 | 0.3125 | 7 | 25.60 | 8 |
| 11/24/2017 | 146676 | A2S3 | NAG | 8.5 | <0.05 | 0.02 | 0.03 | <0.01 | 0.3125 | 9 | 32.00 | 10 |
| 11/24/2017 | 146678 | A2S3 | NAG | 8.6 | <0.05 | 0.01 | 0.02 | <0.01 | 0.3125 | 8 | 25.60 | 8 |
| 11/25/2017 | 146679 | A2S3 | NAG | 8.4 | 0.11 | 0.07 | 0.02 | 0.05 | 1.5625 | 11 | 8.32 | 13 |
| 11/26/2017 | 145598 | A2S3 | NAG | 8.2 | <0.05 | 0.02 | 0.04 | <0.01 | 0.3125 | 7 | 25.60 | 8 |
| 11/26/2017 | 145599 | A2S3 | NAG | 8.4 | <0.05 | 0.02 | 0.02 | <0.01 | 0.3125 | 8 | 28.80 | 9 |
| 11/26/2017 | 145600 | A2S3 | NAG | 8.3 | <0.05 | 0.01 | 0.01 | <0.01 | 0.3125 | 5 | 16.00 | 5 |
| 12/6/2017 | 146684 | A2S3 | OVB/Waste | 8.4 | 0.29 | 0.01 | <0.01 | 0.01 | 0.3125 | 30 | 96.00 | 30 |
| 12/8/2017 | 146685 | A2S3 | NAG | 8.5 | 0.22 | 0.02 | <0.01 | 0.02 | 0.625 | 22 | 36.80 | 23 |
| 12/10/2017 | 146688 | A2S3 | NAG | 8.8 | 0.56 | 0.12 | <0.01 | 0.12 | 3.75 | 40 | 11.73 | 44 |
| 12/10/2017 | 146689 | A2S3 | CGW | 9.1 | 0.23 | 0.02 | <0.01 | 0.02 | 0.625 | 20 | 33.60 | 21 |
| 12/11/2017 | 146687 | A2S3 | CGW | 8.6 | 0.16 | 0.01 | <0.01 | 0.01 | 0.3125 | 20 | 64.00 | 20 |
| 12/11/2017 | 146686 | A2S3 | NAG | 8.4 | <0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 6 | 19.20 | 6 |
| 12/15/2017 | 146694 | A2S3 | SAT | 9 | 0.56 | 0.4 | <0.01 | 0.4 | 12.5 | 2.96 | 2.00 | 25 |
| 12/15/2017 | 146695 | A2S3 | NAG | 8.3 | 0.61 | 0.01 | <0.01 | 0.01 | 0.3125 | 176 | 176.00 | 55 |
| 12/15/2017 | 146693 | A2S3 | NAG | 8.8 | 0.17 | 0.03 | <0.01 | 0.03 | 0.9375 | 17.07 | 16.00 | 15 |
| 12/17/2017 | 146700 | A2S3 | NAG | 8.6 | 0.07 | 0.01 | <0.01 | 0.01 | 0.3125 | 12 | 38.40 | 12 |
| 12/17/2017 | 146699 | A2S3 | CGW | 8.6 | <0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 9 | 28.80 | 9 |
| 12/17/2017 | 146698 | A2S3 | NAG | 8.3 | <0.05 | 0.01 | <0.01 | 0.01 | 0.3125 | 6 | 19.20 | 6 |
| 12/21/2017 | 146726 | A2S3 | NAG | 9 | 0.18 | 0.01 | 0.01 | <0.01 | 0.3125 | 67.2 | 67.20 | 21 |
| 12/21/2017 | 146727 | A2S3 | NAG | 8.4 | 0.07 | 0.12 | <0.01 | 0.12 | 3.75 | 2.93 | 1.87 | 7 |
| 12/22/2017 | 146728 | A2S3 | NAG | 8.9 | 0.09 | 0.01 | <0.01 | 0.01 | 0.3125 | 32 | 32.00 | 10 |
| 12/23/2017 | 146730 | A2S3 | NAG | 9 | 0.41 | 0.14 | 0.01 | 0.13 | 4.0625 | 6.63 | 6.15 | 25 |
| 12/23/2017 | 146729 | A2S3 | CGW | 9 | 0.29 | 0.01 | <0.01 | 0.01 | 0.3125 | 76.8 | 76.80 | 24 |

| Appendix B. Summary A2S3 and A2S4 Pits ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|---|--------|---------------|------------|-------|------|-------|---------------------|---------------------|------------------------------|-------|-------------|----------|
| Sample Date | ABA ID | Sample Source | Waste Type | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | | | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 12/24/2017 | 146731 | A2S3 | NAG | 8.5 | 0.05 | 0.06 | <0.01 | 0.06 | 1.875 | 4.27 | 3.20 | 6 |
| 12/26/2017 | 146732 | A2S3 | CGW | 8.9 | 0.65 | <0.01 | 0.01 | <0.01 | 0.3125 | 262.4 | 131.20 | 41 |
| 12/26/2017 | 146733 | A2S3 | NAG | 8.8 | 0.62 | 0.06 | <0.01 | 0.06 | 1.875 | 24.53 | 23.47 | 44 |
| 12/28/2017 | 146735 | A2S3 | NAG | 8.9 | 0.49 | 0.24 | <0.01 | 0.24 | 7.5 | 4.27 | 3.33 | 25 |
| 12/28/2017 | 146734 | A2S3 | CGW | 9 | 0.27 | 0.1 | <0.01 | 0.1 | 3.125 | 7.36 | 6.40 | 20 |
| 12/30/2017 | 146736 | A2S3 | NAG | 9.1 | 0.19 | 0.02 | <0.01 | 0.02 | 0.625 | 33.6 | 32.00 | 20 |

| Appendix B. Summary Minto East and Area 2 Underground ABA Analysis Results from ALS Mineral for 2017 | | | | | | | | | | | | |
|--|--------|--------|-------|-------|------|------|---------------------|---------------------|------------------------------|-----|-------------|----------|
| Sample Date | ABA ID | Sample | Waste | Paste | TIC | S(T) | S(SO ₄) | S(S ²⁻) | AP | Net | NP:AP Ratio | NP |
| | | Source | Type | pH | % | % | % | % | CaCO ₃ kg / tonne | NP | (NP/AP) | Modified |
| 8/12/2017 | 128565 | SAT | A2 UG | 9.1 | 0.21 | 0.24 | 0.01 | 0.23 | 7.1875 | 12 | 2.643478 | 19 |
| 8/12/2017 | 128564 | SAT | A2 UG | 9.1 | 0.2 | 0.23 | 0.01 | 0.22 | 6.875 | 12 | 2.763636 | 19 |
| 8/12/2017 | 128563 | SAT | A2 UG | 8.7 | 0.2 | 0.29 | 0.03 | 0.26 | 8.125 | 10 | 2.338462 | 19 |
| 8/12/2017 | 128562 | SAT | A2 UG | 8.8 | 0.2 | 0.26 | 0.05 | 0.21 | 6.5625 | 12 | 3.047619 | 20 |
| 8/12/2017 | 128561 | SAT | A2 UG | 9.1 | 0.16 | 0.2 | 0.03 | 0.17 | 5.3125 | 11 | 3.2 | 17 |
| 8/12/2017 | 128560 | SAT | A2 UG | 9.1 | 0.21 | 0.33 | 0.03 | 0.3 | 9.375 | 9 | 2.026667 | 19 |
| 8/12/2017 | 128569 | SAT | ME UG | 9.1 | 0.18 | 0.26 | <0.01 | 0.26 | 8.125 | 11 | 2.338462 | 19 |
| 8/12/2017 | 128568 | SAT | ME UG | 9.1 | 0.18 | 0.24 | 0.01 | 0.23 | 7.1875 | 12 | 2.643478 | 19 |
| 8/12/2017 | 128567 | SAT | ME UG | 9 | 0.23 | 0.27 | 0.02 | 0.25 | 7.8125 | 14 | 2.816 | 22 |
| 8/12/2017 | 128566 | SAT | ME UG | 9 | 0.2 | 0.29 | 0.03 | 0.26 | 8.125 | 11 | 2.461538 | 20 |
| 11/7/2017 | 144599 | SAT | ME UG | 8.8 | 0.42 | 0.34 | <0.01 | 0.34 | 10.625 | 24 | 3.294118 | 35 |
| 11/7/2017 | 144598 | SAT | ME UG | 8.8 | 0.34 | 0.35 | 0.01 | 0.34 | 10.625 | 18 | 2.729412 | 29 |
| 11/7/2017 | 144849 | SAT | ME UG | 8 | 0.27 | 1.38 | 0.33 | 1.05 | 32.8125 | -21 | 0.670476 | 22 |
| 11/7/2017 | 144848 | SAT | ME UG | 8.8 | 0.25 | 0.65 | 0.02 | 0.63 | 19.6875 | 0 | 1.015873 | 20 |
| 11/7/2017 | 144850 | SAT | ME UG | 8.8 | 0.3 | 0.42 | <0.01 | 0.42 | 13.125 | 12 | 1.904762 | 25 |
| 11/7/2017 | 144250 | SAT | ME UG | 8.7 | 0.38 | 0.74 | <0.01 | 0.74 | 23.125 | 7 | 1.297297 | 30 |
| 11/7/2017 | 144249 | SAT | ME UG | 8.5 | 0.26 | 0.16 | <0.01 | 0.16 | 5 | 18 | 4.6 | 23 |
| 11/7/2017 | 144248 | SAT | ME UG | 8.2 | 0.28 | 0.67 | 0.01 | 0.66 | 20.625 | 1 | 1.066667 | 22 |
| 11/7/2017 | 144600 | SAT | ME UG | 8.4 | 0.52 | 0.31 | 0.01 | 0.3 | 9.375 | 38 | 5.12 | 48 |

Appendix C: ALS Minerals Raw Lab Results



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-FEB-17
Report Date: 24-MAR-17 16:21 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1895090
Project P.O. #: 220826
Job Reference:
C of C Numbers: 15-13
Legal Site Desc:

Comments: Mar 24 2017: Please note, the results from ALS Minerals division can be found at the end of this attachment.

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1895090-1 TAILS 01-OCT-16 TAILS OCT 2016 | L1895090-2 TAILS 15-JAN-17 ABA FT THICKENER U/F DEC 5 2016 | L1895090-3 TAILS 15-JAN-17 ABA FT THICKENER U/F DEC 26 2016 | L1895090-4 TAILS 15-JAN-17 ABA FT THICKENER U/F DEC 19 2016 | L1895090-5 TAILS 15-JAN-17 ABA FT NOV 2016 |
|---|--|---|--|--|---|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.2 | 7.9 | 7.9 | 8.1 | 8.0 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.19 | 0.14 | 0.13 | 0.13 | 0.13 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 1.9 | 3.8 | 5.3 | 2.5 | 3.8 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 15 | 16 | 15 | 15 | 15 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 13 | 12 | 10 | 13 | 11 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 8.00 | 4.27 | 2.82 | 6.00 | 4.00 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | 0.01 | 0.04 | 0.08 | 0.03 | 0.06 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | 0.01 | 0.02 | 0.07 | <0.01 | 0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | 0.05 | 0.08 | 0.09 | 0.05 | 0.06 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.06 | 0.12 | 0.17 | 0.08 | 0.12 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 0.90 | 1.25 | 1.10 | 0.99 | 1.12 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.05 | 0.05 | 0.06 | <0.05 | 0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 1.4 | 1.4 | 1.0 | 0.8 | 1.3 |
| | Barium (Ba) (ppm) | | | | |
| | 110 | 230 | 230 | 140 | 230 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.21 | 0.26 | 0.20 | 0.17 | 0.21 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.32 | 0.37 | 0.27 | 0.25 | 0.26 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.33 | 0.26 | 0.27 | 0.27 | 0.27 |
| | Calcium (Ca) (%) | | | | |
| | 0.61 | 0.76 | 0.76 | 0.65 | 0.71 |
| | Cerium (Ce) (ppm) | | | | |
| | 7.70 | 13.70 | 13.45 | 10.65 | 12.80 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.27 | 0.45 | 0.38 | 0.28 | 0.38 |
| | Chromium (Cr) (ppm) | | | | |
| | 6 | 6 | 6 | 6 | 6 |
| | Cobalt (Co) (ppm) | | | | |
| | 6.9 | 7.3 | 7.6 | 6.3 | 7.3 |
| | Copper (Cu) (ppm) | | | | |
| | 1095 | 2020 | 1840 | 1090 | 1800 |
| | Gallium (Ga) (ppm) | | | | |
| | 8.78 | 8.45 | 7.99 | 7.83 | 7.63 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.06 | 0.07 | 0.07 | 0.05 | 0.06 |
| | Gold (Au) (ppm) | | | | |
| | 1.1 | 0.6 | 0.2 | 0.3 | 0.3 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.03 | 0.05 | 0.05 | 0.04 | 0.05 |
| | Indium (In) (ppm) | | | | |
| | 0.086 | 0.083 | 0.071 | 0.070 | 0.071 |
| | Iron (Fe) (%) | | | | |
| | 5.00 | 4.08 | 4.43 | 4.18 | 4.04 |
| | Lanthanum (La) (ppm) | | | | |
| | 4.1 | 6.9 | 7.1 | 5.5 | 6.7 |
| | Lead (Pb) (ppm) | | | | |
| | 4.5 | 4.6 | 3.9 | 3.5 | 3.4 |
| | Lithium (Li) (ppm) | | | | |
| | 4.6 | 6.0 | 4.9 | 4.5 | 4.9 |
| | Magnesium (Mg) (%) | | | | |
| | 0.46 | 0.65 | 0.59 | 0.50 | 0.58 |
| | Manganese (Mn) (ppm) | | | | |
| | 621 | 627 | 602 | 550 | 602 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1895090-6 WASTE 29-JAN-17 133626 | L1895090-7 WASTE 29-JAN-17 133627 | L1895090-8 WASTE 29-JAN-17 133628 | L1895090-9 WASTE 29-JAN-17 133629 | L1895090-10 WASTE 18-FEB-17 133630 |
|-----------------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.3 | 8.6 | 8.3 | 8.2 | 8.0 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.33 | 0.15 | 0.18 | 0.20 | 0.15 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.9 | <0.3 | 0.6 | 0.6 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 34 | 21 | 23 | 23 | 20 |
| | NNP (tCaCO3/1Kt) | 33 | 21 | 22 | 22 | 20 |
| | Ratio (NP/MPA) (Unity) | 36.27 | 134.40 | 36.80 | 36.80 | 64.00 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | <0.01 | 0.02 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | 0.01 | 0.02 | 0.02 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.02 | <0.01 | <0.01 | 0.02 | 0.01 |
| | Total Sulfur (combustion) (%) | 0.03 | <0.01 | 0.02 | 0.02 | 0.01 |
| Total Metals | Aluminum (Al) (%) | 0.71 | 1.01 | 1.25 | 1.12 | 1.08 |
| | Antimony (Sb) (ppm) | 0.09 | 0.06 | 0.35 | 0.61 | 0.41 |
| | Arsenic (As) (ppm) | 4.8 | 1.7 | 4.2 | 6.1 | 6.7 |
| | Barium (Ba) (ppm) | 650 | 310 | 300 | 320 | 360 |
| | Beryllium (Be) (ppm) | 0.44 | 0.33 | 0.38 | 0.44 | 0.50 |
| | Bismuth (Bi) (ppm) | 3.16 | 0.06 | 0.08 | 0.10 | 0.11 |
| | Boron (B) (ppm) | 10 | <10 | <10 | <10 | 10 |
| | Cadmium (Cd) (ppm) | 0.45 | 0.07 | 0.17 | 0.24 | 0.21 |
| | Calcium (Ca) (%) | 1.29 | 0.90 | 1.16 | 1.20 | 0.96 |
| | Cerium (Ce) (ppm) | 13.75 | 20.4 | 25.3 | 26.9 | 22.2 |
| | Cesium (Cs) (ppm) | 0.66 | 0.36 | 0.59 | 0.81 | 0.75 |
| | Chromium (Cr) (ppm) | 4 | 5 | 17 | 25 | 18 |
| | Cobalt (Co) (ppm) | 9.7 | 5.8 | 7.0 | 8.1 | 8.0 |
| | Copper (Cu) (ppm) | 8380 | 1640 | 210 | 66.2 | 389 |
| | Gallium (Ga) (ppm) | 5.79 | 5.26 | 4.81 | 3.87 | 4.90 |
| | Germanium (Ge) (ppm) | 0.09 | 0.06 | 0.06 | 0.06 | 0.06 |
| | Gold (Au) (ppm) | 0.3 | <0.2 | <0.2 | <0.2 | <0.2 |
| | Hafnium (Hf) (ppm) | 0.04 | 0.07 | 0.16 | 0.23 | 0.14 |
| | Indium (In) (ppm) | 0.131 | 0.040 | 0.022 | 0.022 | 0.038 |
| | Iron (Fe) (%) | 4.34 | 2.34 | 2.19 | 2.24 | 2.54 |
| | Lanthanum (La) (ppm) | 7.8 | 10.0 | 12.8 | 13.4 | 11.4 |
| | Lead (Pb) (ppm) | 4.5 | 2.1 | 4.6 | 5.8 | 5.3 |
| | Lithium (Li) (ppm) | 4.5 | 5.7 | 6.5 | 7.8 | 6.7 |
| | Magnesium (Mg) (%) | 0.24 | 0.48 | 0.52 | 0.53 | 0.40 |
| | Manganese (Mn) (ppm) | 644 | 530 | 475 | 458 | 520 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1895090-11 | L1895090-12 | | |
|-----------------------------------|--|--------------|-------------|-------------|--|--|
| | | Description | WASTE | WASTE | | |
| | | Sampled Date | 18-FEB-17 | 18-FEB-17 | | |
| | | Sampled Time | | | | |
| | | Client ID | 133631 | 133632 | | |
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | | 8.3 | 7.9 | | |
| Organic / Inorganic Carbon | Carbon (C) (%) | | 0.23 | 0.17 | | |
| Acid Base Accounting | FIZZ RATING (Unity) | | 2 | 2 | | |
| | MPA (tCaCO3/1Kt) | | 0.6 | 0.6 | | |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | 27 | 19 | | |
| | NNP (tCaCO3/1Kt) | | 26 | 18 | | |
| | Ratio (NP/MPA) (Unity) | | 43.20 | 30.40 | | |
| | Sulfate Sulfur (carbonate leach) (%) | | 0.01 | 0.02 | | |
| | Sulfate Sulfur (HCl leach) (%) | | 0.02 | 0.01 | | |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | 0.01 | <0.01 | | |
| | Total Sulfur (combustion) (%) | | 0.02 | 0.02 | | |
| Total Metals | Aluminum (Al) (%) | | 1.02 | 1.37 | | |
| | Antimony (Sb) (ppm) | | 0.58 | 0.61 | | |
| | Arsenic (As) (ppm) | | 6.7 | 6.3 | | |
| | Barium (Ba) (ppm) | | 300 | 360 | | |
| | Beryllium (Be) (ppm) | | 0.39 | 0.56 | | |
| | Bismuth (Bi) (ppm) | | 0.08 | 0.11 | | |
| | Boron (B) (ppm) | | <10 | <10 | | |
| | Cadmium (Cd) (ppm) | | 0.20 | 0.26 | | |
| | Calcium (Ca) (%) | | 1.27 | 1.01 | | |
| | Cerium (Ce) (ppm) | | 23.9 | 27.3 | | |
| | Cesium (Cs) (ppm) | | 0.68 | 1.07 | | |
| | Chromium (Cr) (ppm) | | 22 | 27 | | |
| | Cobalt (Co) (ppm) | | 7.4 | 9.3 | | |
| | Copper (Cu) (ppm) | | 36.6 | 229 | | |
| | Gallium (Ga) (ppm) | | 3.51 | 5.84 | | |
| | Germanium (Ge) (ppm) | | 0.05 | 0.18 | | |
| | Gold (Au) (ppm) | | <0.2 | <0.2 | | |
| | Hafnium (Hf) (ppm) | | 0.21 | 0.65 | | |
| | Indium (In) (ppm) | | 0.019 | 0.027 | | |
| | Iron (Fe) (%) | | 2.20 | 2.52 | | |
| | Lanthanum (La) (ppm) | | 12.2 | 13.5 | | |
| | Lead (Pb) (ppm) | | 6.1 | 6.3 | | |
| | Lithium (Li) (ppm) | | 6.7 | 9.4 | | |
| | Magnesium (Mg) (%) | | 0.50 | 0.55 | | |
| | Manganese (Mn) (ppm) | | 490 | 484 | | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1895090-1 | L1895090-2 | L1895090-3 | L1895090-4 | L1895090-5 |
|------------------------|--------------------------|--------------|----------------|---------------------------------|----------------------------------|----------------------------------|-----------------|
| | | Description | TAILS | TAILS | TAILS | TAILS | TAILS |
| | | Sampled Date | 01-OCT-16 | 15-JAN-17 | 15-JAN-17 | 15-JAN-17 | 15-JAN-17 |
| | | Sampled Time | | | | | |
| | | Client ID | TAILS OCT 2016 | ABA FT THICKENER U/F DEC 5 2016 | ABA FT THICKENER U/F DEC 26 2016 | ABA FT THICKENER U/F DEC 19 2016 | ABA FT NOV 2016 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| | Molybdenum (Mo) (ppm) | | 0.55 | 1.78 | 1.27 | 0.66 | 1.39 |
| | Nickel (Ni) (ppm) | | 3.0 | 2.9 | 2.9 | 2.8 | 3.0 |
| | Niobium (Nb) (ppm) | | 0.14 | 0.20 | 0.24 | 0.25 | 0.28 |
| | Phosphorus (P) (ppm) | | 360 | 640 | 600 | 470 | 590 |
| | Potassium (K) (%) | | 0.36 | 0.61 | 0.56 | 0.43 | 0.55 |
| | Rhenium (Re) (ppm) | | <0.001 | 0.002 | 0.001 | 0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | | 18.0 | 32.0 | 27.6 | 21.4 | 26.4 |
| | Scandium (Sc) (ppm) | | 2.4 | 3.8 | 3.3 | 2.6 | 3.3 |
| | Selenium (Se) (ppm) | | 1.2 | 1.6 | 1.6 | 1.2 | 1.6 |
| | Silver (Ag) (ppm) | | 1.08 | 0.93 | 0.86 | 0.80 | 0.84 |
| | Sodium (Na) (%) | | 0.05 | 0.06 | 0.06 | 0.07 | 0.07 |
| | Strontium (Sr) (ppm) | | 50.0 | 65.6 | 66.6 | 55.9 | 60.2 |
| | Sulfur (S) (%) | | 0.06 | 0.13 | 0.18 | 0.09 | 0.13 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.27 | 0.29 | 0.22 | 0.20 | 0.24 |
| | Thallium (Tl) (ppm) | | 0.12 | 0.22 | 0.17 | 0.15 | 0.17 |
| | Thorium (Th) (ppm) | | 2.9 | 3.4 | 2.8 | 3.2 | 2.9 |
| | Tin (Sn) (ppm) | | 0.6 | 0.9 | 0.8 | 0.6 | 0.8 |
| | Titanium (Ti) (%) | | 0.068 | 0.115 | 0.112 | 0.083 | 0.106 |
| | Tungsten (W) (ppm) | | 0.06 | 0.06 | 0.08 | 0.07 | 0.08 |
| | Uranium (U) (ppm) | | 0.22 | 0.31 | 0.31 | 0.23 | 0.32 |
| | Vanadium (V) (ppm) | | 77 | 74 | 77 | 68 | 71 |
| | Yttrium (Y) (ppm) | | 2.39 | 4.81 | 4.39 | 3.18 | 4.34 |
| | Zinc (Zn) (ppm) | | 129 | 120 | 111 | 110 | 109 |
| | Zirconium (Zr) (ppm) | | 0.9 | 1.2 | 1.0 | 0.9 | 1.1 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.7 | 0.5 | 0.5 | 0.5 | 0.5 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1895090-6 | L1895090-7 | L1895090-8 | L1895090-9 | L1895090-10 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|-------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 29-JAN-17 | 29-JAN-17 | 29-JAN-17 | 29-JAN-17 | 18-FEB-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 133626 | 133627 | 133628 | 133629 | 133630 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.01 | 0.01 | 0.02 | 0.04 | 0.02 |
| | Molybdenum (Mo) (ppm) | | 1.04 | 0.48 | 1.15 | 1.29 | 1.41 |
| | Nickel (Ni) (ppm) | | 2.9 | 2.9 | 12.8 | 21.7 | 16.7 |
| | Niobium (Nb) (ppm) | | 0.10 | 0.25 | 0.40 | 0.37 | 0.43 |
| | Phosphorus (P) (ppm) | | 720 | 660 | 780 | 860 | 720 |
| | Potassium (K) (%) | | 0.40 | 0.41 | 0.30 | 0.18 | 0.26 |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | 0.001 | 0.001 | <0.001 |
| | Rubidium (Rb) (ppm) | | 19.8 | 19.3 | 14.8 | 9.9 | 14.3 |
| | Scandium (Sc) (ppm) | | 3.1 | 4.2 | 4.3 | 4.2 | 5.3 |
| | Selenium (Se) (ppm) | | 4.6 | 0.9 | 0.8 | 0.9 | 0.6 |
| | Silver (Ag) (ppm) | | 6.80 | 0.30 | 0.13 | 0.11 | 0.12 |
| | Sodium (Na) (%) | | 0.04 | 0.09 | 0.08 | 0.06 | 0.05 |
| | Strontium (Sr) (ppm) | | 37.8 | 47.6 | 70.1 | 55.7 | 48.6 |
| | Sulfur (S) (%) | | 0.03 | 0.01 | 0.03 | 0.02 | 0.01 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 1.02 | 0.07 | 0.01 | 0.02 | 0.05 |
| | Thallium (Tl) (ppm) | | 0.10 | 0.11 | 0.11 | 0.11 | 0.12 |
| | Thorium (Th) (ppm) | | 2.9 | 2.0 | 3.2 | 3.5 | 2.8 |
| | Tin (Sn) (ppm) | | 0.9 | 0.6 | 0.5 | 0.4 | 0.6 |
| | Titanium (Ti) (%) | | 0.056 | 0.081 | 0.091 | 0.078 | 0.067 |
| | Tungsten (W) (ppm) | | 0.30 | 0.44 | 0.16 | 0.19 | 0.32 |
| | Uranium (U) (ppm) | | 0.28 | 0.21 | 0.51 | 0.62 | 0.39 |
| | Vanadium (V) (ppm) | | 98 | 46 | 47 | 47 | 56 |
| | Yttrium (Y) (ppm) | | 5.13 | 9.67 | 8.77 | 9.65 | 10.00 |
| | Zinc (Zn) (ppm) | | 103 | 65 | 58 | 57 | 65 |
| | Zirconium (Zr) (ppm) | | 1.3 | 1.2 | 5.6 | 8.1 | 5.6 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 1.2 | 0.6 | 0.7 | 0.7 | 0.6 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1895090-11 | L1895090-12 | | | |
|------------------------|--------------------------|--------------|-------------|-------------|--|--|--|
| | | Description | WASTE | WASTE | | | |
| | | Sampled Date | 18-FEB-17 | 18-FEB-17 | | | |
| | | Sampled Time | | | | | |
| | | Client ID | 133631 | 133632 | | | |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.03 | 0.04 | | | |
| | Molybdenum (Mo) (ppm) | | 1.14 | 1.52 | | | |
| | Nickel (Ni) (ppm) | | 18.6 | 23.1 | | | |
| | Niobium (Nb) (ppm) | | 0.28 | 1.66 | | | |
| | Phosphorus (P) (ppm) | | 830 | 770 | | | |
| | Potassium (K) (%) | | 0.17 | 0.25 | | | |
| | Rhenium (Re) (ppm) | | 0.001 | 0.001 | | | |
| | Rubidium (Rb) (ppm) | | 9.2 | 19.6 | | | |
| | Scandium (Sc) (ppm) | | 4.0 | 7.3 | | | |
| | Selenium (Se) (ppm) | | 0.6 | 0.7 | | | |
| | Silver (Ag) (ppm) | | 0.08 | 0.16 | | | |
| | Sodium (Na) (%) | | 0.07 | 0.07 | | | |
| | Strontium (Sr) (ppm) | | 61.5 | 65.4 | | | |
| | Sulfur (S) (%) | | 0.02 | 0.02 | | | |
| | Tantalum (Ta) (ppm) | | <0.01 | 0.09 | | | |
| | Tellurium (Te) (ppm) | | 0.01 | 0.02 | | | |
| | Thallium (Tl) (ppm) | | 0.10 | 0.16 | | | |
| | Thorium (Th) (ppm) | | 3.2 | 3.6 | | | |
| | Tin (Sn) (ppm) | | 0.4 | 0.6 | | | |
| | Titanium (Ti) (%) | | 0.078 | 0.078 | | | |
| | Tungsten (W) (ppm) | | 0.25 | 0.31 | | | |
| | Uranium (U) (ppm) | | 0.61 | 0.66 | | | |
| | Vanadium (V) (ppm) | | 45 | 55 | | | |
| | Yttrium (Y) (ppm) | | 8.83 | 9.95 | | | |
| | Zinc (Zn) (ppm) | | 51 | 64 | | | |
| | Zirconium (Zr) (ppm) | | 7.3 | 10.1 | | | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.9 | 0.6 | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|-----------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| <p>A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.</p> | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06-AX | Soil | Sulfide Sulfur Calc from Carbonate Leach | ALS Minerals S-CAL06 |
| <p>Sulfide Sulfur (as S) is calculated by subtracting the Carbonate Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.</p> | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| <p>A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| <p>A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| <p>The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

15-13

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 1
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 23-MAR-2017
 Account: APN

CERTIFICATE VA17039951

Project: L1895090
 P.O. No.: ALSM-CW16-102-APN
 This report is for 12 Other samples submitted to our lab in Vancouver, BC, Canada on 2-MAR-2017.
 The following have access to data associated with this certificate:

| | | |
|--------------------------|----------------------------|-------------|
| ELSE VANCOUVER WEBTRIEVE | SOFTWARE DEVELOPMENT GROUP | SHANE STACK |
|--------------------------|----------------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| SPL-21 | Split sample - riffle splitter |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: ALS ENVIRONMENTAL
 ATTN: SHANE STACK
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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To: ALS ENVIRONMENTAL
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Page: 2 - A
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 23-MAR-2017
 Account: APN

Project: L1895090

CERTIFICATE OF ANALYSIS VA17039951

| Sample Description | Method Analyte Units LOR | WEI-21 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | OA-VOL08m | S-IR08 | S-GRA06 | S-GRA06a | S-CAL06 | C-GAS05 | C-GAS05 | ME-MS41 | ME-MS41 |
|--|--------------------------|--------------|----------------|----------------|----------------|---------------|----------|-----------------|--------|---------|----------|---------|---------|---------|---------|---------|
| | | Recvd Wt. kg | MPA tCaCO3/1Kt | FIZZ RAT Unity | NNP tCaCO3/1Kt | NP tCaCO3/1Kt | pH Unity | Ratio (N) Unity | S % | S % | S % | S % | C % | CO2 % | Ag ppm | Al % |
| L1895090-1 TAILS OCT 2016 | | 1.36 | 1.9 | 2 | 13 | 15 | 8.2 | 8.00 | 0.06 | 0.01 | 0.01 | 0.05 | 0.19 | 0.7 | 1.08 | 0.90 |
| L1895090-2 ABA FT THICKENER U/F DEC 5/16 | | 0.58 | 3.8 | 2 | 12 | 16 | 7.9 | 4.27 | 0.12 | 0.04 | 0.02 | 0.08 | 0.14 | 0.5 | 0.93 | 1.25 |
| L1895090-3 ABA FT THICKENER U/F DEC 26 | | 0.70 | 5.3 | 2 | 10 | 15 | 7.9 | 2.82 | 0.17 | 0.08 | 0.07 | 0.09 | 0.13 | 0.5 | 0.86 | 1.10 |
| L1895090-4 ABA FT THICKENER U/F DEC 19 | | 0.56 | 2.5 | 2 | 13 | 15 | 8.1 | 6.00 | 0.08 | 0.03 | <0.01 | 0.05 | 0.13 | 0.5 | 0.80 | 0.99 |
| L1895090-5 ABA FT NOV 2016 | | 1.04 | 3.8 | 2 | 11 | 15 | 8.0 | 4.00 | 0.12 | 0.06 | 0.01 | 0.06 | 0.13 | 0.5 | 0.84 | 1.12 |
| L1895090-6 133626 | | 1.08 | 0.9 | 2 | 33 | 34 | 8.3 | 36.27 | 0.03 | 0.01 | 0.01 | 0.02 | 0.33 | 1.2 | 6.80 | 0.71 |
| L1895090-7 133627 | | 1.08 | <0.3 | 2 | 21 | 21 | 8.6 | 134.40 | <0.01 | <0.01 | 0.01 | <0.01 | 0.15 | 0.6 | 0.30 | 1.01 |
| L1895090-8 133628 | | 1.08 | 0.6 | 2 | 22 | 23 | 8.3 | 36.80 | 0.02 | 0.02 | 0.02 | <0.01 | 0.18 | 0.7 | 0.13 | 1.25 |
| L1895090-9 133629 | | 1.08 | 0.6 | 2 | 22 | 23 | 8.2 | 36.80 | 0.02 | <0.01 | 0.02 | 0.02 | 0.20 | 0.7 | 0.11 | 1.12 |
| L1895090-10 133630 | | 1.20 | 0.3 | 2 | 20 | 20 | 8.0 | 64.00 | 0.01 | <0.01 | <0.01 | 0.01 | 0.15 | 0.6 | 0.12 | 1.08 |
| L1895090-11 133631 | | 1.04 | 0.6 | 2 | 26 | 27 | 8.3 | 43.20 | 0.02 | 0.01 | 0.02 | 0.01 | 0.23 | 0.9 | 0.08 | 1.02 |
| L1895090-12 133632 | | 1.06 | 0.6 | 2 | 18 | 19 | 7.9 | 30.40 | 0.02 | 0.02 | 0.01 | <0.01 | 0.17 | 0.6 | 0.16 | 1.37 |

***** See Appendix Page for comments regarding this certificate *****



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 Account: APN

Project: L1895090

CERTIFICATE OF ANALYSIS VA17039951

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga |
| | Units LOR | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| L1895090-1 TAILS OCT 2016 | | 0.1 | 0.2 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 |
| L1895090-2 ABA FT THICKENER U/F DEC 5/16 | | 1.4 | 1.1 | <10 | 110 | 0.21 | 0.32 | 0.61 | 0.33 | 7.70 | 6.9 | 6 | 0.27 | 1095 | 5.00 | 8.78 |
| L1895090-3 ABA FT THICKENER U/F DEC 26 | | 1.4 | 0.6 | <10 | 230 | 0.26 | 0.37 | 0.76 | 0.26 | 13.70 | 7.3 | 6 | 0.45 | 2020 | 4.08 | 8.45 |
| L1895090-4 ABA FT THICKENER U/F DEC 19 | | 1.0 | 0.2 | <10 | 230 | 0.20 | 0.27 | 0.76 | 0.27 | 13.45 | 7.6 | 6 | 0.38 | 1840 | 4.43 | 7.99 |
| L1895090-5 ABA FT NOV 2016 | | 0.8 | 0.3 | <10 | 140 | 0.17 | 0.25 | 0.65 | 0.27 | 10.65 | 6.3 | 6 | 0.28 | 1090 | 4.18 | 7.83 |
| L1895090-6 133626 | | 1.3 | 0.3 | <10 | 230 | 0.21 | 0.26 | 0.71 | 0.27 | 12.80 | 7.3 | 6 | 0.38 | 1800 | 4.04 | 7.63 |
| L1895090-7 133627 | | 4.8 | 0.3 | 10 | 650 | 0.44 | 3.16 | 1.29 | 0.45 | 13.75 | 9.7 | 4 | 0.66 | 8380 | 4.34 | 5.79 |
| L1895090-8 133628 | | 1.7 | <0.2 | <10 | 310 | 0.33 | 0.06 | 0.90 | 0.07 | 20.4 | 5.8 | 5 | 0.36 | 1640 | 2.34 | 5.26 |
| L1895090-9 133629 | | 4.2 | <0.2 | <10 | 300 | 0.38 | 0.08 | 1.16 | 0.17 | 25.3 | 7.0 | 17 | 0.59 | 210 | 2.19 | 4.81 |
| L1895090-10 133630 | | 6.1 | <0.2 | <10 | 320 | 0.44 | 0.10 | 1.20 | 0.24 | 26.9 | 8.1 | 25 | 0.81 | 66.2 | 2.24 | 3.87 |
| L1895090-11 133631 | | 6.7 | <0.2 | 10 | 360 | 0.50 | 0.11 | 0.96 | 0.21 | 22.2 | 8.0 | 18 | 0.75 | 389 | 2.54 | 4.90 |
| L1895090-12 133632 | | 6.7 | <0.2 | <10 | 300 | 0.39 | 0.08 | 1.27 | 0.20 | 23.9 | 7.4 | 22 | 0.68 | 36.6 | 2.20 | 3.51 |
| | | 6.3 | <0.2 | <10 | 360 | 0.56 | 0.11 | 1.01 | 0.26 | 27.3 | 9.3 | 27 | 1.07 | 229 | 2.52 | 5.84 |



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CERTIFICATE OF ANALYSIS VA17039951

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P | Pb |
| Units | | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm | ppm |
| LOR | | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 |
| L1895090-1 TAILS OCT 2016 | | 0.06 | 0.03 | <0.01 | 0.086 | 0.36 | 4.1 | 4.6 | 0.46 | 621 | 0.55 | 0.05 | 0.14 | 3.0 | 360 | 4.5 |
| L1895090-2 ABA FT THICKENER U/F DEC 5/16 | | 0.07 | 0.05 | 0.01 | 0.083 | 0.61 | 6.9 | 6.0 | 0.65 | 627 | 1.78 | 0.06 | 0.20 | 2.9 | 640 | 4.6 |
| L1895090-3 ABA FT THICKENER U/F DEC 26 | | 0.07 | 0.05 | 0.01 | 0.071 | 0.56 | 7.1 | 4.9 | 0.59 | 602 | 1.27 | 0.06 | 0.24 | 2.9 | 600 | 3.9 |
| L1895090-4 ABA FT THICKENER U/F DEC 19 | | 0.05 | 0.04 | 0.01 | 0.070 | 0.43 | 5.5 | 4.5 | 0.50 | 550 | 0.66 | 0.07 | 0.25 | 2.8 | 470 | 3.5 |
| L1895090-5 ABA FT NOV 2016 | | 0.06 | 0.05 | 0.02 | 0.071 | 0.55 | 6.7 | 4.9 | 0.58 | 602 | 1.39 | 0.07 | 0.28 | 3.0 | 590 | 3.4 |
| L1895090-6 133626 | | 0.09 | 0.04 | 0.01 | 0.131 | 0.40 | 7.8 | 4.5 | 0.24 | 644 | 1.04 | 0.04 | 0.10 | 2.9 | 720 | 4.5 |
| L1895090-7 133627 | | 0.06 | 0.07 | 0.01 | 0.040 | 0.41 | 10.0 | 5.7 | 0.48 | 530 | 0.48 | 0.09 | 0.25 | 2.9 | 660 | 2.1 |
| L1895090-8 133628 | | 0.06 | 0.16 | 0.02 | 0.022 | 0.30 | 12.8 | 6.5 | 0.52 | 475 | 1.15 | 0.08 | 0.40 | 12.8 | 780 | 4.6 |
| L1895090-9 133629 | | 0.06 | 0.23 | 0.04 | 0.022 | 0.18 | 13.4 | 7.8 | 0.53 | 458 | 1.29 | 0.06 | 0.37 | 21.7 | 860 | 5.8 |
| L1895090-10 133630 | | 0.06 | 0.14 | 0.02 | 0.038 | 0.26 | 11.4 | 6.7 | 0.40 | 520 | 1.41 | 0.05 | 0.43 | 16.7 | 720 | 5.3 |
| L1895090-11 133631 | | 0.05 | 0.21 | 0.03 | 0.019 | 0.17 | 12.2 | 6.7 | 0.50 | 490 | 1.14 | 0.07 | 0.28 | 18.6 | 830 | 6.1 |
| L1895090-12 133632 | | 0.18 | 0.65 | 0.04 | 0.027 | 0.25 | 13.5 | 9.4 | 0.55 | 484 | 1.52 | 0.07 | 1.66 | 23.1 | 770 | 6.3 |

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CERTIFICATE OF ANALYSIS VA17039951

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U | V |
| | Units | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm |
| | LOR | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 |
| L1895090-1 TAILS OCT 2016 | | 18.0 | <0.001 | 0.06 | 0.05 | 2.4 | 1.2 | 0.6 | 50.0 | <0.01 | 0.27 | 2.9 | 0.068 | 0.12 | 0.22 | 77 |
| L1895090-2 ABA FT THICKENER U/F DEC 5/16 | | 32.0 | 0.002 | 0.13 | 0.05 | 3.8 | 1.6 | 0.9 | 65.6 | <0.01 | 0.29 | 3.4 | 0.115 | 0.22 | 0.31 | 74 |
| L1895090-3 ABA FT THICKENER U/F DEC 26 | | 27.6 | 0.001 | 0.18 | 0.06 | 3.3 | 1.6 | 0.8 | 66.6 | <0.01 | 0.22 | 2.8 | 0.112 | 0.17 | 0.31 | 77 |
| L1895090-4 ABA FT THICKENER U/F DEC 19 | | 21.4 | 0.001 | 0.09 | <0.05 | 2.6 | 1.2 | 0.6 | 55.9 | <0.01 | 0.20 | 3.2 | 0.083 | 0.15 | 0.23 | 68 |
| L1895090-5 ABA FT NOV 2016 | | 26.4 | 0.001 | 0.13 | 0.05 | 3.3 | 1.6 | 0.8 | 60.2 | <0.01 | 0.24 | 2.9 | 0.106 | 0.17 | 0.32 | 71 |
| L1895090-6 133626 | | 19.8 | <0.001 | 0.03 | 0.09 | 3.1 | 4.6 | 0.9 | 37.8 | <0.01 | 1.02 | 2.9 | 0.056 | 0.10 | 0.28 | 98 |
| L1895090-7 133627 | | 19.3 | <0.001 | 0.01 | 0.06 | 4.2 | 0.9 | 0.6 | 47.6 | <0.01 | 0.07 | 2.0 | 0.081 | 0.11 | 0.21 | 46 |
| L1895090-8 133628 | | 14.8 | 0.001 | 0.03 | 0.35 | 4.3 | 0.8 | 0.5 | 70.1 | <0.01 | 0.01 | 3.2 | 0.091 | 0.11 | 0.51 | 47 |
| L1895090-9 133629 | | 9.9 | 0.001 | 0.02 | 0.61 | 4.2 | 0.9 | 0.4 | 55.7 | <0.01 | 0.02 | 3.5 | 0.078 | 0.11 | 0.62 | 47 |
| L1895090-10 133630 | | 14.3 | <0.001 | 0.01 | 0.41 | 5.3 | 0.6 | 0.6 | 48.6 | <0.01 | 0.05 | 2.8 | 0.067 | 0.12 | 0.39 | 56 |
| L1895090-11 133631 | | 9.2 | 0.001 | 0.02 | 0.58 | 4.0 | 0.6 | 0.4 | 61.5 | <0.01 | 0.01 | 3.2 | 0.078 | 0.10 | 0.61 | 45 |
| L1895090-12 133632 | | 19.6 | 0.001 | 0.02 | 0.61 | 7.3 | 0.7 | 0.6 | 65.4 | 0.09 | 0.02 | 3.6 | 0.078 | 0.16 | 0.66 | 55 |

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CERTIFICATE OF ANALYSIS VA17039951

| Sample Description | Method Analyte Units LOR | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|---|-----------------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| L1895090-1 TAILS OCT 2016 | | 0.06 | 2.39 | 129 | 0.9 |
| <small>L1895090-2 ABA FT THICKENER U/F DEC 5/16</small> | | 0.06 | 4.81 | 120 | 1.2 |
| <small>L1895090-3 ABA FT THICKENER U/F DEC 26</small> | | 0.08 | 4.39 | 111 | 1.0 |
| <small>L1895090-4 ABA FT THICKENER U/F DEC 19</small> | | 0.07 | 3.18 | 110 | 0.9 |
| L1895090-5 ABA FT NOV 2016 | | 0.08 | 4.34 | 109 | 1.1 |
| L1895090-6 133626 | | 0.30 | 5.13 | 103 | 1.3 |
| L1895090-7 133627 | | 0.44 | 9.67 | 65 | 1.2 |
| L1895090-8 133628 | | 0.16 | 8.77 | 58 | 5.6 |
| L1895090-9 133629 | | 0.19 | 9.65 | 57 | 8.1 |
| L1895090-10 133630 | | 0.32 | 10.00 | 65 | 5.6 |
| L1895090-11 133631 | | 0.25 | 8.83 | 51 | 7.3 |
| L1895090-12 133632 | | 0.31 | 9.95 | 64 | 10.1 |

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CERTIFICATE OF ANALYSIS VA17039951

CERTIFICATE COMMENTS

| | | | | | | | | | | | | | | | | | |
|--------------------|--|---------|----------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|--|--|
| | ANALYTICAL COMMENTS | | | | | | | | | | | | | | | | |
| Applies to Method: | Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41 | | | | | | | | | | | | | | | | |
| | LABORATORY ADDRESSES | | | | | | | | | | | | | | | | |
| Applies to Method: | <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> <td style="width: 33%;">OA-ELE07</td> </tr> <tr> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> <td>S-CAL06</td> </tr> <tr> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> <td>SPL-21</td> </tr> <tr> <td>WEI-21</td> <td></td> <td></td> <td></td> </tr> </table> | C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | | |
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | | | | | | | | | | | | | | |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | | | | | | | | | | | | | | |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | | | | | | | | | | | | | | |
| WEI-21 | | | | | | | | | | | | | | | | | |



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QC CERTIFICATE VA17039951

Project: L1895090
 P.O. No.: ALSM-CW16-102-APN
 This report is for 12 Other samples submitted to our lab in Vancouver, BC, Canada on 2-MAR-2017.
 The following have access to data associated with this certificate:

| | | |
|--------------------------|----------------------------|-------------|
| ELSE VANCOUVER WEBTRIEVE | SOFTWARE DEVELOPMENT GROUP | SHANE STACK |
|--------------------------|----------------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| SPL-21 | Split sample - riffle splitter |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: ALS ENVIRONMENTAL
 ATTN: SHANE STACK
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17039951

| Method Analyte Units LOR | OA-VOL08m MPA | OA-VOL08m FIZZ RAT | OA-VOL08m NNP | OA-VOL08m NP | OA-ELE07 pH | OA-VOL08m Ratio (N) | S-IR08 S | S-GRA06 S | S-GRA06a S | S-CAL06 S | C-GAS05 C | C-GAS05 CO2 | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As |
|----------------------------|---------------|--------------------|---------------|--------------|-------------|---------------------|----------|-----------|------------|-----------|-----------|-------------|------------|------------|------------|
| Sample Description | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | % | ppm | % | ppm |
| | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | 6.1 | | | | | | | | | | |
| Buffer pH6 | | | | | 6.1 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.3 | | | | | | | | | | |
| Upper Bound | | | | | 6.7 | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | 0.50 | 1.8 | | | |
| Target Range - Lower Bound | | | | | | | | | | | 0.42 | 1.5 | | | |
| Upper Bound | | | | | | | | | | | 0.64 | 2.4 | | | |
| DS-1 | | | | | | | | 2.55 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 2.51 | | | | | | | |
| Upper Bound | | | | | | | | 2.71 | | | | | | | |
| GS310-10 | | | | | | | | 0.27 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.25 | | | | | | | |
| Upper Bound | | | | | | | | 0.29 | | | | | | | |
| KZK-1 | 25.0 | 2 | 31 | 56 | | 2.24 | | | | | | | | | |
| KZK-1 | 25.0 | 2 | 31 | 56 | | 2.24 | | | | | | | | | |
| Target Range - Lower Bound | 22.9 | <1 | 30 | 54 | | 2.18 | | | | | | | | | |
| Upper Bound | 27.1 | >4 | 38 | 64 | | 2.53 | | | | | | | | | |
| MA-3a | | | | | | | | | | | 2.33 | 8.5 | | | |
| Target Range - Lower Bound | | | | | | | | | | | 2.31 | 8.4 | | | |
| Upper Bound | | | | | | | | | | | 2.77 | 10.2 | | | |
| MP-1b | | | | | | | | 14.00 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 13.30 | | | | | | | |
| Upper Bound | | | | | | | | 14.30 | | | | | | | |
| MRGeo08 | | | | | | | | | | | | | 4.39 | 2.59 | 34.2 |
| MRGeo08 | | | | | | | | | | | | | 4.44 | 2.61 | 33.3 |
| Target Range - Lower Bound | | | | | | | | | | | | | 4.00 | 2.44 | 29.6 |
| Upper Bound | | | | | | | | | | | | | 4.92 | 3.00 | 36.4 |
| OREAS 905 | | | | | | | | | | | | | 0.50 | 0.73 | 33.1 |
| OREAS 905 | | | | | | | | | | | | | 0.53 | 0.76 | 32.7 |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.45 | 0.73 | 28.4 |
| Upper Bound | | | | | | | | | | | | | 0.58 | 0.91 | 35.0 |
| SY-4 | | | | | | | | | | | 0.86 | 3.2 | | | |
| SY-4 | | | | | | | | | | | 0.90 | 3.3 | | | |
| Target Range - Lower Bound | | | | | | | | | | | 0.84 | 3.0 | | | |
| Upper Bound | | | | | | | | | | | 1.08 | 4.0 | | | |
| UTS-1 | | | | | | | | 0.88 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.83 | | | | | | | |
| Upper Bound | | | | | | | | 0.93 | | | | | | | |
| UTS-1 | | | | | | | | | 0.87 | | | | | | |



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

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Project: L1895090

QC CERTIFICATE OF ANALYSIS VA17039951

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Au ppm | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % | Ga ppm | Ge ppm | |
| | 0.2 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MP-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | <0.2 | <10 | 440 | 0.81 | 0.68 | 1.06 | 2.21 | 73.2 | 17.8 | 89 | 10.65 | 608 | 3.45 | 9.52 | 0.14 | |
| MRGeo08 | <0.2 | <10 | 440 | 0.79 | 0.68 | 1.07 | 2.23 | 73.6 | 19.0 | 89 | 10.70 | 616 | 3.57 | 9.30 | 0.14 | |
| Target Range - Lower Bound | <0.2 | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 | 3.22 | 8.73 | 0.07 | |
| Upper Bound | 0.4 | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 | 3.96 | 10.80 | 0.29 | |
| OREAS 905 | 0.4 | <10 | 230 | 0.98 | 5.43 | 0.32 | 0.36 | 75.3 | 12.8 | 16 | 1.17 | 1485 | 3.24 | 5.83 | 0.09 | |
| OREAS 905 | 0.4 | <10 | 240 | 0.90 | 5.73 | 0.33 | 0.33 | 79.7 | 13.9 | 18 | 1.16 | 1530 | 3.38 | 6.00 | 0.10 | |
| Target Range - Lower Bound | <0.2 | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 | 3.14 | 5.74 | <0.05 | |
| Upper Bound | 0.8 | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 | 3.86 | 7.12 | 0.22 | |
| SY-4 | | | | | | | | | | | | | | | | |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039951

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | |
| | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MP-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 0.73 | 0.08 | 0.158 | 1.27 | 37.2 | 32.1 | 1.13 | 411 | 14.35 | 0.32 | 0.85 | 680 | 980 | 1045 | 148.0 | |
| MRGeo08 | 0.77 | 0.07 | 0.149 | 1.27 | 36.5 | 34.2 | 1.12 | 413 | 13.60 | 0.33 | 0.97 | 678 | 1000 | 1070 | 140.0 | |
| Target Range - Lower Bound | 0.64 | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 | 900 | 959 | 132.0 | |
| Upper Bound | 0.83 | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 | 1130 | 1175 | 162.0 | |
| OREAS 905 | 1.16 | 0.10 | 0.556 | 0.30 | 38.6 | 4.5 | 0.14 | 332 | 2.95 | 0.08 | 0.25 | 8.5 | 240 | 16.1 | 18.4 | |
| OREAS 905 | 1.12 | 0.02 | 0.569 | 0.31 | 39.3 | 4.5 | 0.14 | 340 | 2.85 | 0.09 | 0.33 | 9.3 | 230 | 15.8 | 18.0 | |
| Target Range - Lower Bound | 1.08 | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 | | 15.2 | 17.3 | |
| Upper Bound | 1.36 | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 | | 19.0 | 21.3 | |
| SY-4 | | | | | | | | | | | | | | | | |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039951

| Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|----------------------------|----------------------|-------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|---------------------|---------------------|---------------------|
| Sample Description | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MP-1b | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 0.008 | 0.30 | 2.99 | 7.2 | 1.3 | 3.3 | 79.1 | 0.01 | 0.02 | 22.1 | 0.373 | 0.84 | 5.41 | 98 | 2.91 |
| MRGeo08 | 0.007 | 0.31 | 3.13 | 7.0 | 1.4 | 3.2 | 78.9 | 0.01 | 0.02 | 20.9 | 0.371 | 0.77 | 5.29 | 99 | 2.87 |
| Target Range - Lower Bound | 0.006 | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 | 4.93 | 90 | 2.44 |
| Upper Bound | 0.010 | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 | 6.13 | 112 | 3.42 |
| OREAS 905 | <0.001 | 0.07 | 0.98 | 1.6 | 2.6 | 1.2 | 12.2 | <0.01 | 0.07 | 8.3 | 0.019 | 0.10 | 2.13 | 5 | 0.66 |
| OREAS 905 | <0.001 | 0.07 | 1.15 | 1.7 | 2.9 | 1.2 | 12.6 | <0.01 | 0.07 | 8.8 | 0.019 | 0.11 | 2.17 | 6 | 0.57 |
| Target Range - Lower Bound | <0.001 | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 | 2.08 | 4 | 0.44 |
| Upper Bound | 0.002 | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 | 2.66 | 8 | 0.76 |
| SY-4 | | | | | | | | | | | | | | | |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17039951

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|--------------------------|--------------------|------------------|--------------------|
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| CO-ASSAY | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS310-10 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-3a | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MP-1b | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MRGeo08 | | 19.80 | 775 | 21.7 |
| MRGeo08 | | 19.50 | 780 | 22.2 |
| Target Range - Lower Bound | | 17.50 | 708 | 18.1 |
| Upper Bound | | 21.5 | 870 | 25.7 |
| OREAS 905 | | 6.64 | 63 | 45.2 |
| OREAS 905 | | 7.24 | 64 | 43.6 |
| Target Range - Lower Bound | | 6.32 | 58 | 39.9 |
| Upper Bound | | 7.84 | 76 | 55.1 |
| SY-4 | | | | |
| SY-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039951

| Method Analyte Units LOR | OA-VOL08m MPA | OA-VOL08m FIZZ RAT | OA-VOL08m NNP | OA-VOL08m NP | OA-ELE07 pH | OA-VOL08m Ratio (N) | S-IR08 S | S-GRA06 S | S-GRA06a S | S-CAL06 S | C-GAS05 C | C-GAS05 CO2 | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As | |
|----------------------------|---------------|--------------------|---------------|--------------|-------------|---------------------|----------|-----------|------------|-----------|-----------|-------------|------------|------------|------------|--|
| Sample Description | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | % | ppm | % | ppm | |
| | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | 1.76 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.64 | | | | | | | | |
| Upper Bound | | | | | | | | 1.84 | | | | | | | | |
| UTS-4 | | | | | | | | | | 1.74 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 1.61 | | | | | | |
| Upper Bound | | | | | | | | | | 1.87 | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | <0.05 | <0.2 | | | | |
| BLANK | | | | | | | | | | | <0.05 | <0.2 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | <0.05 | <0.2 | | | | |
| Upper Bound | | | | | | | | | | | 0.10 | 0.4 | | | | |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | 0.1 | |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | |
| Upper Bound | | | | | | | | | | | | | 0.02 | 0.02 | 0.2 | |
| BLANK | | | | | 6.1 | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.5 | | | | | | | | | | | |
| Upper Bound | | | | | 6.9 | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Au ppm | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % | Ga ppm | Ge ppm | |
| | 0.2 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | <0.2 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | 0.2 | <0.01 | <0.05 | <0.05 | |
| BLANK | <0.2 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | |
| Target Range - Lower Bound | <0.2 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | |
| Upper Bound | 0.4 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039951

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | |
| | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | |
| BLANK | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | 0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | |
| Target Range - Lower Bound | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | |
| Upper Bound | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039951

| Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|----------------------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|
| Sample Description | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| BLANK | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Target Range - Lower Bound | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Upper Bound | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039951

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|--------------------------|--------------------|------------------|--------------------|
| STANDARDS | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANKS | | | | |
| BLANK | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | <0.05 | <2 | <0.5 |
| BLANK | | <0.05 | <2 | <0.5 |
| Target Range - Lower Bound | | <0.05 | <2 | <0.5 |
| Upper Bound | | 0.10 | 4 | 1.0 |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039951

| Sample Description | Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | S-CAL06 S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|-------------|---------------|----------------|--------------|----------------|
| | | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 |
| ORIGINAL DUP | | | | | | | | | | | | | | 0.14 | 0.27 | 1300 |
| Target Range - Lower Bound | | | | | | | | | | | | | | 0.14 | 0.27 | 1295 |
| Upper Bound | | | | | | | | | | | | | | 0.12 | 0.25 | 1235 |
| | | | | | | | | | | | | | | 0.16 | 0.29 | 1360 |
| ORIGINAL DUP | | | | | | | | | 0.02 | 0.02 | | 0.07 | 0.3 | | | |
| Target Range - Lower Bound | | | | | | | | | <0.01 | <0.01 | | <0.05 | <0.2 | | | |
| Upper Bound | | | | | | | | | 0.03 | 0.03 | | 0.10 | 0.4 | | | |
| L1895090-8 133628 DUP | | | | | | | | | | | | | | 0.13 | 1.25 | 4.2 |
| Target Range - Lower Bound | | | | | | | | | | | | | | 0.12 | 1.30 | 4.4 |
| Upper Bound | | | | | | | | | | | | | | 0.11 | 1.20 | 4.0 |
| | | | | | | | | | | | | | | 0.14 | 1.35 | 4.6 |
| L1895090-10 133630 DUP | | 0.3 | 2 | 20 | 20 | 8.0 | 64.00 | 0.01 | <0.01 | | 0.01 | | | | | |
| Target Range - Lower Bound | | 0.3 | 2 | 19 | 19 | 8.0 | 60.80 | 0.01 | <0.01 | | 0.01 | | | | | |
| Upper Bound | | <0.3 | <1 | 18 | 18 | 7.5 | 59.27 | <0.01 | <0.01 | | <0.01 | | | | | |
| | | 0.6 | 3 | 21 | 21 | 8.5 | 65.53 | 0.02 | 0.02 | | 0.02 | | | | | |
| L1895095-4 133636 DUP | | | | | | | | | | | | <0.05 | <0.2 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | <0.05 | <0.2 | | | |
| Upper Bound | | | | | | | | | | | | 0.10 | 0.4 | | | |

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| Sample Description | Method Analyte Units LOR | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm |
|----------------------------|-----------------------------------|----------------------|---------------------|----------------------|----------------------|----------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|----------------------|
| | | 0.2 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| | | DUPLICATES | | | | | | | | | | | | | | |
| ORIGINAL | | 0.2 | 10 | 40 | 0.86 | 0.04 | 6.10 | 0.35 | 17.70 | 14.4 | 19 | 8.34 | 45.9 | 3.59 | 0.93 | 0.06 |
| DUP | | 0.2 | 10 | 40 | 0.80 | 0.09 | 6.12 | 0.31 | 17.40 | 14.2 | 16 | 8.43 | 46.1 | 3.56 | 0.90 | 0.06 |
| Target Range - Lower Bound | | <0.2 | <10 | 30 | 0.74 | 0.05 | 5.79 | 0.30 | 16.65 | 13.5 | 16 | 7.92 | 44.2 | 3.39 | 0.82 | <0.05 |
| Upper Bound | | 0.4 | 20 | 50 | 0.92 | 0.08 | 6.43 | 0.36 | 18.45 | 15.1 | 19 | 8.85 | 47.8 | 3.76 | 1.01 | 0.10 |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895090-8 133628 | | <0.2 | <10 | 300 | 0.38 | 0.08 | 1.16 | 0.17 | 25.3 | 7.0 | 17 | 0.59 | 210 | 2.19 | 4.81 | 0.06 |
| DUP | | <0.2 | <10 | 300 | 0.40 | 0.12 | 1.20 | 0.16 | 25.0 | 7.0 | 18 | 0.60 | 207 | 2.24 | 4.90 | 0.06 |
| Target Range - Lower Bound | | <0.2 | <10 | 270 | 0.32 | 0.09 | 1.11 | 0.15 | 23.9 | 6.6 | 16 | 0.52 | 201 | 2.09 | 4.56 | <0.05 |
| Upper Bound | | 0.4 | 20 | 330 | 0.46 | 0.12 | 1.25 | 0.18 | 26.4 | 7.5 | 19 | 0.67 | 216 | 2.34 | 5.15 | 0.10 |
| L1895090-10 133630 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895095-4 133636 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039951

| Sample Description | Method Analyte Units LOR | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm |
|----------------------------|-----------------------------------|----------------------|----------------------|----------------------|-------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
| | | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 0.10 | 20.3 | 0.034 | 0.13 | 7.3 | 1.1 | 2.69 | 442 | 5.27 | 0.01 | 0.06 | 37.0 | 1630 | 6.7 | 7.3 |
| DUP | | 0.10 | 21.5 | 0.032 | 0.13 | 7.2 | 1.1 | 2.67 | 444 | 5.12 | 0.01 | 0.06 | 36.9 | 1600 | 7.6 | 7.4 |
| Target Range - Lower Bound | | 0.08 | 19.30 | 0.026 | 0.11 | 6.7 | 0.9 | 2.54 | 416 | 4.89 | <0.01 | <0.05 | 34.9 | 1520 | 6.6 | 6.9 |
| Upper Bound | | 0.13 | 22.5 | 0.040 | 0.15 | 7.8 | 1.3 | 2.82 | 470 | 5.50 | 0.02 | 0.10 | 39.0 | 1710 | 7.7 | 7.8 |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895090-8 133628 | | 0.16 | 0.02 | 0.022 | 0.30 | 12.8 | 6.5 | 0.52 | 475 | 1.15 | 0.08 | 0.40 | 12.8 | 780 | 4.6 | 14.8 |
| DUP | | 0.17 | 0.02 | 0.023 | 0.31 | 12.8 | 6.9 | 0.54 | 479 | 1.18 | 0.08 | 0.35 | 13.1 | 780 | 4.7 | 14.7 |
| Target Range - Lower Bound | | 0.14 | <0.01 | 0.016 | 0.28 | 12.0 | 6.3 | 0.49 | 448 | 1.06 | 0.07 | 0.31 | 12.1 | 730 | 4.2 | 13.9 |
| Upper Bound | | 0.19 | 0.03 | 0.029 | 0.33 | 13.6 | 7.1 | 0.57 | 506 | 1.27 | 0.09 | 0.44 | 13.8 | 830 | 5.1 | 15.6 |
| L1895090-10 133630 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895095-4 133636 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17039951

| Sample Description | Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|----------------------------|-----------------------------------|----------------------|-------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|---------------------|---------------------|---------------------|
| | | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| | | DUPLICATES | | | | | | | | | | | | | | |
| ORIGINAL | | 0.002 | 2.02 | 13.30 | 7.3 | 2.0 | 0.3 | 95.7 | <0.01 | 1.31 | 2.2 | <0.005 | 4.40 | 1.12 | 22 | 36.7 |
| DUP | | 0.003 | 2.00 | 13.20 | 7.1 | 1.5 | 0.3 | 93.4 | <0.01 | 1.43 | 2.1 | <0.005 | 4.35 | 1.06 | 22 | 32.8 |
| Target Range - Lower Bound | | <0.001 | 1.90 | 12.20 | 6.7 | 1.5 | <0.2 | 89.6 | <0.01 | 1.29 | 1.8 | <0.005 | 4.03 | 0.99 | 20 | 32.1 |
| Upper Bound | | 0.004 | 2.12 | 14.30 | 7.7 | 2.0 | 0.4 | 99.5 | 0.02 | 1.45 | 2.5 | 0.010 | 4.72 | 1.19 | 24 | 37.4 |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895090-8 133628 | | 0.001 | 0.03 | 0.35 | 4.3 | 0.8 | 0.5 | 70.1 | <0.01 | 0.01 | 3.2 | 0.091 | 0.11 | 0.51 | 47 | 0.16 |
| DUP | | 0.001 | 0.03 | 0.35 | 4.2 | 0.6 | 0.5 | 71.0 | <0.01 | 0.02 | 3.3 | 0.095 | 0.11 | 0.51 | 49 | 0.15 |
| Target Range - Lower Bound | | <0.001 | 0.02 | 0.27 | 3.9 | 0.5 | 0.3 | 66.8 | <0.01 | <0.01 | 2.9 | 0.083 | 0.08 | 0.43 | 45 | 0.09 |
| Upper Bound | | 0.002 | 0.04 | 0.43 | 4.6 | 0.9 | 0.7 | 74.3 | 0.02 | 0.02 | 3.6 | 0.103 | 0.14 | 0.59 | 51 | 0.22 |
| L1895090-10 133630 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895095-4 133636 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039951

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|-----------------------------------|-----------------------------|---------------------------|-----------------------------|
| DUPLICATES | | | | |
| ORIGINAL | | 12.30 | 91 | 4.3 |
| DUP | | 11.30 | 84 | 4.0 |
| Target Range - Lower Bound | | 11.15 | 81 | 3.3 |
| Upper Bound | | 12.45 | 94 | 5.0 |
| ORIGINAL | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L1895090-8 133628 | | 8.77 | 58 | 5.6 |
| DUP | | 8.76 | 58 | 5.6 |
| Target Range - Lower Bound | | 8.28 | 53 | 4.7 |
| Upper Bound | | 9.25 | 63 | 6.5 |
| L1895090-10 133630 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L1895095-4 133636 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

***** See Appendix Page for comments regarding this certificate *****



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: Appendix 1
 Total # Appendix Pages: 1
 Finalized Date: 23-MAR-2017
 Account: APN

Project: L1895090

QC CERTIFICATE OF ANALYSIS VA17039951

| CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | | |
|-----------------------------|---|---------|----------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|--|--|
| Applies to Method: | <p style="text-align: center;">ANALYTICAL COMMENTS</p> <p>Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41</p> | | | | | | | | | | | | | | | | |
| Applies to Method: | <p style="text-align: center;">LABORATORY ADDRESSES</p> <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> <td style="width: 33%;">OA-ELE07</td> </tr> <tr> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> <td>S-CAL06</td> </tr> <tr> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> <td>SPL-21</td> </tr> <tr> <td>WEI-21</td> <td></td> <td></td> <td></td> </tr> </table> | C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | | |
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | | | | | | | | | | | | | | |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | | | | | | | | | | | | | | |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | | | | | | | | | | | | | | |
| WEI-21 | | | | | | | | | | | | | | | | | |



Chain of Custody (COC) / Analytical Request Form



COC Number: 15 - 13

Canada Toll Free: 1 800 668 9878

L1895090-COFC

Page of

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| | | | | | |
|---|---|--|--|--|-----------------------------|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | |
| Company: | Minto Explorations Ltd. | Select Report Format: | <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | 4 day [P4] <input type="checkbox"/> | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | 3 day [P3] <input type="checkbox"/> | |
| Company address below will appear on the final report | | Select Distribution: | <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | 2 day [P2] <input type="checkbox"/> | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax | minto_environment@mintomine.com | EMERGENCY | |
| City/Province: | Vancouver, British Columbia | Email 2 | | 1 Business day [E1] <input type="checkbox"/> | |
| Postal Code: | V6B 0M3 | Email 3 | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | |
| Company: | Minto Explorations Ltd. | Select Invoice Distribution: | <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | For tests that can not be performed according to the service level selected, you will be contacted. | |
| Contact: | Ruth Cayetano | Email 1 or Fax | ap@mintomine.com | Analysis Request | |
| Project Information | | Oil and Gas Required Fields (client use) | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | |
| ALS Account # / Quote #: | | AFE/Cost Center: | PO# | Total Metals - Aqua regia digestion (ICP) | |
| Job #: | | Major/Minor Code: | Routing Code: | Total Metals | Paste pH |
| PO / AFE: | TBD | Requisitioner: | | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) |
| LSD: | | Location: | | AP - determination by % sulphide sulphur | Modified NP - (MEND 1981) |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Number of Containers |
| 1 | TAILS OCT 2016 | OCT 2016 | | TAILS | |
| 2 | LABA TRANKS FT THICKENER V/F DEC. 5, 2016 | JAN 15, 2017 | | TAILS | |
| 3 | LABA FT THICKENER V/F DEC. 26, 2016 | 15 JAN 17 | | TAILS | |
| 4 | LABA FT THICKENER V/F DEC. 19, 2016 | 15 JAN 17 | | TAILS | |
| 5 | LABA FT. NOV. 2016 | 15 JAN 17 | | TAILS | |
| 6 | ✓ 133626 | JAN 29/17 | | WASTE | |
| 7 | ✓ 133627 | | | WASTE | |
| 8 | ✓ 133628 | | | WASTE | |
| 9 | ✓ 133629 | | | WASTE | |
| 10 | ✓ 133630 | | | WASTE | |
| 11 | ✓ 133631 | FEB 18/17 | | WASTE | |
| 12 | ✓ 133632 | FEB 18/17 | | WASTE | |
| Drinking Water (DW) Samples (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | |
| | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | |
| | | Cooling Initiated <input type="checkbox"/> | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | FINAL SHIPMENT RECEPTION (lab use only) | |
| Released by: | Date: | Received by: | Date: | Received by: | Date: |
| | | VD | FEB 27/17 | | |
| Time: | | Time: | | Time: | |
| | | 9:30 | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form...

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-FEB-17
Report Date: 31-MAR-17 10:03 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1895095
Project P.O. #: 220826
Job Reference:
C of C Numbers: 15-14
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1895095-1 WASTE 18-FEB-17 133633 | L1895095-2 WASTE 18-FEB-17 133634 | L1895095-3 WASTE 18-FEB-17 133635 | L1895095-4 WASTE 18-FEB-17 133636 | L1895095-5 WASTE 18-FEB-17 133637 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.1 | 8.2 | 8.0 | 8.7 | 8.6 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.16 | 0.16 | 0.07 | <0.05 | 0.13 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 0.6 | 0.6 | 0.6 | <0.3 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 20 | 20 | 11 | 11 | 19 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 19 | 19 | 10 | 11 | 19 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 32.00 | 32.00 | 17.60 | 70.40 | 60.80 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | 0.02 | 0.02 | 0.02 | <0.01 | 0.01 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.02 | 0.02 | 0.02 | <0.01 | 0.01 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.49 | 1.37 | 1.25 | 1.37 | 1.14 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.77 | 0.56 | 0.32 | 0.05 | 0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 9.6 | 6.8 | 4.7 | 2.5 | 1.0 |
| | Barium (Ba) (ppm) | | | | |
| | 380 | 330 | 300 | 320 | 270 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.52 | 0.46 | 0.45 | 0.25 | 0.29 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.12 | 0.08 | 0.08 | 0.06 | 0.03 |
| | Boron (B) (ppm) | | | | |
| | 10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.32 | 0.24 | 0.19 | 0.14 | 0.09 |
| | Calcium (Ca) (%) | | | | |
| | 1.08 | 1.07 | 0.60 | 0.41 | 0.82 |
| | Cerium (Ce) (ppm) | | | | |
| | 28.6 | 27.2 | 27.5 | 20.2 | 20.9 |
| | Cesium (Cs) (ppm) | | | | |
| | 1.00 | 0.86 | 0.83 | 0.71 | 0.39 |
| | Chromium (Cr) (ppm) | | | | |
| | 30 | 28 | 17 | 7 | 5 |
| | Cobalt (Co) (ppm) | | | | |
| | 9.5 | 8.8 | 8.4 | 6.9 | 6.2 |
| | Copper (Cu) (ppm) | | | | |
| | 95.3 | 48.2 | 406 | 2620 | 651 |
| | Gallium (Ga) (ppm) | | | | |
| | 5.12 | 4.63 | 4.98 | 6.39 | 5.79 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.11 | <0.05 | 0.05 | 0.06 | 0.06 |
| | Gold (Au) (ppm) | | | | |
| | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.25 | 0.27 | 0.16 | 0.06 | 0.06 |
| | Indium (In) (ppm) | | | | |
| | 0.030 | 0.022 | 0.035 | 0.074 | 0.033 |
| | Iron (Fe) (%) | | | | |
| | 2.69 | 2.43 | 2.59 | 3.13 | 2.32 |
| | Lanthanum (La) (ppm) | | | | |
| | 14.4 | 13.9 | 14.6 | 11.5 | 10.9 |
| | Lead (Pb) (ppm) | | | | |
| | 9.3 | 6.1 | 6.5 | 3.1 | 3.6 |
| | Lithium (Li) (ppm) | | | | |
| | 9.4 | 8.2 | 6.3 | 5.4 | 6.5 |
| | Magnesium (Mg) (%) | | | | |
| | 0.55 | 0.54 | 0.43 | 0.54 | 0.54 |
| | Manganese (Mn) (ppm) | | | | |
| | 541 | 466 | 532 | 609 | 555 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1895095-1 | L1895095-2 | L1895095-3 | L1895095-4 | L1895095-5 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 18-FEB-17 | 18-FEB-17 | 18-FEB-17 | 18-FEB-17 | 18-FEB-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 133633 | 133634 | 133635 | 133636 | 133637 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.04 | 0.03 | 0.02 | 0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | | 1.51 | 1.48 | 1.49 | 1.43 | 0.97 |
| | Nickel (Ni) (ppm) | | 25.8 | 22.9 | 14.8 | 3.3 | 2.3 |
| | Niobium (Nb) (ppm) | | 0.32 | 0.53 | 0.34 | 0.22 | 0.13 |
| | Phosphorus (P) (ppm) | | 800 | 840 | 700 | 820 | 590 |
| | Potassium (K) (%) | | 0.30 | 0.23 | 0.31 | 0.78 | 0.44 |
| | Rhenium (Re) (ppm) | | 0.001 | <0.001 | 0.001 | <0.001 | <0.001 |
| | Rubidium (Rb) (ppm) | | 17.1 | 13.5 | 17.3 | 39.2 | 21.3 |
| | Scandium (Sc) (ppm) | | 5.2 | 5.2 | 5.5 | 6.3 | 4.1 |
| | Selenium (Se) (ppm) | | 0.7 | 0.8 | 0.9 | 1.3 | 1.0 |
| | Silver (Ag) (ppm) | | 0.16 | 0.11 | 0.19 | 0.28 | 0.16 |
| | Sodium (Na) (%) | | 0.07 | 0.07 | 0.05 | 0.08 | 0.09 |
| | Strontium (Sr) (ppm) | | 60.8 | 61.9 | 41.5 | 41.1 | 46.4 |
| | Sulfur (S) (%) | | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.04 | 0.01 | 0.05 | 0.09 | 0.03 |
| | Thallium (Tl) (ppm) | | 0.15 | 0.12 | 0.13 | 0.25 | 0.12 |
| | Thorium (Th) (ppm) | | 3.7 | 3.8 | 3.5 | 3.0 | 2.0 |
| | Tin (Sn) (ppm) | | 0.6 | 0.5 | 0.6 | 1.0 | 0.7 |
| | Titanium (Ti) (%) | | 0.089 | 0.085 | 0.062 | 0.129 | 0.077 |
| | Tungsten (W) (ppm) | | 0.46 | 0.48 | 0.14 | 0.08 | 0.26 |
| | Uranium (U) (ppm) | | 0.61 | 0.75 | 0.38 | 0.20 | 0.20 |
| | Vanadium (V) (ppm) | | 59 | 54 | 56 | 69 | 48 |
| | Yttrium (Y) (ppm) | | 10.35 | 10.45 | 9.73 | 7.67 | 8.09 |
| | Zinc (Zn) (ppm) | | 70 | 57 | 68 | 74 | 65 |
| | Zirconium (Zr) (ppm) | | 8.6 | 9.0 | 5.8 | 1.5 | 1.0 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.6 | 0.6 | 0.3 | <0.2 | 0.5 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06-AX | Soil | Sulfide Sulfur Calc from Carbonate Leach | ALS Minerals S-CAL06 |
| Sulfide Sulfur (as S) is calculated by subtracting the Carbonate Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

15-14

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Page: 1
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 29-MAR-2017
 Account: APN

CERTIFICATE VA17039953

Project: L1895095
 P.O. No.: ALSM-CW16-102-APN
 This report is for 5 Other samples submitted to our lab in Vancouver, BC, Canada on 2-MAR-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| SPL-21 | Split sample - riffle splitter |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 2 - A
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 29-MAR-2017
 Account: APN

Project: L1895095

CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | S-CAL06 S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % |
|--------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|-------------|---------------|----------------|--------------|
| L1895095-1 133633 | | 0.02 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 |
| L1895095-2 133634 | | 0.48 | 0.6 | 2 | 19 | 20 | 8.1 | 32.00 | 0.02 | <0.01 | <0.01 | 0.02 | 0.16 | 0.6 | 0.16 | 1.49 |
| L1895095-3 133635 | | 1.08 | 0.6 | 2 | 19 | 20 | 8.2 | 32.00 | 0.02 | <0.01 | <0.01 | 0.02 | 0.16 | 0.6 | 0.11 | 1.37 |
| L1895095-4 133636 | | 1.04 | 0.6 | 2 | 10 | 11 | 8.0 | 17.60 | 0.02 | <0.01 | <0.01 | 0.02 | 0.07 | 0.3 | 0.19 | 1.25 |
| L1895095-5 133637 | | 1.04 | <0.3 | 2 | 11 | 11 | 8.7 | 70.40 | <0.01 | <0.01 | <0.01 | <0.01 | <0.05 | <0.2 | 0.28 | 1.37 |
| L1895095-5 133637 | | 1.06 | 0.3 | 2 | 19 | 19 | 8.6 | 60.80 | 0.01 | <0.01 | <0.01 | 0.01 | 0.13 | 0.5 | 0.16 | 1.14 |

***** See Appendix Page for comments regarding this certificate *****



ALS Canada Ltd.
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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

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 Plus Appendix Pages
 Finalized Date: 29-MAR-2017
 Account: APN

Project: L1895095

CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|-----------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga |
| | | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| | | 0.1 | 0.2 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 |
| L1895095-1 133633 | | 9.6 | <0.2 | 10 | 380 | 0.52 | 0.12 | 1.08 | 0.32 | 28.6 | 9.5 | 30 | 1.00 | 95.3 | 2.69 | 5.12 |
| L1895095-2 133634 | | 6.8 | <0.2 | <10 | 330 | 0.46 | 0.08 | 1.07 | 0.24 | 27.2 | 8.8 | 28 | 0.86 | 48.2 | 2.43 | 4.63 |
| L1895095-3 133635 | | 4.7 | <0.2 | <10 | 300 | 0.45 | 0.08 | 0.60 | 0.19 | 27.5 | 8.4 | 17 | 0.83 | 406 | 2.59 | 4.98 |
| L1895095-4 133636 | | 2.5 | <0.2 | <10 | 320 | 0.25 | 0.06 | 0.41 | 0.14 | 20.2 | 6.9 | 7 | 0.71 | 2620 | 3.13 | 6.39 |
| L1895095-5 133637 | | 1.0 | <0.2 | <10 | 270 | 0.29 | 0.03 | 0.82 | 0.09 | 20.9 | 6.2 | 5 | 0.39 | 651 | 2.32 | 5.79 |

***** See Appendix Page for comments regarding this certificate *****



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Project: L1895095

CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 | ME-MS41 Hg ppm 0.01 | ME-MS41 In ppm 0.005 | ME-MS41 K % 0.01 | ME-MS41 La ppm 0.2 | ME-MS41 Li ppm 0.1 | ME-MS41 Mg % 0.01 | ME-MS41 Mn ppm 5 | ME-MS41 Mo ppm 0.05 | ME-MS41 Na % 0.01 | ME-MS41 Nb ppm 0.05 | ME-MS41 Ni ppm 0.2 | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 |
|--------------------|-----------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|---------------------------|-----------------------------|-----------------------------|----------------------------|---------------------------|------------------------------|----------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|
| L1895095-1 133633 | | 0.11 | 0.25 | 0.04 | 0.030 | 0.30 | 14.4 | 9.4 | 0.55 | 541 | 1.51 | 0.07 | 0.32 | 25.8 | 800 | 9.3 |
| L1895095-2 133634 | | <0.05 | 0.27 | 0.03 | 0.022 | 0.23 | 13.9 | 8.2 | 0.54 | 466 | 1.48 | 0.07 | 0.53 | 22.9 | 840 | 6.1 |
| L1895095-3 133635 | | 0.05 | 0.16 | 0.02 | 0.035 | 0.31 | 14.6 | 6.3 | 0.43 | 532 | 1.49 | 0.05 | 0.34 | 14.8 | 700 | 6.5 |
| L1895095-4 133636 | | 0.06 | 0.06 | 0.01 | 0.074 | 0.78 | 11.5 | 5.4 | 0.54 | 609 | 1.43 | 0.08 | 0.22 | 3.3 | 820 | 3.1 |
| L1895095-5 133637 | | 0.06 | 0.06 | 0.01 | 0.033 | 0.44 | 10.9 | 6.5 | 0.54 | 555 | 0.97 | 0.09 | 0.13 | 2.3 | 590 | 3.6 |

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CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|-----------------------------------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-----------|----------|----------|
| | | Rb ppm | Re ppm | S % | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm | V ppm |
| L1895095-1 133633 | | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 |
| L1895095-2 133634 | | 17.1 | 0.001 | 0.02 | 0.77 | 5.2 | 0.7 | 0.6 | 60.8 | <0.01 | 0.04 | 3.7 | 0.089 | 0.15 | 0.61 | 59 |
| L1895095-3 133635 | | 13.5 | <0.001 | 0.02 | 0.56 | 5.2 | 0.8 | 0.5 | 61.9 | <0.01 | 0.01 | 3.8 | 0.085 | 0.12 | 0.75 | 54 |
| L1895095-4 133636 | | 17.3 | 0.001 | 0.02 | 0.32 | 5.5 | 0.9 | 0.6 | 41.5 | <0.01 | 0.05 | 3.5 | 0.062 | 0.13 | 0.38 | 56 |
| L1895095-5 133637 | | 39.2 | <0.001 | 0.01 | 0.05 | 6.3 | 1.3 | 1.0 | 41.1 | <0.01 | 0.09 | 3.0 | 0.129 | 0.25 | 0.20 | 69 |
| | | 21.3 | <0.001 | 0.01 | 0.05 | 4.1 | 1.0 | 0.7 | 46.4 | <0.01 | 0.03 | 2.0 | 0.077 | 0.12 | 0.20 | 48 |

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Project: L1895095

CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|--------------------|-----------------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| L1895095-1 133633 | | 0.46 | 10.35 | 70 | 8.6 |
| L1895095-2 133634 | | 0.48 | 10.45 | 57 | 9.0 |
| L1895095-3 133635 | | 0.14 | 9.73 | 68 | 5.8 |
| L1895095-4 133636 | | 0.08 | 7.67 | 74 | 1.5 |
| L1895095-5 133637 | | 0.26 | 8.09 | 65 | 1.0 |
| | | | | | |



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CERTIFICATE OF ANALYSIS VA17039953

CERTIFICATE COMMENTS

| | | | | | | | | | | | | | | | | | |
|--------------------|--|---------|----------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|--|--|
| | ANALYTICAL COMMENTS | | | | | | | | | | | | | | | | |
| Applies to Method: | Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41 | | | | | | | | | | | | | | | | |
| | LABORATORY ADDRESSES | | | | | | | | | | | | | | | | |
| Applies to Method: | Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada. | | | | | | | | | | | | | | | | |
| | <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> <td style="width: 33%;">OA-ELE07</td> </tr> <tr> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> <td>S-CAL06</td> </tr> <tr> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> <td>SPL-21</td> </tr> <tr> <td>WEI-21</td> <td></td> <td></td> <td></td> </tr> </table> | C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | | |
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | | | | | | | | | | | | | | |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | | | | | | | | | | | | | | |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | | | | | | | | | | | | | | |
| WEI-21 | | | | | | | | | | | | | | | | | |



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QC CERTIFICATE VA17039953

Project: L1895095
 P.O. No.: ALSM-CW16-102-APN
 This report is for 5 Other samples submitted to our lab in Vancouver, BC, Canada on 2-MAR-2017.
 The following have access to data associated with this certificate:
 ALSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| SPL-21 | Split sample - riffle splitter |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: ALS ENVIRONMENTAL
 ATTN: SHANE STACK
 100 - 8081 LOUGHEED HWY.
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17039953

| Method Analyte Units LOR | OA-VOL08m MPA | OA-VOL08m FIZZ RAT | OA-VOL08m NNP | OA-VOL08m NP | OA-ELE07 pH | OA-VOL08m Ratio (N) | S-IR08 S | S-GRA06 S | S-GRA06a S | C-GAS05 C | C-GAS05 CO2 | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As | ME-MS41 Au |
|----------------------------|---------------|--------------------|---------------|--------------|-------------|---------------------|----------|-----------|------------|-----------|-------------|------------|------------|------------|------------|
| Sample Description | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | ppm | % | ppm | ppm |
| | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | 6.1 | | | | | | | | | | |
| Buffer pH6 | | | | | 6.0 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.3 | | | | | | | | | | |
| Upper Bound | | | | | 6.7 | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | 0.46 | 1.7 | | | | |
| CO-ASSAY | | | | | | | | | | 0.50 | 1.8 | | | | |
| CO-ASSAY | | | | | | | | | | 0.48 | 1.8 | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.42 | 1.5 | | | | |
| Upper Bound | | | | | | | | | | 0.64 | 2.4 | | | | |
| DS-1 | | | | | | | 2.60 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 2.51 | | | | | | | | |
| Upper Bound | | | | | | | 2.71 | | | | | | | | |
| GS310-10 | | | | | | | 0.28 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 0.25 | | | | | | | | |
| Upper Bound | | | | | | | 0.29 | | | | | | | | |
| KZK-1 | 25.0 | 2 | 31 | 56 | | 2.24 | | | | | | | | | |
| KZK-1 | 25.0 | 2 | 30 | 55 | | 2.20 | | | | | | | | | |
| Target Range - Lower Bound | 22.9 | <1 | 30 | 54 | | 2.18 | | | | | | | | | |
| Upper Bound | 27.1 | >4 | 38 | 64 | | 2.53 | | | | | | | | | |
| MA-2c | | | | | | | | | | 1.56 | 5.7 | | | | |
| Target Range - Lower Bound | | | | | | | | | | 1.50 | 5.5 | | | | |
| Upper Bound | | | | | | | | | | 1.84 | 6.8 | | | | |
| MGeo08 | | | | | | | | | | | | 4.55 | 2.64 | 33.6 | <0.2 |
| Target Range - Lower Bound | | | | | | | | | | | | 4.00 | 2.44 | 29.6 | <0.2 |
| Upper Bound | | | | | | | | | | | | 4.92 | 3.00 | 36.4 | 0.4 |
| OGGeo08 | | | | | | | | | | | | 20.9 | 2.20 | 123.0 | <0.2 |
| Target Range - Lower Bound | | | | | | | | | | | | 18.15 | 2.05 | 107.0 | <0.2 |
| Upper Bound | | | | | | | | | | | | 22.2 | 2.53 | 131.0 | 0.4 |
| OREAS 905 | | | | | | | | | | | | 0.52 | 0.80 | 32.8 | 0.4 |
| Target Range - Lower Bound | | | | | | | | | | | | 0.45 | 0.73 | 28.4 | <0.2 |
| Upper Bound | | | | | | | | | | | | 0.58 | 0.91 | 35.0 | 0.8 |
| OREAS 920 | | | | | | | | | | | | 0.10 | 2.43 | 4.6 | <0.2 |
| Target Range - Lower Bound | | | | | | | | | | | | 0.07 | 2.18 | 3.8 | <0.2 |
| Upper Bound | | | | | | | | | | | | 0.12 | 2.68 | 4.9 | 0.4 |
| SY-4 | | | | | | | | | | 0.90 | 3.3 | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.84 | 3.0 | | | | |
| Upper Bound | | | | | | | | | | 1.08 | 4.0 | | | | |
| UTS-1 | | | | | | | | 0.83 | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 B ppm 10 | ME-MS41 Ba ppm 10 | ME-MS41 Be ppm 0.05 | ME-MS41 Bi ppm 0.01 | ME-MS41 Ca % 0.01 | ME-MS41 Cd ppm 0.01 | ME-MS41 Ce ppm 0.02 | ME-MS41 Co ppm 0.1 | ME-MS41 Cr ppm 1 | ME-MS41 Cs ppm 0.05 | ME-MS41 Cu ppm 0.2 | ME-MS41 Fe % 0.01 | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 |
|----------------------------|--------------------------|------------------|-------------------|---------------------|---------------------|-------------------|---------------------|---------------------|--------------------|------------------|---------------------|--------------------|-------------------|---------------------|---------------------|---------------------|
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | | <10 | 450 | 0.77 | 0.68 | 1.08 | 2.30 | 76.3 | 19.9 | 90 | 10.95 | 627 | 3.60 | 9.41 | 0.19 | 0.66 |
| Target Range - Lower Bound | | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 | 3.22 | 8.73 | 0.07 | 0.64 |
| Upper Bound | | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 | 3.96 | 10.80 | 0.29 | 0.83 |
| OGGeo08 | | 10 | 100 | 0.71 | 9.92 | 0.89 | 19.30 | 61.3 | 96.6 | 81 | 9.49 | 8380 | 5.07 | 8.18 | 0.16 | 0.77 |
| Target Range - Lower Bound | | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | 4.51 | 8.05 | 0.21 | 0.72 |
| Upper Bound | | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | 5.53 | 9.95 | 0.45 | 0.92 |
| OREAS 905 | | <10 | 240 | 0.88 | 5.69 | 0.33 | 0.35 | 80.8 | 14.5 | 17 | 1.25 | 1550 | 3.41 | 6.01 | 0.16 | 1.15 |
| Target Range - Lower Bound | | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 | 3.14 | 5.74 | <0.05 | 1.08 |
| Upper Bound | | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 | 3.86 | 7.12 | 0.22 | 1.36 |
| OREAS 920 | | <10 | 80 | 0.70 | 0.83 | 0.32 | 0.06 | 73.3 | 15.1 | 42 | 1.90 | 113.5 | 3.61 | 6.54 | 0.09 | 0.58 |
| Target Range - Lower Bound | | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | 3.26 | 6.12 | <0.05 | 0.53 |
| Upper Bound | | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | 4.00 | 7.60 | 0.22 | 0.69 |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039953

| Method Analyte Units LOR | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm |
|----------------------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|
| Sample Description | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 0.08 | 0.159 | 1.26 | 38.3 | 35.2 | 1.15 | 410 | 13.70 | 0.33 | 0.84 | 698 | 1020 | 1070 | 148.0 | 0.008 |
| Target Range - Lower Bound | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 | 900 | 959 | 132.0 | 0.006 |
| Upper Bound | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 | 1130 | 1175 | 162.0 | 0.010 |
| OGGeo08 | 0.49 | 1.435 | 1.04 | 30.0 | 31.9 | 0.95 | 386 | 875 | 0.28 | 1.03 | 8800 | 810 | 7150 | 120.0 | 1.390 |
| Target Range - Lower Bound | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 | 700 | 6520 | 109.5 | 1.295 |
| Upper Bound | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 | 880 | 7970 | 134.5 | 1.585 |
| OREAS 905 | 0.02 | 0.590 | 0.31 | 40.9 | 4.2 | 0.15 | 335 | 2.94 | 0.09 | 0.29 | 8.6 | 250 | 16.4 | 19.6 | <0.001 |
| Target Range - Lower Bound | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 | | 15.2 | 17.3 | <0.001 |
| Upper Bound | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 | | 19.0 | 21.3 | 0.002 |
| OREAS 920 | 0.01 | 0.030 | 0.41 | 37.0 | 22.3 | 1.08 | 508 | 0.36 | 0.02 | 0.33 | 38.2 | 720 | 20.7 | 24.1 | <0.001 |
| Target Range - Lower Bound | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 | | 19.2 | 22.2 | <0.001 |
| Upper Bound | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 | | 23.9 | 27.4 | 0.002 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |



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Project: L1895095

QC CERTIFICATE OF ANALYSIS VA17039953

| Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|----------------------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|---------------|
| Sample Description | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 0.31 | 2.85 | 7.7 | 1.6 | 3.3 | 80.5 | 0.01 | 0.02 | 21.6 | 0.374 | 0.83 | 5.67 | 101 | 2.52 | 20.5 |
| Target Range - Lower Bound | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 | 4.93 | 90 | 2.44 | 17.50 |
| Upper Bound | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 | 6.13 | 112 | 3.42 | 21.5 |
| OGGeo08 | 2.79 | 18.55 | 6.2 | 11.0 | 12.8 | 64.0 | 0.01 | 0.15 | 16.8 | 0.305 | 1.39 | 4.87 | 80 | 3.02 | 16.95 |
| Target Range - Lower Bound | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | 4.45 | 70 | 2.58 | 15.35 |
| Upper Bound | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | 5.55 | 88 | 3.60 | 18.85 |
| OREAS 905 | 0.07 | 0.95 | 1.7 | 2.7 | 1.2 | 13.5 | <0.01 | 0.08 | 9.0 | 0.020 | 0.12 | 2.31 | 5 | 0.55 | 7.64 |
| Target Range - Lower Bound | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 | 2.08 | 4 | 0.44 | 6.32 |
| Upper Bound | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 | 2.66 | 8 | 0.76 | 7.84 |
| OREAS 920 | 0.03 | 0.53 | 2.8 | 1.2 | 1.0 | 17.4 | 0.01 | 0.02 | 16.0 | 0.123 | 0.15 | 2.11 | 25 | 0.48 | 18.20 |
| Target Range - Lower Bound | <0.01 | 0.45 | 2.5 | 0.4 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | 1.89 | 23 | 0.31 | 16.85 |
| Upper Bound | 0.05 | 0.77 | 3.3 | 1.3 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | 2.42 | 30 | 0.61 | 20.7 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm | ME-MS41 Zr ppm |
|----------------------------|--------------------------|----------------|----------------|
| STANDARDS | | | |
| Buffer pH6 | | | |
| Buffer pH6 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| CO-ASSAY | | | |
| CO-ASSAY | | | |
| CO-ASSAY | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| DS-1 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| GS310-10 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| KZK-1 | | | |
| KZK-1 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| MA-2c | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| MGeo08 | | 770 | 22.3 |
| Target Range - Lower Bound | | 708 | 18.1 |
| Upper Bound | | 870 | 25.7 |
| OGGeo08 | | 6980 | 23.1 |
| Target Range - Lower Bound | | 6500 | 19.5 |
| Upper Bound | | 7950 | 27.5 |
| OREAS 905 | | 64 | 45.5 |
| Target Range - Lower Bound | | 58 | 39.9 |
| Upper Bound | | 76 | 55.1 |
| OREAS 920 | | 104 | 22.3 |
| Target Range - Lower Bound | | 93 | 17.6 |
| Upper Bound | | 119 | 25.0 |
| SY-4 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-1 | | | |

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QC CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|---------------|----------------|--------------|----------------|----------------|
| | | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.83 | | | | | | | |
| Upper Bound | | | | | | | | | 0.93 | | | | | | | |
| UTS-1 | | | | | | | | | | 0.91 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.81 | | | | | | |
| Upper Bound | | | | | | | | | | 0.95 | | | | | | |
| UTS-4 | | | | | | | | 1.68 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.64 | | | | | | | | |
| Upper Bound | | | | | | | | 1.84 | | | | | | | | |
| UTS-4 | | | | | | | | | | 1.76 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 1.61 | | | | | | |
| Upper Bound | | | | | | | | | | 1.87 | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | <0.05 | <0.2 | | | | |
| BLANK | | | | | | | | | | | <0.05 | <0.2 | | | | |
| BLANK | | | | | | | | | | | <0.05 | <0.2 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | <0.05 | <0.2 | | | | |
| Upper Bound | | | | | | | | | | | 0.10 | 0.4 | | | | |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | <0.2 |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | <0.2 |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | <0.2 |
| Upper Bound | | | | | | | | | | | | | 0.02 | 0.02 | 0.2 | 0.4 |
| BLANK | | | | | 6.1 | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.5 | | | | | | | | | | | |
| Upper Bound | | | | | 6.9 | | | | | | | | | | | |
| BLANK | | | | | | | | | <0.01 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | <0.01 | | | | | | | |
| Upper Bound | | | | | | | | | 0.02 | | | | | | | |
| BLANK | | | | | | | | | | <0.01 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.01 | | | | | | |
| Upper Bound | | | | | | | | | | 0.02 | | | | | | |
| BLANK | | | | | | | | 0.01 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.01 | | | | | | | | |
| Upper Bound | | | | | | | | 0.02 | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 B ppm 10 | ME-MS41 Ba ppm 10 | ME-MS41 Be ppm 0.05 | ME-MS41 Bi ppm 0.01 | ME-MS41 Ca % 0.01 | ME-MS41 Cd ppm 0.01 | ME-MS41 Ce ppm 0.02 | ME-MS41 Co ppm 0.1 | ME-MS41 Cr ppm 1 | ME-MS41 Cs ppm 0.05 | ME-MS41 Cu ppm 0.2 | ME-MS41 Fe % 0.01 | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 |
|----------------------------|--------------------------|------------------|-------------------|---------------------|---------------------|-------------------|---------------------|---------------------|--------------------|------------------|---------------------|--------------------|-------------------|---------------------|---------------------|---------------------|
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
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| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | <10 | <10 | <0.05 | 0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | 0.2 | <0.01 | <0.05 | 0.05 | <0.02 |
| BLANK | | <10 | <10 | <0.05 | 0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | <0.02 |
| Target Range - Lower Bound | | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | <0.02 |
| Upper Bound | | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 | 0.04 |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039953

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | Re ppm | |
| | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | 0.2 | <0.1 | <0.001 | |
| BLANK | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | <0.001 | |
| Target Range - Lower Bound | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | <0.001 | |
| Upper Bound | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 | 0.002 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U | V | W | Y |
| | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm |
| | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | 0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| BLANK | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Upper Bound | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | 0.10 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm | ME-MS41 Zr ppm |
|----------------------------|--------------------------|----------------|----------------|
| | | 2 | 0.5 |
| STANDARDS | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-1 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-4 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-4 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANKS | | | |
| BLANK | | | |
| BLANK | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | <2 | <0.5 |
| BLANK | | <2 | <0.5 |
| Target Range - Lower Bound | | <2 | <0.5 |
| Upper Bound | | 4 | 1.0 |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |

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QC CERTIFICATE OF ANALYSIS VA17039953

| Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|---------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.2 |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | 0.04 | 0.29 | 9.3 | <0.2 |
| DUP | | | | | | | | | | | | 0.04 | 0.29 | 9.5 | <0.2 |
| Target Range - Lower Bound | | | | | | | | | | | | 0.03 | 0.27 | 8.8 | <0.2 |
| Upper Bound | | | | | | | | | | | | 0.05 | 0.31 | 10.0 | 0.4 |
| ORIGINAL | | | | | | | | | | | | 2.00 | 1.86 | 328 | <0.2 |
| DUP | | | | | | | | | | | | 1.99 | 1.88 | 332 | <0.2 |
| Target Range - Lower Bound | | | | | | | | | | | | 1.89 | 1.77 | 313 | <0.2 |
| Upper Bound | | | | | | | | | | | | 2.10 | 1.97 | 347 | 0.4 |
| ORIGINAL | | | | | | | | 0.05 | 0.12 | | | | | | |
| DUP | | | | | | | | 0.07 | 0.12 | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.05 | 0.10 | | | | | | |
| Upper Bound | | | | | | | | 0.07 | 0.14 | | | | | | |
| L1895095-4 133636 | | | | | | | | | | <0.05 | <0.2 | | | | |
| DUP | | | | | | | | | | <0.05 | <0.2 | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.05 | <0.2 | | | | |
| Upper Bound | | | | | | | | | | 0.10 | 0.4 | | | | |
| L1895095-5 133637 | 0.3 | 2 | 19 | 19 | | 60.80 | | | | 0.13 | 0.5 | | | | |
| DUP | 0.3 | 2 | 18 | 18 | | 57.60 | | | | 0.13 | 0.5 | | | | |
| Target Range - Lower Bound | <0.3 | <1 | 17 | 17 | | 56.23 | | | | 0.07 | 0.3 | | | | |
| Upper Bound | 0.6 | 3 | 20 | 20 | | 62.17 | | | | 0.19 | 0.7 | | | | |
| ORIGINAL | | | | | | 9.0 | | | | | | | | | |
| DUP | | | | | | 9.0 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 8.5 | | | | | | | | | |
| Upper Bound | | | | | | 9.6 | | | | | | | | | |
| ORIGINAL | | | | | | | | 8.58 | | | | | | | |
| DUP | | | | | | | | 8.69 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 8.41 | | | | | | | |
| Upper Bound | | | | | | | | 8.86 | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 B ppm 10 | ME-MS41 Ba ppm 10 | ME-MS41 Be ppm 0.05 | ME-MS41 Bi ppm 0.01 | ME-MS41 Ca % 0.01 | ME-MS41 Cd ppm 0.01 | ME-MS41 Ce ppm 0.02 | ME-MS41 Co ppm 0.1 | ME-MS41 Cr ppm 1 | ME-MS41 Cs ppm 0.05 | ME-MS41 Cu ppm 0.2 | ME-MS41 Fe % 0.01 | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 |
|----------------------------|--------------------------|-------------------|-------------------|---------------------|---------------------|-------------------|---------------------|---------------------|--------------------|------------------|---------------------|--------------------|-------------------|---------------------|---------------------|---------------------|
| | | DUPLICATES | | | | | | | | | | | | | | |
| ORIGINAL | | 10 | 190 | 0.80 | 0.16 | 12.20 | 0.08 | 14.50 | 3.7 | 39 | 5.36 | 5.0 | 2.27 | 1.29 | 0.07 | 0.07 |
| DUP | | 10 | 190 | 0.85 | 0.16 | 12.05 | 0.09 | 13.35 | 3.8 | 38 | 5.47 | 6.0 | 2.23 | 1.32 | 0.07 | 0.06 |
| Target Range - Lower Bound | | <10 | 170 | 0.73 | 0.14 | 11.50 | 0.07 | 13.20 | 3.5 | 36 | 5.09 | 5.1 | 2.13 | 1.19 | <0.05 | 0.04 |
| Upper Bound | | 20 | 210 | 0.92 | 0.18 | 12.75 | 0.10 | 14.65 | 4.0 | 41 | 5.74 | 5.9 | 2.37 | 1.42 | 0.10 | 0.09 |
| ORIGINAL | | 10 | 160 | 1.89 | 0.05 | 6.13 | 4.78 | 24.8 | 50.0 | 38 | 3.21 | 25.2 | 1.17 | 1.59 | 0.13 | 0.09 |
| DUP | | <10 | 170 | 2.01 | 0.05 | 6.28 | 4.81 | 25.7 | 51.4 | 39 | 3.30 | 27.0 | 1.18 | 1.64 | 0.14 | 0.09 |
| Target Range - Lower Bound | | <10 | 140 | 1.80 | 0.04 | 5.88 | 4.55 | 24.0 | 48.1 | 36 | 3.04 | 25.0 | 1.11 | 1.48 | 0.08 | 0.07 |
| Upper Bound | | 20 | 190 | 2.10 | 0.06 | 6.53 | 5.04 | 26.5 | 53.3 | 41 | 3.47 | 27.2 | 1.24 | 1.75 | 0.19 | 0.11 |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895095-4 133636 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895095-5 133637 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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 Account: APN

Project: L1895095

QC CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|-----------------------------------|-----------|-----------|---------|-----------|-----------|---------|-----------|-----------|---------|-----------|-----------|----------|-----------|-----------|-----------|
| | | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | Re ppm |
| | | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 0.01 | 0.033 | 0.04 | 21.7 | 2.7 | 0.10 | 336 | 0.47 | <0.01 | 0.10 | 6.6 | 10 | 12.2 | 6.4 | <0.001 |
| DUP | | 0.01 | 0.033 | 0.04 | 21.9 | 2.8 | 0.10 | 330 | 0.63 | <0.01 | 0.09 | 8.7 | 10 | 14.2 | 6.6 | <0.001 |
| Target Range - Lower Bound | | <0.01 | 0.026 | 0.03 | 20.5 | 2.5 | 0.09 | 311 | 0.47 | <0.01 | <0.05 | 7.1 | <10 | 12.3 | 6.1 | <0.001 |
| Upper Bound | | 0.02 | 0.040 | 0.05 | 23.1 | 3.0 | 0.12 | 355 | 0.63 | 0.02 | 0.10 | 8.2 | 20 | 14.1 | 6.9 | 0.002 |
| ORIGINAL | | 2.74 | 0.010 | 0.20 | 26.8 | 8.6 | 0.07 | 337 | 5.51 | 0.03 | <0.05 | 227 | >10000 | 8.9 | 11.9 | 0.001 |
| DUP | | 2.71 | 0.012 | 0.20 | 27.7 | 9.5 | 0.07 | 346 | 5.67 | 0.03 | <0.05 | 231 | >10000 | 8.9 | 12.2 | <0.001 |
| Target Range - Lower Bound | | 2.51 | <0.005 | 0.18 | 25.7 | 8.5 | 0.06 | 319 | 5.26 | 0.02 | <0.05 | 217 | 9490 | 8.3 | 11.3 | <0.001 |
| Upper Bound | | 2.94 | 0.017 | 0.22 | 28.8 | 9.6 | 0.08 | 364 | 5.92 | 0.04 | 0.10 | 241 | >10000 | 9.5 | 12.8 | 0.002 |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895095-4 133636 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895095-5 133637 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|-----------------------------------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-----------|----------|----------|----------|----------|
| | | S % | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm | V ppm | W ppm | Y ppm |
| | | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | <0.01 | 0.48 | 6.8 | 1.0 | 1.1 | 31.7 | <0.01 | 0.03 | 4.5 | 0.011 | 0.04 | 0.20 | 32 | 0.27 | 18.75 |
| DUP | | <0.01 | 0.48 | 6.9 | 0.9 | 1.1 | 31.9 | <0.01 | 0.02 | 4.5 | 0.010 | 0.04 | 0.20 | 32 | 0.26 | 18.80 |
| Target Range - Lower Bound | | <0.01 | 0.39 | 6.4 | 0.7 | 0.8 | 30.0 | <0.01 | <0.01 | 4.1 | <0.005 | <0.02 | 0.14 | 29 | 0.20 | 17.80 |
| Upper Bound | | 0.02 | 0.57 | 7.3 | 1.2 | 1.4 | 33.6 | 0.02 | 0.04 | 4.9 | 0.016 | 0.06 | 0.26 | 35 | 0.33 | 19.75 |
| ORIGINAL | | 0.10 | 12.90 | 2.7 | 3.2 | 0.3 | 187.0 | <0.01 | 0.02 | 2.4 | <0.005 | 15.00 | 14.00 | 18 | 3.20 | 91.0 |
| DUP | | 0.11 | 13.20 | 2.7 | 3.0 | 0.3 | 189.5 | <0.01 | 0.02 | 2.5 | <0.005 | 15.20 | 14.05 | 18 | 3.29 | 92.1 |
| Target Range - Lower Bound | | 0.09 | 12.00 | 2.5 | 2.7 | <0.2 | 178.5 | <0.01 | <0.01 | 2.1 | <0.005 | 13.95 | 13.25 | 16 | 2.95 | 86.9 |
| Upper Bound | | 0.12 | 14.10 | 2.9 | 3.5 | 0.4 | 198.0 | 0.02 | 0.03 | 2.8 | 0.010 | 16.25 | 14.80 | 20 | 3.54 | 96.2 |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895095-4 133636 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1895095-5 133637 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17039953

| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm | ME-MS41 Zr ppm |
|----------------------------|--------------------------|----------------|----------------|
| | | 2 | 0.5 |
| DUPLICATES | | | |
| ORIGINAL | | 7 | 1.6 |
| DUP | | 8 | 1.6 |
| Target Range - Lower Bound | | 5 | 1.0 |
| Upper Bound | | 10 | 2.2 |
| ORIGINAL | | 478 | 2.1 |
| DUP | | 488 | 2.1 |
| Target Range - Lower Bound | | 457 | 1.4 |
| Upper Bound | | 509 | 2.8 |
| ORIGINAL | | | |
| DUP | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| L1895095-4 133636 | | | |
| DUP | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| L1895095-5 133637 | | | |
| DUP | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| ORIGINAL | | | |
| DUP | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| ORIGINAL | | | |
| DUP | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| | | | |

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| | CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | |
|--------------------|---|---------|----------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|--|--|
| Applies to Method: | <p style="text-align: center;">ANALYTICAL COMMENTS</p> <p>Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41</p> | | | | | | | | | | | | | | | | |
| Applies to Method: | <p style="text-align: center;">LABORATORY ADDRESSES</p> <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> <td style="width: 33%;">OA-ELE07</td> </tr> <tr> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> <td>S-CAL06</td> </tr> <tr> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> <td>SPL-21</td> </tr> <tr> <td>WEI-21</td> <td></td> <td></td> <td></td> </tr> </table> | C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | | |
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | | | | | | | | | | | | | | |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | | | | | | | | | | | | | | |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | | | | | | | | | | | | | | |
| WEI-21 | | | | | | | | | | | | | | | | | |



Chain of Custody (COC) / Analytical Request Form



L1895095-COFC

COC Number: 15 - 14

Page of

Canada Toll Free: 1 800 668 9878

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| Report To | | Contact and company name below will appear on the final report | | Report Format / Distribution | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | |
|--|---|--|-------------|---|--------------|--|---|---|-----------------------|---|--|---|----------------------|--|--|--|--|
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | |
| Phone: | 1-604-759-4659 | Company address below will appear on the final report | | Email 1 or Fax minto_environment@mintomine.com | | Date and Time Required for all E&P TATs: | | dd-mm-yy | | hh:mm | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | |
| Street: | 2100-510 West Georgia St | Email 2 | | Email 3 | | Analysis Request | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Invoice To | | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Indicate Filtered (F); Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | |
| Invoice To | Same as Report To | Company: | | Minto Explorations Ltd. | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Contact: | | Ruth Cayetano | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | |
| ALS Account # / Quote # | | AFE/Cost Center | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE | TBD | Requisitioner: | | Location: | | | | | | | | | | | | | |
| LSD | | ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | Total Metals - Aqua regia digestion (CIP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1091) | Number of Containers | | | | |
| 1 | 133633 | | | 18-Feb-17 | | WASTE | R | R | R | R | R | | | | | | |
| 2 | 133634 | | | 18-Feb-17 | | WASTE | | | | | | | | | | | |
| 3 | 133635 | | | 18-Feb-17 | | WASTE | | | | | | | | | | | |
| 4 | 133636 | | | 18-Feb-17 | | WASTE | | | | | | | | | | | |
| 5 | 133637 | | | 18-Feb-17 | | WASTE | | | | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | Cooling Initiated <input type="checkbox"/> | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | INITIAL COOLER TEMPERATURES °C | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | |
| Released by | Date | Time | Received by | Date | Time | Received by | Date | Time | | | | | | | | | |
| | | | VD | 2027/17 | 9:30 | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form

WHITE - LABORATORY COPY YELLOW - CLIENT COPY



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 31-MAR-17
Report Date: 24-APR-17 16:34 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1908256
Project P.O. #: 220826
Job Reference:
C of C Numbers: 15-15
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1908256-1 Waste ABA COMP MM 133640 | L1908256-2 Waste ABA COMP MM 133641 | L1908256-3 Waste ABA COMP MM 133639 | L1908256-4 Waste ABA COMP MM 133645 | L1908256-5 Waste ABA COMP MM 133642 |
|---|--|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 7.9 | 7.9 | 8.2 | 7.5 | 7.8 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.19 | 0.19 | 0.48 | 0.21 | 0.17 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.3 | 0.3 | 1.3 | 1.3 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 21 | 18 | 42 | 18 | 18 |
| | NNP (tCaCO3/1Kt) | 21 | 18 | 41 | 17 | 17 |
| | Ratio (NP/MPA) (Unity) | 67.20 | 57.60 | 33.60 | 14.40 | 28.80 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.01 | 0.01 | 0.04 | 0.04 | 0.02 |
| | Total Sulfur (combustion) (%) | 0.01 | 0.01 | 0.04 | 0.04 | 0.02 |
| Total Metals | Aluminum (Al) (%) | 1.14 | 1.01 | 0.55 | 1.15 | 1.16 |
| | Antimony (Sb) (ppm) | 0.48 | 0.56 | 0.14 | 0.59 | 0.56 |
| | Arsenic (As) (ppm) | 5.9 | 6.4 | 5.9 | 7.0 | 6.3 |
| | Barium (Ba) (ppm) | 360 | 310 | 880 | 290 | 300 |
| | Beryllium (Be) (ppm) | 0.43 | 0.47 | 0.56 | 0.48 | 0.44 |
| | Bismuth (Bi) (ppm) | 0.08 | 0.11 | 1.04 | 0.11 | 0.11 |
| | Boron (B) (ppm) | <10 | <10 | 10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.22 | 0.23 | 0.20 | 0.31 | 0.25 |
| | Calcium (Ca) (%) | 1.05 | 0.92 | 1.83 | 1.02 | 0.96 |
| | Cerium (Ce) (ppm) | 26.2 | 23.4 | 6.99 | 27.0 | 26.1 |
| | Cesium (Cs) (ppm) | 0.88 | 0.90 | 0.55 | 0.91 | 0.92 |
| | Chromium (Cr) (ppm) | 19 | 21 | 4 | 27 | 27 |
| | Cobalt (Co) (ppm) | 9.0 | 8.8 | 6.8 | 9.4 | 8.9 |
| | Copper (Cu) (ppm) | 475 | 150.5 | 3150 | 95.3 | 87.3 |
| | Gallium (Ga) (ppm) | 4.56 | 4.24 | 4.66 | 4.06 | 4.08 |
| | Germanium (Ge) (ppm) | 0.06 | 0.06 | 0.05 | 0.05 | 0.05 |
| | Gold (Au) (ppm) | <0.02 | <0.02 | 0.29 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.20 | 0.19 | 0.07 | 0.25 | 0.22 |
| | Indium (In) (ppm) | 0.031 | 0.032 | 0.068 | 0.023 | 0.023 |
| | Iron (Fe) (%) | 2.69 | 2.57 | 3.60 | 2.54 | 2.53 |
| | Lanthanum (La) (ppm) | 13.5 | 12.1 | 3.9 | 13.8 | 13.2 |
| | Lead (Pb) (ppm) | 5.3 | 6.0 | 6.6 | 6.7 | 6.5 |
| | Lithium (Li) (ppm) | 7.8 | 7.7 | 3.1 | 8.8 | 8.5 |
| | Magnesium (Mg) (%) | 0.54 | 0.46 | 0.14 | 0.61 | 0.56 |
| | Manganese (Mn) (ppm) | 588 | 529 | 654 | 550 | 504 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1908256-6 Waste ABA COMP MM 133644 | L1908256-7 Waste ABA COMP MM 133643 | L1908256-8 Waste ABA COMP MM 133647 | L1908256-9 Waste ABA COMP MM 133646 | L1908256-10 Tails 28-MAR-17 TAILS COMP FEB 2017 |
|---|--|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.6 | 8.2 | 8.5 | 7.8 | 8.2 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.29 | 0.47 | 0.19 | 0.30 | 0.26 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.3 | 0.6 | 3.1 | 1.6 | 1.9 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 31 | 39 | 20 | 25 | 25 |
| | NNP (tCaCO3/1Kt) | 31 | 38 | 17 | 23 | 23 |
| | Ratio (NP/MPA) (Unity) | 99.20 | 62.40 | 6.40 | 16.00 | 13.33 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.01 | 0.02 | 0.10 | 0.05 | 0.06 |
| | Total Sulfur (combustion) (%) | 0.01 | 0.02 | 0.10 | 0.05 | 0.06 |
| Total Metals | Aluminum (Al) (%) | 1.02 | 1.01 | 1.37 | 1.20 | 1.47 |
| | Antimony (Sb) (ppm) | <0.05 | 0.69 | <0.05 | 0.58 | <0.05 |
| | Arsenic (As) (ppm) | 1.2 | 8.1 | 0.8 | 9.3 | 1.7 |
| | Barium (Ba) (ppm) | 220 | 320 | 310 | 330 | 200 |
| | Beryllium (Be) (ppm) | 0.27 | 0.38 | 0.25 | 0.47 | 0.30 |
| | Bismuth (Bi) (ppm) | 0.02 | 0.09 | 0.07 | 0.12 | 0.20 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.04 | 0.26 | 0.15 | 0.33 | 0.22 |
| | Calcium (Ca) (%) | 1.29 | 1.85 | 0.86 | 1.32 | 1.24 |
| | Cerium (Ce) (ppm) | 26.4 | 24.7 | 32.3 | 30.4 | 22.6 |
| | Cesium (Cs) (ppm) | 0.48 | 0.82 | 0.53 | 0.99 | 0.57 |
| | Chromium (Cr) (ppm) | 4 | 23 | 5 | 27 | 6 |
| | Cobalt (Co) (ppm) | 5.4 | 7.6 | 7.1 | 10.2 | 6.3 |
| | Copper (Cu) (ppm) | 155.5 | 56.9 | 2130 | 450 | 1420 |
| | Gallium (Ga) (ppm) | 5.08 | 3.31 | 7.41 | 4.24 | 7.61 |
| | Germanium (Ge) (ppm) | 0.06 | <0.05 | 0.07 | 0.05 | 0.06 |
| | Gold (Au) (ppm) | <0.02 | <0.02 | 0.04 | 0.02 | 0.08 |
| | Hafnium (Hf) (ppm) | 0.03 | 0.22 | 0.03 | 0.22 | 0.04 |
| | Indium (In) (ppm) | 0.024 | 0.023 | 0.082 | 0.040 | 0.086 |
| | Iron (Fe) (%) | 2.25 | 2.48 | 3.26 | 2.79 | 3.19 |
| | Lanthanum (La) (ppm) | 14.1 | 12.3 | 16.9 | 15.2 | 11.9 |
| | Lead (Pb) (ppm) | 2.7 | 9.0 | 3.0 | 8.3 | 2.8 |
| | Lithium (Li) (ppm) | 5.3 | 7.2 | 7.5 | 8.4 | 7.6 |
| | Magnesium (Mg) (%) | 0.55 | 0.58 | 0.79 | 0.63 | 0.80 |
| | Manganese (Mn) (ppm) | 580 | 555 | 589 | 585 | 615 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1908256-11 | L1908256-12 | | | |
|-----------------------------------|--|--------------|-----------------------|-----------------------|--|--|--|
| | | Description | Waste | Waste | | | |
| | | Sampled Date | 28-MAR-17 | 28-MAR-17 | | | |
| | | Sampled Time | | | | | |
| | | Client ID | ABA COMP MM 133649 | ABA COMP MM 133650 | | | |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Physical Tests | pH (Unity) | | 7.9 | 7.9 | | | |
| Organic / Inorganic Carbon | Carbon (C) (%) | | 0.14 | 0.22 | | | |
| Acid Base Accounting | FIZZ RATING (Unity) | | 2 | 2 | | | |
| | MPA (tCaCO3/1Kt) | | 0.6 | 0.6 | | | |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | 16 | 21 | | | |
| | NNP (tCaCO3/1Kt) | | 15 | 20 | | | |
| | Ratio (NP/MPA) (Unity) | | 25.60 | 33.60 | | | |
| | Sulfate Sulfur (carbonate leach) (%) | | <0.01 | <0.01 | | | |
| | Sulfate Sulfur (HCl leach) (%) | | 0.03 | 0.02 | | | |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | 0.02 | 0.02 | | | |
| | Total Sulfur (combustion) (%) | | 0.02 | 0.02 | | | |
| Total Metals | Aluminum (Al) (%) | | 1.10 | 1.14 | | | |
| | Antimony (Sb) (ppm) | | 0.58 | 0.59 | | | |
| | Arsenic (As) (ppm) | | 7.0 | 6.5 | | | |
| | Barium (Ba) (ppm) | | 290 | 270 | | | |
| | Beryllium (Be) (ppm) | | 0.46 | 0.48 | | | |
| | Bismuth (Bi) (ppm) | | 0.11 | 0.10 | | | |
| | Boron (B) (ppm) | | <10 | <10 | | | |
| | Cadmium (Cd) (ppm) | | 0.24 | 0.25 | | | |
| | Calcium (Ca) (%) | | 0.91 | 1.08 | | | |
| | Cerium (Ce) (ppm) | | 27.7 | 27.2 | | | |
| | Cesium (Cs) (ppm) | | 0.82 | 0.95 | | | |
| | Chromium (Cr) (ppm) | | 27 | 26 | | | |
| | Cobalt (Co) (ppm) | | 9.0 | 9.0 | | | |
| | Copper (Cu) (ppm) | | 201 | 74.5 | | | |
| | Gallium (Ga) (ppm) | | 4.12 | 4.24 | | | |
| | Germanium (Ge) (ppm) | | 0.05 | 0.05 | | | |
| | Gold (Au) (ppm) | | 0.05 | <0.02 | | | |
| | Hafnium (Hf) (ppm) | | 0.25 | 0.26 | | | |
| | Indium (In) (ppm) | | 0.023 | 0.023 | | | |
| | Iron (Fe) (%) | | 2.54 | 2.47 | | | |
| | Lanthanum (La) (ppm) | | 14.2 | 13.9 | | | |
| | Lead (Pb) (ppm) | | 6.4 | 7.3 | | | |
| | Lithium (Li) (ppm) | | 8.6 | 8.8 | | | |
| | Magnesium (Mg) (%) | | 0.52 | 0.60 | | | |
| | Manganese (Mn) (ppm) | | 504 | 519 | | | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1908256-1 Waste ABA COMP MM 133640 | L1908256-2 Waste ABA COMP MM 133641 | L1908256-3 Waste ABA COMP MM 133639 | L1908256-4 Waste ABA COMP MM 133645 | L1908256-5 Waste ABA COMP MM 133642 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.02 | 0.03 | 0.01 | 0.05 | 0.03 |
| | Molybdenum (Mo) (ppm) | 1.33 | 1.22 | 1.41 | 1.21 | 1.38 |
| | Nickel (Ni) (ppm) | 16.3 | 19.4 | 2.9 | 24.4 | 23.9 |
| | Niobium (Nb) (ppm) | 0.46 | 0.35 | 0.07 | 0.99 | 0.68 |
| | Phosphorus (P) (ppm) | 1020 | 760 | 430 | 830 | 870 |
| | Potassium (K) (%) | 0.37 | 0.22 | 0.24 | 0.18 | 0.19 |
| | Rhenium (Re) (ppm) | <0.001 | <0.001 | <0.001 | 0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | 18.6 | 12.9 | 13.6 | 11.4 | 11.4 |
| | Scandium (Sc) (ppm) | 5.1 | 5.3 | 4.5 | 4.7 | 4.6 |
| | Selenium (Se) (ppm) | 0.5 | 0.5 | 1.4 | 0.8 | 0.7 |
| | Silver (Ag) (ppm) | 0.08 | 0.10 | 0.85 | 0.10 | 0.10 |
| | Sodium (Na) (%) | 0.04 | 0.03 | 0.02 | 0.04 | 0.04 |
| | Strontium (Sr) (ppm) | 46.2 | 40.8 | 64.2 | 51.8 | 48.2 |
| | Sulfur (S) (%) | 0.02 | 0.02 | 0.03 | 0.03 | 0.01 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.01 | 0.03 | 0.65 | 0.01 | 0.03 |
| | Thallium (Tl) (ppm) | 0.14 | 0.12 | 0.09 | 0.13 | 0.12 |
| | Thorium (Th) (ppm) | 3.3 | 3.5 | 1.3 | 4.2 | 4.0 |
| | Tin (Sn) (ppm) | 0.6 | 0.6 | 0.8 | 0.5 | 0.5 |
| | Titanium (Ti) (%) | 0.081 | 0.060 | 0.032 | 0.068 | 0.071 |
| | Tungsten (W) (ppm) | 0.56 | 0.60 | 0.18 | 0.45 | 0.69 |
| | Uranium (U) (ppm) | 0.56 | 0.47 | 0.25 | 0.96 | 0.76 |
| | Vanadium (V) (ppm) | 56 | 53 | 74 | 53 | 52 |
| | Yttrium (Y) (ppm) | 11.30 | 9.87 | 7.42 | 9.55 | 9.28 |
| | Zinc (Zn) (ppm) | 69 | 66 | 84 | 70 | 63 |
| | Zirconium (Zr) (ppm) | 6.1 | 6.1 | 2.2 | 8.3 | 7.7 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.7 | 0.7 | 1.8 | 0.8 | 0.6 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1908256-6 Waste ABA COMP MM 133644 | L1908256-7 Waste ABA COMP MM 133643 | L1908256-8 Waste ABA COMP MM 133647 | L1908256-9 Waste ABA COMP MM 133646 | L1908256-10 Tails 28-MAR-17 TAILS COMP FEB 2017 |
|---|--------------------------|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | 0.03 | <0.01 | 0.03 | 0.01 |
| | Molybdenum (Mo) (ppm) | 0.51 | 2.81 | 1.54 | 2.64 | 0.94 |
| | Nickel (Ni) (ppm) | 2.1 | 19.9 | 2.5 | 25.1 | 3.0 |
| | Niobium (Nb) (ppm) | 0.10 | 0.22 | 0.19 | 0.53 | 0.23 |
| | Phosphorus (P) (ppm) | 620 | 900 | 820 | 970 | 1060 |
| | Potassium (K) (%) | 0.45 | 0.14 | 0.68 | 0.18 | 0.67 |
| | Rhenium (Re) (ppm) | <0.001 | 0.001 | 0.002 | 0.003 | 0.001 |
| | Rubidium (Rb) (ppm) | 20.5 | 7.5 | 32.2 | 10.6 | 37.1 |
| | Scandium (Sc) (ppm) | 4.0 | 3.9 | 4.5 | 5.2 | 4.3 |
| | Selenium (Se) (ppm) | 0.3 | 0.5 | 1.5 | 1.1 | 1.2 |
| | Silver (Ag) (ppm) | 0.03 | 0.11 | 0.54 | 0.20 | 0.53 |
| | Sodium (Na) (%) | 0.05 | 0.06 | 0.05 | 0.05 | 0.05 |
| | Strontium (Sr) (ppm) | 48.2 | 72.8 | 35.1 | 62.4 | 103.0 |
| | Sulfur (S) (%) | <0.01 | 0.02 | 0.13 | 0.06 | 0.06 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.01 | 0.02 | 0.10 | 0.03 | 0.23 |
| | Thallium (Tl) (ppm) | 0.13 | 0.09 | 0.25 | 0.12 | 0.24 |
| | Thorium (Th) (ppm) | 3.3 | 3.7 | 3.9 | 4.2 | 5.3 |
| | Tin (Sn) (ppm) | 0.5 | 0.4 | 1.2 | 0.6 | 1.0 |
| | Titanium (Ti) (%) | 0.065 | 0.068 | 0.123 | 0.071 | 0.117 |
| | Tungsten (W) (ppm) | 0.17 | 0.31 | 0.12 | 0.37 | 0.06 |
| | Uranium (U) (ppm) | 0.22 | 0.64 | 0.24 | 0.70 | 0.37 |
| | Vanadium (V) (ppm) | 46 | 44 | 66 | 57 | 68 |
| | Yttrium (Y) (ppm) | 7.70 | 10.35 | 6.86 | 11.40 | 7.52 |
| | Zinc (Zn) (ppm) | 62 | 53 | 73 | 69 | 97 |
| | Zirconium (Zr) (ppm) | 0.7 | 7.1 | 0.7 | 7.8 | 1.0 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.1 | 1.7 | 0.7 | 1.1 | 1.0 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1908256-11 | L1908256-12 | | |
|------------------------|--------------------------|--------------|-----------------------|-----------------------|--|--|
| | | Description | Waste | Waste | | |
| | | Sampled Date | 28-MAR-17 | 28-MAR-17 | | |
| | | Sampled Time | | | | |
| | | Client ID | ABA COMP MM 133649 | ABA COMP MM 133650 | | |
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.03 | 0.04 | | |
| | Molybdenum (Mo) (ppm) | | 1.37 | 1.20 | | |
| | Nickel (Ni) (ppm) | | 24.8 | 23.8 | | |
| | Niobium (Nb) (ppm) | | 0.80 | 0.65 | | |
| | Phosphorus (P) (ppm) | | 820 | 820 | | |
| | Potassium (K) (%) | | 0.17 | 0.19 | | |
| | Rhenium (Re) (ppm) | | 0.001 | 0.001 | | |
| | Rubidium (Rb) (ppm) | | 10.6 | 11.8 | | |
| | Scandium (Sc) (ppm) | | 4.8 | 4.8 | | |
| | Selenium (Se) (ppm) | | 0.6 | 0.7 | | |
| | Silver (Ag) (ppm) | | 0.12 | 0.10 | | |
| | Sodium (Na) (%) | | 0.04 | 0.04 | | |
| | Strontium (Sr) (ppm) | | 45.3 | 49.8 | | |
| | Sulfur (S) (%) | | 0.01 | 0.01 | | |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | | |
| | Tellurium (Te) (ppm) | | 0.02 | 0.02 | | |
| | Thallium (Tl) (ppm) | | 0.11 | 0.13 | | |
| | Thorium (Th) (ppm) | | 4.4 | 4.3 | | |
| | Tin (Sn) (ppm) | | 0.5 | 0.5 | | |
| | Titanium (Ti) (%) | | 0.069 | 0.065 | | |
| | Tungsten (W) (ppm) | | 0.91 | 0.77 | | |
| | Uranium (U) (ppm) | | 0.77 | 0.94 | | |
| | Vanadium (V) (ppm) | | 53 | 51 | | |
| | Yttrium (Y) (ppm) | | 9.69 | 9.50 | | |
| | Zinc (Zn) (ppm) | | 60 | 62 | | |
| | Zirconium (Zr) (ppm) | | 7.9 | 7.7 | | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.5 | 0.8 | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06-AX | Soil | Sulfide Sulfur Calc from Carbonate Leach | ALS Minerals S-CAL06 |
| Sulfide Sulfur (as S) is calculated by subtracting the Carbonate Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

15-15

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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CERTIFICATE VA17065185

Project: L1908256
 P.O. No.: ALSM-CW16-102-APN
 This report is for 12 Other samples submitted to our lab in Vancouver, BC, Canada on 4-APR-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method | WEI-21 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------------------|---------|-----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | Analyte | Recvd Wt. | Ag | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs |
| | Units | kg | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm |
| | LOR | | | | | | | | | | | | | | | |
| L1908256-1 ABA COMP MM 133640 | | 0.02 | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 |
| L1908256-2 ABA COMP MM 133641 | | 1.10 | 0.08 | 1.14 | 5.9 | <0.02 | <10 | 360 | 0.43 | 0.08 | 1.05 | 0.22 | 26.2 | 9.0 | 19 | 0.88 |
| L1908256-3 ABA COMP MM 133639 | | 1.12 | 0.10 | 1.01 | 6.4 | <0.02 | <10 | 310 | 0.47 | 0.11 | 0.92 | 0.23 | 23.4 | 8.8 | 21 | 0.90 |
| L1908256-4 ABA COMP MM 133645 | | 1.10 | 0.85 | 0.55 | 5.9 | 0.29 | 10 | 880 | 0.56 | 1.04 | 1.83 | 0.20 | 6.99 | 6.8 | 4 | 0.55 |
| L1908256-5 ABA COMP MM 133642 | | 1.14 | 0.10 | 1.15 | 7.0 | <0.02 | <10 | 290 | 0.48 | 0.11 | 1.02 | 0.31 | 27.0 | 9.4 | 27 | 0.91 |
| L1908256-6 ABA COMP MM 133644 | | 1.14 | 0.10 | 1.16 | 6.3 | <0.02 | <10 | 300 | 0.44 | 0.11 | 0.96 | 0.25 | 26.1 | 8.9 | 27 | 0.92 |
| L1908256-7 ABA COMP MM 133643 | | 1.14 | 0.03 | 1.02 | 1.2 | <0.02 | <10 | 220 | 0.27 | 0.02 | 1.29 | 0.04 | 26.4 | 5.4 | 4 | 0.48 |
| L1908256-8 ABA COMP MM 133647 | | 1.14 | 0.11 | 1.01 | 8.1 | <0.02 | <10 | 320 | 0.38 | 0.09 | 1.85 | 0.26 | 24.7 | 7.6 | 23 | 0.82 |
| L1908256-9 ABA COMP MM 133646 | | 1.06 | 0.54 | 1.37 | 0.8 | 0.04 | <10 | 310 | 0.25 | 0.07 | 0.86 | 0.15 | 32.3 | 7.1 | 5 | 0.53 |
| L1908256-10 TAILS COMP FEB2017 | | 1.14 | 0.20 | 1.20 | 9.3 | 0.02 | <10 | 330 | 0.47 | 0.12 | 1.32 | 0.33 | 30.4 | 10.2 | 27 | 0.99 |
| L1908256-11 ABA COMP MM 133649 | | 0.46 | 0.53 | 1.47 | 1.7 | 0.08 | <10 | 200 | 0.30 | 0.20 | 1.24 | 0.22 | 22.6 | 6.3 | 6 | 0.57 |
| L1908256-12 ABA COMP MM 133650 | | 1.12 | 0.12 | 1.10 | 7.0 | 0.05 | <10 | 290 | 0.46 | 0.11 | 0.91 | 0.24 | 27.7 | 9.0 | 27 | 0.82 |
| | | 1.10 | 0.10 | 1.14 | 6.5 | <0.02 | <10 | 270 | 0.48 | 0.10 | 1.08 | 0.25 | 27.2 | 9.0 | 26 | 0.95 |



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| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Cu | Fe | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | |
| Units | | ppm | % | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | |
| LOR | | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | |
| L1908256-1 ABA COMP MM 133640 | | 475 | 2.69 | 4.56 | 0.06 | 0.20 | 0.02 | 0.031 | 0.37 | 13.5 | 7.8 | 0.54 | 588 | 1.33 | 0.04 | 0.46 |
| L1908256-2 ABA COMP MM 133641 | | 150.5 | 2.57 | 4.24 | 0.06 | 0.19 | 0.03 | 0.032 | 0.22 | 12.1 | 7.7 | 0.46 | 529 | 1.22 | 0.03 | 0.35 |
| L1908256-3 ABA COMP MM 133639 | | 3150 | 3.60 | 4.66 | 0.05 | 0.07 | 0.01 | 0.068 | 0.24 | 3.9 | 3.1 | 0.14 | 654 | 1.41 | 0.02 | 0.07 |
| L1908256-4 ABA COMP MM 133645 | | 95.3 | 2.54 | 4.06 | 0.05 | 0.25 | 0.05 | 0.023 | 0.18 | 13.8 | 8.8 | 0.61 | 550 | 1.21 | 0.04 | 0.99 |
| L1908256-5 ABA COMP MM 133642 | | 87.3 | 2.53 | 4.08 | 0.05 | 0.22 | 0.03 | 0.023 | 0.19 | 13.2 | 8.5 | 0.56 | 504 | 1.38 | 0.04 | 0.68 |
| L1908256-6 ABA COMP MM 133644 | | 155.5 | 2.25 | 5.08 | 0.06 | 0.03 | <0.01 | 0.024 | 0.45 | 14.1 | 5.3 | 0.55 | 580 | 0.51 | 0.05 | 0.10 |
| L1908256-7 ABA COMP MM 133643 | | 56.9 | 2.48 | 3.31 | <0.05 | 0.22 | 0.03 | 0.023 | 0.14 | 12.3 | 7.2 | 0.58 | 555 | 2.81 | 0.06 | 0.22 |
| L1908256-8 ABA COMP MM 133647 | | 2130 | 3.26 | 7.41 | 0.07 | 0.03 | <0.01 | 0.082 | 0.68 | 16.9 | 7.5 | 0.79 | 589 | 1.54 | 0.05 | 0.19 |
| L1908256-9 ABA COMP MM 133646 | | 450 | 2.79 | 4.24 | 0.05 | 0.22 | 0.03 | 0.040 | 0.18 | 15.2 | 8.4 | 0.63 | 585 | 2.64 | 0.05 | 0.53 |
| L1908256-10 TAILS COMP FEB2017 | | 1420 | 3.19 | 7.61 | 0.06 | 0.04 | 0.01 | 0.086 | 0.67 | 11.9 | 7.6 | 0.80 | 615 | 0.94 | 0.05 | 0.23 |
| L1908256-11 ABA COMP MM 133649 | | 201 | 2.54 | 4.12 | 0.05 | 0.25 | 0.03 | 0.023 | 0.17 | 14.2 | 8.6 | 0.52 | 504 | 1.37 | 0.04 | 0.80 |
| L1908256-12 ABA COMP MM 133650 | | 74.5 | 2.47 | 4.24 | 0.05 | 0.26 | 0.04 | 0.023 | 0.19 | 13.9 | 8.8 | 0.60 | 519 | 1.20 | 0.04 | 0.65 |

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| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------------------|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| | | Ni | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti |
| | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % |
| | | 0.2 | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 |
| L1908256-1 ABA COMP MM 133640 | | 16.3 | 1020 | 5.3 | 18.6 | <0.001 | 0.02 | 0.48 | 5.1 | 0.5 | 0.6 | 46.2 | <0.01 | 0.01 | 3.3 | 0.081 |
| L1908256-2 ABA COMP MM 133641 | | 19.4 | 760 | 6.0 | 12.9 | <0.001 | 0.02 | 0.56 | 5.3 | 0.5 | 0.6 | 40.8 | <0.01 | 0.03 | 3.5 | 0.060 |
| L1908256-3 ABA COMP MM 133639 | | 2.9 | 430 | 6.6 | 13.6 | <0.001 | 0.03 | 0.14 | 4.5 | 1.4 | 0.8 | 64.2 | <0.01 | 0.65 | 1.3 | 0.032 |
| L1908256-4 ABA COMP MM 133645 | | 24.4 | 830 | 6.7 | 11.4 | 0.001 | 0.03 | 0.59 | 4.7 | 0.8 | 0.5 | 51.8 | <0.01 | 0.01 | 4.2 | 0.068 |
| L1908256-5 ABA COMP MM 133642 | | 23.9 | 870 | 6.5 | 11.4 | 0.001 | 0.01 | 0.56 | 4.6 | 0.7 | 0.5 | 48.2 | <0.01 | 0.03 | 4.0 | 0.071 |
| L1908256-6 ABA COMP MM 133644 | | 2.1 | 620 | 2.7 | 20.5 | <0.001 | <0.01 | <0.05 | 4.0 | 0.3 | 0.5 | 48.2 | <0.01 | 0.01 | 3.3 | 0.065 |
| L1908256-7 ABA COMP MM 133643 | | 19.9 | 900 | 9.0 | 7.5 | 0.001 | 0.02 | 0.69 | 3.9 | 0.5 | 0.4 | 72.8 | <0.01 | 0.02 | 3.7 | 0.068 |
| L1908256-8 ABA COMP MM 133647 | | 2.5 | 820 | 3.0 | 32.2 | 0.002 | 0.13 | <0.05 | 4.5 | 1.5 | 1.2 | 35.1 | <0.01 | 0.10 | 3.9 | 0.123 |
| L1908256-9 ABA COMP MM 133646 | | 25.1 | 970 | 8.3 | 10.6 | 0.003 | 0.06 | 0.58 | 5.2 | 1.1 | 0.6 | 62.4 | <0.01 | 0.03 | 4.2 | 0.071 |
| L1908256-10 TAILS COMP FEB2017 | | 3.0 | 1060 | 2.8 | 37.1 | 0.001 | 0.06 | <0.05 | 4.3 | 1.2 | 1.0 | 103.0 | <0.01 | 0.23 | 5.3 | 0.117 |
| L1908256-11 ABA COMP MM 133649 | | 24.8 | 820 | 6.4 | 10.6 | 0.001 | 0.01 | 0.58 | 4.8 | 0.6 | 0.5 | 45.3 | <0.01 | 0.02 | 4.4 | 0.069 |
| L1908256-12 ABA COMP MM 133650 | | 23.8 | 820 | 7.3 | 11.8 | 0.001 | 0.01 | 0.59 | 4.8 | 0.7 | 0.5 | 49.8 | <0.01 | 0.02 | 4.3 | 0.065 |

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| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | OA-VOL08m | S-IR08 | S-GRA06 |
|--------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|------------|-----------|------------|------------|----------|-----------|--------|---------|
| | Analyte | TI | U | V | W | Y | Zn | Zr | MPA | FIZZ RAT | NNP | NP | pH | Ratio (N | S | S |
| Units | | | | | | | | | | | | | Unity | Unity | % | % |
| LOR | | | | | | | | | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | | |
| L1908256-1 ABA COMP MM 133640 | | 0.02 | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 |
| L1908256-2 ABA COMP MM 133641 | | 0.14 | 0.56 | 56 | 0.56 | 11.30 | 69 | 6.1 | 0.3 | 2 | 21 | 21 | 7.9 | 67.20 | 0.01 | <0.01 |
| L1908256-3 ABA COMP MM 133639 | | 0.12 | 0.47 | 53 | 0.60 | 9.87 | 66 | 6.1 | 0.3 | 2 | 18 | 18 | 7.9 | 57.60 | 0.01 | <0.01 |
| L1908256-4 ABA COMP MM 133645 | | 0.09 | 0.25 | 74 | 0.18 | 7.42 | 84 | 2.2 | 1.3 | 2 | 41 | 42 | 8.2 | 33.60 | 0.04 | <0.01 |
| L1908256-5 ABA COMP MM 133642 | | 0.13 | 0.96 | 53 | 0.45 | 9.55 | 70 | 8.3 | 1.3 | 2 | 17 | 18 | 7.5 | 14.40 | 0.04 | <0.01 |
| L1908256-6 ABA COMP MM 133644 | | 0.12 | 0.76 | 52 | 0.69 | 9.28 | 63 | 7.7 | 0.6 | 2 | 17 | 18 | 7.8 | 28.80 | 0.02 | <0.01 |
| L1908256-7 ABA COMP MM 133643 | | 0.13 | 0.22 | 46 | 0.17 | 7.70 | 62 | 0.7 | 0.3 | 2 | 31 | 31 | 8.6 | 99.20 | 0.01 | <0.01 |
| L1908256-8 ABA COMP MM 133647 | | 0.09 | 0.64 | 44 | 0.31 | 10.35 | 53 | 7.1 | 0.6 | 2 | 38 | 39 | 8.2 | 62.40 | 0.02 | <0.01 |
| L1908256-9 ABA COMP MM 133646 | | 0.25 | 0.24 | 66 | 0.12 | 6.86 | 73 | 0.7 | 3.1 | 2 | 17 | 20 | 8.5 | 6.40 | 0.10 | <0.01 |
| L1908256-10 TAILS COMP FEB2017 | | 0.12 | 0.70 | 57 | 0.37 | 11.40 | 69 | 7.8 | 1.6 | 2 | 23 | 25 | 7.8 | 16.00 | 0.05 | <0.01 |
| L1908256-11 ABA COMP MM 133649 | | 0.24 | 0.37 | 68 | 0.06 | 7.52 | 97 | 1.0 | 1.9 | 2 | 23 | 25 | 8.2 | 13.33 | 0.06 | <0.01 |
| L1908256-12 ABA COMP MM 133650 | | 0.11 | 0.77 | 53 | 0.91 | 9.69 | 60 | 7.9 | 0.6 | 2 | 15 | 16 | 7.9 | 25.60 | 0.02 | <0.01 |
| | | 0.13 | 0.94 | 51 | 0.77 | 9.50 | 62 | 7.7 | 0.6 | 2 | 20 | 21 | 7.9 | 33.60 | 0.02 | <0.01 |

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CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | S-GRA06a S % | S-CAL06 S % | C-GAS05 C % | C-GAS05 CO2 % |
|--------------------------------|--------------------------|--------------|-------------|-------------|---------------|
| L1908256-1 ABA COMP MM 133640 | | 0.01 | 0.01 | 0.19 | 0.7 |
| L1908256-2 ABA COMP MM 133641 | | 0.01 | 0.01 | 0.19 | 0.7 |
| L1908256-3 ABA COMP MM 133639 | | 0.02 | 0.04 | 0.48 | 1.8 |
| L1908256-4 ABA COMP MM 133645 | | 0.02 | 0.04 | 0.21 | 0.8 |
| L1908256-5 ABA COMP MM 133642 | | 0.02 | 0.02 | 0.17 | 0.6 |
| L1908256-6 ABA COMP MM 133644 | | 0.02 | 0.01 | 0.29 | 1.1 |
| L1908256-7 ABA COMP MM 133643 | | 0.03 | 0.02 | 0.47 | 1.7 |
| L1908256-8 ABA COMP MM 133647 | | 0.03 | 0.10 | 0.19 | 0.7 |
| L1908256-9 ABA COMP MM 133646 | | 0.02 | 0.05 | 0.30 | 1.1 |
| L1908256-10 TAILS COMP FEB2017 | | 0.02 | 0.06 | 0.26 | 1.0 |
| L1908256-11 ABA COMP MM 133649 | | 0.03 | 0.02 | 0.14 | 0.5 |
| L1908256-12 ABA COMP MM 133650 | | 0.02 | 0.02 | 0.22 | 0.8 |



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CERTIFICATE OF ANALYSIS VA17065185

| | CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | |
|--------------------|---|---------|----------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|--|--|
| Applies to Method: | <p style="text-align: center;">ANALYTICAL COMMENTS</p> <p>Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41</p> | | | | | | | | | | | | | | | | |
| Applies to Method: | <p style="text-align: center;">LABORATORY ADDRESSES</p> <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> <td style="width: 33%;">OA-ELE07</td> </tr> <tr> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> <td>S-CAL06</td> </tr> <tr> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> <td>SPL-21</td> </tr> <tr> <td>WEI-21</td> <td></td> <td></td> <td></td> </tr> </table> | C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | | |
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | | | | | | | | | | | | | | |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | | | | | | | | | | | | | | |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | | | | | | | | | | | | | | |
| WEI-21 | | | | | | | | | | | | | | | | | |



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QC CERTIFICATE VA17065185

Project: L1908256
 P.O. No.: ALSM-CW16-102-APN
 This report is for 12 Other samples submitted to our lab in Vancouver, BC, Canada on 4-APR-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | |
|----------------------------|--------------------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--|
| | | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| MRGeo08 | | 4.39 | 2.57 | 32.0 | <0.02 | <10 | 430 | 0.78 | 0.67 | 1.07 | 2.10 | 70.0 | 17.6 | 90 | 10.35 | 601 | |
| MRGeo08 | | 4.20 | 2.74 | 33.8 | <0.02 | <10 | 470 | 0.74 | 0.71 | 1.16 | 2.28 | 78.6 | 19.0 | 97 | 11.60 | 624 | |
| Target Range - Lower Bound | | 4.00 | 2.44 | 29.6 | <0.02 | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 | |
| Upper Bound | | 4.92 | 3.00 | 36.4 | 0.04 | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 | |
| NBM-1 | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| OREAS 905 | | 0.50 | 0.84 | 34.9 | 0.40 | <10 | 260 | 0.86 | 6.32 | 0.37 | 0.37 | 83.8 | 14.5 | 19 | 1.30 | 1620 | |
| Target Range - Lower Bound | | 0.45 | 0.73 | 28.4 | 0.33 | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 | |
| Upper Bound | | 0.58 | 0.91 | 35.0 | 0.45 | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 | |
| UTS-1 | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| UTS-2 | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | |



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| Sample Description | Method Analyte Units LOR | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm |
|----------------------------|--------------------------|--------------|----------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|
| | | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | | 3.52 | 9.13 | 0.13 | 0.75 | 0.06 | 0.145 | 1.23 | 34.8 | 31.1 | 1.12 | 405 | 13.60 | 0.33 | 0.69 | 683 |
| MRGeo08 | | 3.88 | 9.92 | 0.15 | 0.74 | 0.06 | 0.154 | 1.33 | 40.8 | 32.0 | 1.25 | 438 | 14.55 | 0.35 | 1.01 | 751 |
| Target Range - Lower Bound | | 3.22 | 8.73 | 0.07 | 0.64 | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 |
| Upper Bound | | 3.96 | 10.80 | 0.29 | 0.83 | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 |
| NBM-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS 905 | | 3.79 | 6.20 | 0.10 | 1.20 | 0.01 | 0.608 | 0.33 | 43.5 | 4.3 | 0.17 | 371 | 2.96 | 0.10 | 0.32 | 9.0 |
| Target Range - Lower Bound | | 3.14 | 5.74 | <0.05 | 1.08 | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 |
| Upper Bound | | 3.86 | 7.12 | 0.22 | 1.36 | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-2 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm |
|----------------------------|--------------------------|---------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | | 1000 | 1015 | 136.0 | 0.008 | 0.28 | 2.80 | 6.8 | 1.3 | 3.1 | 77.0 | 0.01 | 0.02 | 21.4 | 0.358 | 0.81 |
| MRGeo08 | | 1070 | 1125 | 152.0 | 0.007 | 0.33 | 3.66 | 7.2 | 1.3 | 3.6 | 82.4 | 0.02 | 0.02 | 23.0 | 0.394 | 0.84 |
| Target Range - Lower Bound | | 900 | 959 | 132.0 | 0.006 | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 |
| Upper Bound | | 1130 | 1175 | 162.0 | 0.010 | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 |
| NBM-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS 905 | | 260 | 17.6 | 19.2 | <0.001 | 0.08 | 1.24 | 1.6 | 2.5 | 1.4 | 13.4 | <0.01 | 0.07 | 9.1 | 0.021 | 0.11 |
| Target Range - Lower Bound | | | 15.2 | 17.3 | <0.001 | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 |
| Upper Bound | | | 19.0 | 21.3 | 0.002 | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-2 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % |
|----------------------------|--------------------------|---------------|---------------|---------------|---------------|----------------|----------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|
| | | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | 6.0 | | | | |
| Buffer pH6 | | | | | | | | | | | | 6.1 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | 5.3 | | | | |
| Upper Bound | | | | | | | | | | | | 6.7 | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | 1.26 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | 1.19 | | |
| Upper Bound | | | | | | | | | | | | | | 1.29 | | |
| KZK-1 | | | | | | | | 25.0 | 2 | 32 | 57 | | | 2.28 | | |
| Target Range - Lower Bound | | | | | | | | 22.9 | <1 | 30 | 54 | | | 2.18 | | |
| Upper Bound | | | | | | | | 27.1 | >4 | 38 | 64 | | | 2.53 | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | | 5.73 | 100 | 2.80 | 18.70 | 756 | 21.3 | | | | | | | | | |
| MRGeo08 | | 6.05 | 107 | 3.08 | 20.4 | 824 | 20.5 | | | | | | | | | |
| Target Range - Lower Bound | | 4.93 | 90 | 2.44 | 17.50 | 708 | 18.1 | | | | | | | | | |
| Upper Bound | | 6.13 | 112 | 3.42 | 21.5 | 870 | 25.7 | | | | | | | | | |
| NBM-1 | | | | | | | | 9.3 | 2 | 41 | 50 | | | 5.37 | | |
| Target Range - Lower Bound | | | | | | | | 8.4 | <1 | 33 | 42 | | | 4.64 | | |
| Upper Bound | | | | | | | | 10.3 | >4 | 42 | 51 | | | 5.37 | | |
| OREAS 905 | | 2.41 | 6 | 0.67 | 7.39 | 69 | 43.0 | | | | | | | | | |
| Target Range - Lower Bound | | 2.08 | 4 | 0.44 | 6.32 | 58 | 39.9 | | | | | | | | | |
| Upper Bound | | 2.66 | 8 | 0.76 | 7.84 | 76 | 55.1 | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | 0.88 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 0.83 |
| Upper Bound | | | | | | | | | | | | | | | | 0.93 |
| UTS-1 | | | | | | | | | | | | | | | | 0.89 |
| UTS-1 | | | | | | | | | | | | | | | | 0.90 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 0.81 |
| Upper Bound | | | | | | | | | | | | | | | | 0.95 |
| UTS-2 | | | | | | | | | | | | | | 3.27 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | 3.11 | | |
| Upper Bound | | | | | | | | | | | | | | 3.35 | | |
| UTS-4 | | | | | | | | | | | | | | | 1.70 | |

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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

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QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | C-GAS05 C % | C-GAS05 CO2 % |
|----------------------------|--------------------------|-------------------|---------------------|
| | | 0.05 | 0.2 |
| STANDARDS | | | |
| Buffer pH6 | | | |
| Buffer pH6 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| CO-ASSAY | | 0.53 | 1.9 |
| Target Range - Lower Bound | | 0.42 | 1.5 |
| Upper Bound | | 0.64 | 2.4 |
| GS313-8 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| KZK-1 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| MA-2c | | 1.61 | 5.9 |
| Target Range - Lower Bound | | 1.50 | 5.5 |
| Upper Bound | | 1.84 | 6.8 |
| MGeo08 | | | |
| MGeo08 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| NBM-1 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| OREAS 905 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-1 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-1 | | | |
| UTS-1 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-2 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-4 | | | |

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QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | |
|----------------------------|--------------------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--|
| | | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | | |
| BLANK | | 0.01 | <0.01 | 0.2 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | |
| Target Range - Lower Bound | | <0.01 | <0.01 | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | 0.2 | |
| Upper Bound | | <0.01 | <0.01 | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | |
| BLANK | | 0.02 | 0.02 | 0.2 | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm |
|----------------------------|-----------------------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|
| | | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | <0.01 | <0.05 | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 |
| Target Range - Lower Bound | | <0.01 | <0.05 | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 |
| Upper Bound | | 0.02 | 0.10 | 0.10 | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17065185

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|-----------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| Sample Description | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | |
| | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <10 | 0.2 | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | |
| BLANK | <10 | 0.2 | <0.1 | <0.001 | 0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | |
| Target Range - Lower Bound | <10 | <0.2 | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | |
| Upper Bound | 20 | 0.4 | 0.2 | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm 0.05 | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | OA-VOL08m MPA tCaCO3/1Kt 0.3 | OA-VOL08m FIZZ RAT Unity 1 | OA-VOL08m NNP tCaCO3/1Kt 1 | OA-VOL08m NP tCaCO3/1Kt 1 | OA-ELE07 pH Unity 0.1 | OA-VOL08m Ratio (N) Unity 0.01 | S-IR08 S % 0.01 | S-GRA06 S % 0.01 | S-GRA06a S % 0.01 | |
|----------------------------|--------------------------|--------------------|-----------------|--------------------|--------------------|------------------|--------------------|------------------------------|----------------------------|----------------------------|---------------------------|-----------------------|--------------------------------|-----------------|------------------|-------------------|-------|
| STANDARDS | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 1.64 | | |
| Target Range - Upper Bound | | | | | | | | | | | | | | | 1.84 | | |
| UTS-4 | | | | | | | | | | | | | | | | | 1.77 |
| UTS-4 | | | | | | | | | | | | | | | | | 1.77 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | 1.61 |
| Target Range - Upper Bound | | | | | | | | | | | | | | | | | 1.87 |
| BLANKS | | | | | | | | | | | | | | | | | |
| BLANK | | <0.05 | <1 | <0.05 | <0.05 | <2 | <0.5 | | | | | | | | | | |
| Target Range - Lower Bound | | <0.05 | <1 | <0.05 | <0.05 | <2 | <0.5 | | | | | | | | | | |
| Target Range - Upper Bound | | 0.10 | 2 | 0.10 | 0.10 | 4 | 1.0 | | | | | | | | | | |
| BLANK | | | | | | | | | | | | 6.0 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | 5.5 | | | | | |
| Target Range - Upper Bound | | | | | | | | | | | | 6.9 | | | | | |
| BLANK | | | | | | | | | | | | | | | <0.01 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | <0.01 | | |
| Target Range - Upper Bound | | | | | | | | | | | | | | | 0.02 | | |
| BLANK | | | | | | | | | | | | | | | | | <0.01 |
| BLANK | | | | | | | | | | | | | | | | | <0.01 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | <0.01 |
| Target Range - Upper Bound | | | | | | | | | | | | | | | | | 0.02 |
| BLANK | | | | | | | | | | | | | | | | | <0.01 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | <0.01 |
| Target Range - Upper Bound | | | | | | | | | | | | | | | | | 0.02 |



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QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units | C-GAS05 C % | C-GAS05 CO2 % |
|----------------------------|----------------------|-------------------|---------------------|
| | LOR | 0.05 | 0.2 |
| STANDARDS | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-4 | | | |
| UTS-4 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANKS | | | |
| BLANK | | <0.05 | <0.2 |
| Target Range - Lower Bound | | <0.05 | <0.2 |
| Upper Bound | | 0.10 | 0.4 |
| BLANK | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |



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QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------------------|-----------------------------------|-----------|---------|-----------|-----------|----------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|
| | | Ag ppm | Al % | As ppm | Au ppm | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm |
| | | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 0.18 | 1.99 | 0.6 | <0.02 | <10 | 40 | 0.17 | 0.01 | 1.42 | 0.03 | 7.19 | 16.0 | 16 | 0.08 | 88.9 |
| DUP | | 0.16 | 2.06 | 0.6 | <0.02 | <10 | 40 | 0.15 | 0.01 | 1.47 | 0.03 | 7.09 | 15.3 | 17 | 0.09 | 88.1 |
| Target Range - Lower Bound | | 0.15 | 1.91 | 0.5 | <0.02 | <10 | 30 | 0.10 | <0.01 | 1.36 | 0.02 | 6.76 | 14.8 | 15 | <0.05 | 85.2 |
| Upper Bound | | 0.19 | 2.14 | 0.7 | 0.04 | 20 | 50 | 0.22 | 0.02 | 1.53 | 0.04 | 7.52 | 16.5 | 18 | 0.10 | 91.8 |
| L1908256-3 ABA COMP MM 133639 | | 0.85 | 0.55 | 5.9 | 0.29 | 10 | 880 | 0.56 | 1.04 | 1.83 | 0.20 | 6.99 | 6.8 | 4 | 0.55 | 3150 |
| DUP | | 0.82 | 0.52 | 5.4 | 0.14 | 10 | 830 | 0.55 | 1.02 | 1.74 | 0.20 | 6.85 | 6.6 | 4 | 0.53 | 3010 |
| Target Range - Lower Bound | | 0.78 | 0.50 | 5.3 | 0.18 | <10 | 780 | 0.48 | 0.97 | 1.69 | 0.18 | 6.55 | 6.3 | 3 | 0.46 | 2970 |
| Upper Bound | | 0.89 | 0.57 | 6.0 | 0.25 | 20 | 930 | 0.63 | 1.09 | 1.88 | 0.22 | 7.29 | 7.1 | 5 | 0.62 | 3190 |
| L1908256-7 ABA COMP MM 133643 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1908256-8 ABA COMP MM 133647 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1908256-10 TAILS COMP FEB2017 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1908256-12 ABA COMP MM 133650 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------------------|-----------------------------------|-------------------|-----------|-----------|-----------|-----------|-----------|---------|-----------|-----------|---------|-----------|-----------|---------|-----------|-----------|
| | | Fe % | Ga ppm | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm |
| | | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| | | DUPLICATES | | | | | | | | | | | | | | |
| ORIGINAL | | 2.92 | 5.75 | <0.05 | 0.10 | <0.01 | 0.006 | 0.07 | 3.0 | 12.4 | 1.62 | 799 | 0.93 | 0.05 | 0.08 | 12.5 |
| DUP | | 2.99 | 5.54 | <0.05 | 0.10 | <0.01 | 0.007 | 0.08 | 3.0 | 11.2 | 1.64 | 811 | 1.01 | 0.05 | 0.09 | 12.4 |
| Target Range - Lower Bound | | 2.80 | 5.31 | <0.05 | 0.08 | <0.01 | <0.005 | 0.06 | 2.7 | 11.1 | 1.54 | 760 | 0.87 | 0.04 | <0.05 | 11.6 |
| Upper Bound | | 3.11 | 5.98 | 0.10 | 0.13 | 0.02 | 0.010 | 0.09 | 3.4 | 12.5 | 1.72 | 850 | 1.07 | 0.06 | 0.10 | 13.3 |
| L1908256-3 ABA COMP MM 133639 | | 3.60 | 4.66 | 0.05 | 0.07 | 0.01 | 0.068 | 0.24 | 3.9 | 3.1 | 0.14 | 654 | 1.41 | 0.02 | 0.07 | 2.9 |
| DUP | | 3.44 | 4.57 | 0.05 | 0.07 | 0.01 | 0.069 | 0.23 | 3.8 | 3.0 | 0.14 | 623 | 1.33 | 0.02 | 0.07 | 2.9 |
| Target Range - Lower Bound | | 3.33 | 4.33 | <0.05 | 0.05 | <0.01 | 0.060 | 0.21 | 3.5 | 2.8 | 0.12 | 602 | 1.25 | <0.01 | <0.05 | 2.6 |
| Upper Bound | | 3.71 | 4.90 | 0.10 | 0.09 | 0.02 | 0.077 | 0.26 | 4.2 | 3.3 | 0.16 | 675 | 1.49 | 0.03 | 0.10 | 3.2 |
| L1908256-7 ABA COMP MM 133643 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1908256-8 ABA COMP MM 133647 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1908256-10 TAILS COMP FEB2017 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1908256-12 ABA COMP MM 133650 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

***** See Appendix Page for comments regarding this certificate *****



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 100 - 8081 LOUGHEED HWY.
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 Account: APN

Project: L1908256

QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 | ME-MS41 Rb ppm 0.1 | ME-MS41 Re ppm 0.001 | ME-MS41 S % 0.01 | ME-MS41 Sb ppm 0.05 | ME-MS41 Sc ppm 0.1 | ME-MS41 Se ppm 0.2 | ME-MS41 Sn ppm 0.2 | ME-MS41 Sr ppm 0.2 | ME-MS41 Ta ppm 0.01 | ME-MS41 Te ppm 0.01 | ME-MS41 Th ppm 0.2 | ME-MS41 Ti % 0.005 | ME-MS41 Tl ppm 0.02 |
|--------------------------------|-----------------------------------|---------------------------|-----------------------------|-----------------------------|-------------------------------|---------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 570 | 1.0 | 1.5 | <0.001 | 0.03 | 0.24 | 3.0 | 0.2 | 0.3 | 49.4 | <0.01 | <0.01 | 1.7 | 0.181 | <0.02 |
| DUP | | 570 | 1.6 | 1.6 | <0.001 | 0.03 | 0.25 | 3.0 | 0.3 | 0.3 | 51.8 | <0.01 | <0.01 | 1.4 | 0.193 | <0.02 |
| Target Range - Lower Bound | | 530 | 1.0 | 1.4 | <0.001 | 0.02 | 0.18 | 2.8 | <0.2 | <0.2 | 47.9 | <0.01 | <0.01 | 1.3 | 0.173 | <0.02 |
| Upper Bound | | 610 | 1.6 | 1.7 | 0.002 | 0.04 | 0.31 | 3.3 | 0.4 | 0.4 | 53.3 | 0.02 | 0.02 | 1.8 | 0.201 | 0.04 |
| L1908256-3 ABA COMP MM 133639 | | 430 | 6.6 | 13.6 | <0.001 | 0.03 | 0.14 | 4.5 | 1.4 | 0.8 | 64.2 | <0.01 | 0.65 | 1.3 | 0.032 | 0.09 |
| DUP | | 420 | 6.5 | 13.3 | <0.001 | 0.03 | 0.12 | 4.3 | 1.4 | 0.8 | 63.6 | <0.01 | 0.65 | 1.2 | 0.030 | 0.08 |
| Target Range - Lower Bound | | 390 | 6.0 | 12.7 | <0.001 | 0.02 | 0.07 | 4.1 | 1.1 | 0.6 | 60.5 | <0.01 | 0.61 | 1.0 | 0.024 | 0.06 |
| Upper Bound | | 460 | 7.1 | 14.2 | 0.002 | 0.04 | 0.19 | 4.7 | 1.7 | 1.0 | 67.3 | 0.02 | 0.69 | 1.5 | 0.038 | 0.11 |
| L1908256-7 ABA COMP MM 133643 | | DUP | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1908256-8 ABA COMP MM 133647 | | DUP | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1908256-10 TAILS COMP FEB2017 | | DUP | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1908256-12 ABA COMP MM 133650 | | DUP | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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 Finalized Date: 24-APR-2017
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QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % |
|--------------------------------|--------------------------|---------------|---------------|---------------|---------------|----------------|----------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|
| | | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 0.60 | 51 | 0.21 | 6.10 | 89 | 1.0 | | | | | | | | | |
| DUP | | 0.55 | 53 | 0.21 | 6.20 | 90 | 1.4 | | | | | | | | | |
| Target Range - Lower Bound | | 0.50 | 48 | 0.14 | 5.79 | 83 | 0.6 | | | | | | | | | |
| Upper Bound | | 0.65 | 56 | 0.28 | 6.51 | 96 | 1.8 | | | | | | | | | |
| L1908256-3 ABA COMP MM 133639 | | 0.25 | 74 | 0.18 | 7.42 | 84 | 2.2 | | | | | | | | | |
| DUP | | 0.24 | 71 | 0.16 | 7.18 | 78 | 2.1 | | | | | | | | | |
| Target Range - Lower Bound | | 0.18 | 68 | 0.11 | 6.89 | 75 | 1.5 | | | | | | | | | |
| Upper Bound | | 0.31 | 77 | 0.23 | 7.72 | 87 | 2.8 | | | | | | | | | |
| L1908256-7 ABA COMP MM 133643 | | | | | | | | | | | | | | | | 0.03 |
| DUP | | | | | | | | | | | | | | | | 0.03 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 0.02 |
| Upper Bound | | | | | | | | | | | | | | | | 0.04 |
| L1908256-8 ABA COMP MM 133647 | | | | | | | | | | | | | | 0.10 | | |
| DUP | | | | | | | | | | | | | | 0.11 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | 0.09 | | |
| Upper Bound | | | | | | | | | | | | | | 0.12 | | |
| L1908256-10 TAILS COMP FEB2017 | | | | | | | | 1.9 | 2 | 23 | 25 | 8.2 | 13.33 | | | <0.01 |
| DUP | | | | | | | | 1.9 | 2 | 23 | 25 | 8.2 | 13.33 | | | <0.01 |
| Target Range - Lower Bound | | | | | | | | 1.5 | <1 | 21 | 23 | 7.7 | 12.65 | | | <0.01 |
| Upper Bound | | | | | | | | 2.3 | 3 | 25 | 27 | 8.7 | 14.01 | | | 0.02 |
| L1908256-12 ABA COMP MM 133650 | | | | | | | | | | | | | | | | 0.02 |
| DUP | | | | | | | | | | | | | | | | 0.02 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | <0.01 |
| Upper Bound | | | | | | | | | | | | | | | | 0.03 |

***** See Appendix Page for comments regarding this certificate *****



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 Total # Pages: 4 (A - E)
 Plus Appendix Pages
 Finalized Date: 24-APR-2017
 Account: APN

Project: L1908256

QC CERTIFICATE OF ANALYSIS VA17065185

| Sample Description | Method Analyte Units LOR | C-GAS05 C % | C-GAS05 CO2 % |
|--|--------------------------|-------------------|---------------------|
| | | 0.05 | 0.2 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | DUPLICATES | | |
| L1908256-3 ABA COMP MM 133639 DUP Target Range - Lower Bound Upper Bound | | | |
| L1908256-7 ABA COMP MM 133643 DUP Target Range - Lower Bound Upper Bound | | | |
| L1908256-8 ABA COMP MM 133647 DUP Target Range - Lower Bound Upper Bound | | | |
| L1908256-10 TAILS COMP FEB2017 DUP Target Range - Lower Bound Upper Bound | 0.26 | 1.0 | |
| | 0.26 | 0.9 | |
| | 0.20 | 0.7 | |
| | 0.32 | 1.2 | |
| L1908256-12 ABA COMP MM 133650 DUP Target Range - Lower Bound Upper Bound | | | |
| | | | |

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QC CERTIFICATE OF ANALYSIS VA17065185

CERTIFICATE COMMENTS

| | | | | | | | | | | | | | | | | | |
|--------------------|--|---------|----------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|--|--|
| | ANALYTICAL COMMENTS | | | | | | | | | | | | | | | | |
| Applies to Method: | Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41 | | | | | | | | | | | | | | | | |
| | LABORATORY ADDRESSES | | | | | | | | | | | | | | | | |
| Applies to Method: | Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada. | | | | | | | | | | | | | | | | |
| | <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> <td style="width: 33%;">OA-ELE07</td> </tr> <tr> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> <td>S-CAL06</td> </tr> <tr> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> <td>SPL-21</td> </tr> <tr> <td>WEI-21</td> <td></td> <td></td> <td></td> </tr> </table> | C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | | |
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | | | | | | | | | | | | | | |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | | | | | | | | | | | | | | |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | | | | | | | | | | | | | | |
| WEI-21 | | | | | | | | | | | | | | | | | |



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Canada Toll Free: 1 800 668 9878



L1908256-COFC

COC Number: 15 - 15

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| | | | | | | | |
|--|--|---|---|---|--|-------------------------|---|
| Report To Contact and company name below will appear on the final report | | Report Format / L. | | <input type="checkbox"/> Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply <input type="checkbox"/> 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] | | | |
| Company: Minto Explorations Ltd. | Contact: Minto Environment - Coordinator | Phone: 1-604-759-4659 | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: minto_environment@mintomine.com Email 2 Email 3 | | 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> |
| Company address below will appear on the final report | | Invoice To | | Analysis Request | | | |
| Street: 2100-510 West Georgia St. | City/Province: Vancouver, British Columbia | Postal Code: V6B 0M3 | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: ap@mintomine.com Email 2 | | Date and Time Required for all E&P TATs: dd-mmm-yy hh.mm For tests that can not be performed according to the service level selected, you will be contacted. |
| Project Information | | Oil and Gas Required Fields (client use) | | Indicate Filtered (F) Preserved (P) or Filtered and Preserved (F/P) below | | | |
| ALS Account # / Quote # | Job # | PO / AFE: TBD | ALS Lab Work Order # (lab use only) | AFE/Cost Center | PO# | Major/Minor Code | Routing Code |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Requisitioner: | Location: | ALS Contact: | Sampler: |
| | ABA COMP mm 133640 | | | | | | |
| | ABA COMP mm 133641 | | | | | | |
| | ABA COMP mm 133639 | | | | | | |
| | ABA COMP mm 133645 | | | | | | |
| | ABA COMP mm 133642 | | | | | | |
| | ABA COMP mm 133644 | | | | | | |
| | ABA COMP mm 133643 | | | | | | |
| | ABA COMP mm 1333647 | | | | | | |
| | ABA COMP mm 1333646 | | | | | | |
| | TAILS COMP FEB 2017 | MARCH 28/17 | | | | | |
| | ABA COMP mm 133649 | MARCH 28/17 | | | | | |
| | ABA COMP mm 133650 | MARCH 28/17 | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input checked="" type="checkbox"/> | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | INITIAL COOLER TEMPERATURES °C: 9.0 FINAL COOLER TEMPERATURES °C: 5 | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | FINAL SHIPMENT RECEPTION (lab use only) | | | |
| Released by: JOEY M | Date: MARCH 29/17 | Time: | Received by: EHF | Date: 31 March 2017 | Time: 16:18 | Received by: JK | Date: 04/04/2017 |
| | | | | | | | Time: 14:35 |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 18-APR-17
Report Date: 09-MAY-17 17:20 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1914704
Project P.O. #: 220826
Job Reference:
C of C Numbers: 15-16
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1914704-1 WASTE 28-MAR-17 132276 | L1914704-2 WASTE 01-APR-17 133648 | L1914704-3 WASTE 13-APR-17 132277 | L1914704-4 WASTE 13-APR-17 132279 | L1914704-5 WASTE 13-APR-17 132280 |
|-------------------------------|---|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.1 | 8.3 | 8.1 | 8.5 | 8.0 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.24 | 0.14 | 0.07 | 0.52 | 0.27 |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | 1 | 1 | 2 | 1 |
| | MPA (tCaCO3/1Kt) | 0.9 | 0.6 | 0.6 | 0.3 | 1.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 23 | 16 | 10 | 49 | 23 |
| | NNP (tCaCO3/1Kt) | 22 | 15 | 9 | 49 | 21 |
| | Ratio (NP/MPA) (Unity) | 24.53 | 25.60 | 16.00 | 156.80 | 14.72 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.01 | <0.01 | <0.01 | <0.01 | 0.04 |
| | Total Sulfur (combustion) (%) | 0.03 | 0.02 | 0.02 | 0.01 | 0.05 |
| Total Metals | Aluminum (Al) (%) | 1.20 | 1.04 | 0.97 | 0.77 | 1.30 |
| | Antimony (Sb) (ppm) | 0.29 | 0.25 | 0.40 | <0.05 | 0.66 |
| | Arsenic (As) (ppm) | 3.2 | 5.0 | 6.4 | 1.3 | 6.6 |
| | Barium (Ba) (ppm) | 240 | 300 | 260 | 140 | 310 |
| | Beryllium (Be) (ppm) | 0.44 | 0.43 | 0.56 | 0.46 | 0.57 |
| | Bismuth (Bi) (ppm) | 0.06 | 0.10 | 0.12 | 0.08 | 0.12 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.14 | 0.16 | 0.19 | 0.06 | 0.22 |
| | Calcium (Ca) (%) | 1.14 | 0.80 | 0.58 | 2.14 | 1.20 |
| | Cerium (Ce) (ppm) | 34.2 | 25.0 | 23.5 | 28.1 | 29.5 |
| | Cesium (Cs) (ppm) | 0.80 | 0.67 | 0.76 | 0.69 | 0.93 |
| | Chromium (Cr) (ppm) | 13 | 12 | 16 | 5 | 28 |
| | Cobalt (Co) (ppm) | 8.8 | 7.9 | 8.3 | 6.7 | 10.4 |
| | Copper (Cu) (ppm) | 334 | 1310 | 747 | 352 | 317 |
| | Gallium (Ga) (ppm) | 5.78 | 5.24 | 5.32 | 4.16 | 4.85 |
| | Germanium (Ge) (ppm) | 0.06 | 0.06 | 0.05 | 0.05 | 0.06 |
| | Gold (Au) (ppm) | 0.04 | 0.02 | 0.07 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.12 | 0.10 | 0.15 | 0.05 | 0.21 |
| | Indium (In) (ppm) | 0.035 | 0.038 | 0.043 | 0.040 | 0.031 |
| | Iron (Fe) (%) | 2.78 | 2.43 | 2.55 | 2.51 | 2.57 |
| | Lanthanum (La) (ppm) | 17.4 | 12.5 | 12.1 | 14.6 | 14.8 |
| | Lead (Pb) (ppm) | 5.2 | 3.3 | 5.3 | 3.3 | 6.7 |
| | Lithium (Li) (ppm) | 7.3 | 6.8 | 6.1 | 2.7 | 8.4 |
| | Magnesium (Mg) (%) | 0.60 | 0.46 | 0.35 | 0.25 | 0.62 |
| | Manganese (Mn) (ppm) | 587 | 554 | 497 | 683 | 526 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1914704-6 WASTE 13-APR-17 132283 | L1914704-7 WASTE 13-APR-17 132284 | L1914704-8 WASTE 13-APR-17 132286 | L1914704-9 WASTE 13-APR-17 132288 | L1914704-10 WASTE 13-APR-17 132289 |
|-------------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.5 | 7.9 | 8.0 | 8.6 | 8.4 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.11 | 0.15 | 0.28 | 0.19 | 0.69 |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | 1 | 1 | 1 | 2 |
| | MPA (tCaCO3/1Kt) | 0.6 | 0.9 | 1.3 | 0.9 | 10.9 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 12 | 18 | 26 | 20 | 55 |
| | NNP (tCaCO3/1Kt) | 11 | 17 | 25 | 19 | 44 |
| | Ratio (NP/MPA) (Unity) | 19.20 | 19.20 | 20.80 | 21.33 | 5.03 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.01 | 0.02 | 0.03 | 0.02 | 0.34 |
| | Total Sulfur (combustion) (%) | 0.02 | 0.03 | 0.04 | 0.03 | 0.35 |
| Total Metals | Aluminum (Al) (%) | 0.83 | 1.53 | 1.48 | 1.12 | 1.19 |
| | Antimony (Sb) (ppm) | 0.22 | 0.79 | 0.81 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 5.3 | 7.7 | 8.0 | 1.0 | 1.0 |
| | Barium (Ba) (ppm) | 340 | 340 | 340 | 280 | 290 |
| | Beryllium (Be) (ppm) | 0.43 | 0.62 | 0.68 | 0.26 | 0.37 |
| | Bismuth (Bi) (ppm) | 0.05 | 0.13 | 0.26 | 0.03 | 0.13 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.11 | 0.28 | 0.32 | 0.10 | 0.42 |
| | Calcium (Ca) (%) | 0.62 | 1.04 | 1.32 | 0.87 | 2.39 |
| | Cerium (Ce) (ppm) | 15.95 | 32.1 | 33.0 | 43.1 | 23.3 |
| | Cesium (Cs) (ppm) | 0.61 | 1.25 | 1.28 | 0.37 | 0.32 |
| | Chromium (Cr) (ppm) | 10 | 36 | 33 | 7 | 5 |
| | Cobalt (Co) (ppm) | 6.2 | 11.7 | 12.3 | 7.2 | 8.4 |
| | Copper (Cu) (ppm) | 183.0 | 62.1 | 686 | 1300 | 3740 |
| | Gallium (Ga) (ppm) | 5.34 | 5.12 | 5.28 | 6.02 | 7.47 |
| | Germanium (Ge) (ppm) | 0.05 | 0.05 | 0.06 | 0.07 | 0.05 |
| | Gold (Au) (ppm) | <0.02 | <0.02 | <0.02 | 0.09 | 0.04 |
| | Hafnium (Hf) (ppm) | 0.10 | 0.27 | 0.27 | 0.03 | 0.03 |
| | Indium (In) (ppm) | 0.043 | 0.028 | 0.037 | 0.048 | 0.075 |
| | Iron (Fe) (%) | 2.34 | 2.83 | 2.91 | 2.74 | 3.24 |
| | Lanthanum (La) (ppm) | 7.7 | 16.2 | 16.2 | 22.0 | 12.7 |
| | Lead (Pb) (ppm) | 4.2 | 7.6 | 7.8 | 3.2 | 4.0 |
| | Lithium (Li) (ppm) | 4.7 | 10.3 | 10.6 | 5.6 | 7.2 |
| | Magnesium (Mg) (%) | 0.25 | 0.70 | 0.76 | 0.55 | 0.65 |
| | Manganese (Mn) (ppm) | 389 | 532 | 573 | 628 | 1120 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1914704-11 WASTE 13-APR-17 132290 | | | | |
|---|---|-------|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | 7.9 | | | |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.16 | | | |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | | | |
| | MPA (tCaCO3/1Kt) | 1.3 | | | |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 14 | | | |
| | NNP (tCaCO3/1Kt) | 13 | | | |
| | Ratio (NP/MPA) (Unity) | 11.20 | | | |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | | | |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | | | |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.03 | | | |
| | Total Sulfur (combustion) (%) | 0.04 | | | |
| Total Metals | Aluminum (Al) (%) | 1.20 | | | |
| | Antimony (Sb) (ppm) | 0.56 | | | |
| | Arsenic (As) (ppm) | 6.2 | | | |
| | Barium (Ba) (ppm) | 310 | | | |
| | Beryllium (Be) (ppm) | 0.48 | | | |
| | Bismuth (Bi) (ppm) | 0.10 | | | |
| | Boron (B) (ppm) | <10 | | | |
| | Cadmium (Cd) (ppm) | 0.22 | | | |
| | Calcium (Ca) (%) | 0.88 | | | |
| | Cerium (Ce) (ppm) | 27.5 | | | |
| | Cesium (Cs) (ppm) | 0.80 | | | |
| | Chromium (Cr) (ppm) | 26 | | | |
| | Cobalt (Co) (ppm) | 9.8 | | | |
| | Copper (Cu) (ppm) | 101.5 | | | |
| | Gallium (Ga) (ppm) | 4.53 | | | |
| | Germanium (Ge) (ppm) | 0.05 | | | |
| | Gold (Au) (ppm) | <0.02 | | | |
| | Hafnium (Hf) (ppm) | 0.23 | | | |
| | Indium (In) (ppm) | 0.023 | | | |
| | Iron (Fe) (%) | 2.42 | | | |
| | Lanthanum (La) (ppm) | 14.2 | | | |
| | Lead (Pb) (ppm) | 5.8 | | | |
| | Lithium (Li) (ppm) | 8.6 | | | |
| | Magnesium (Mg) (%) | 0.58 | | | |
| | Manganese (Mn) (ppm) | 521 | | | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1914704-1 | L1914704-2 | L1914704-3 | L1914704-4 | L1914704-5 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 28-MAR-17 | 01-APR-17 | 13-APR-17 | 13-APR-17 | 13-APR-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 132276 | 133648 | 132277 | 132279 | 132280 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | <0.01 | 0.01 | <0.01 | 0.02 |
| | Molybdenum (Mo) (ppm) | | 1.13 | 1.40 | 1.31 | 1.65 | 1.68 |
| | Nickel (Ni) (ppm) | | 10.9 | 8.7 | 13.2 | 2.1 | 24.3 |
| | Niobium (Nb) (ppm) | | 0.25 | 0.36 | 0.53 | 0.07 | 0.78 |
| | Phosphorus (P) (ppm) | | 860 | 800 | 700 | 750 | 820 |
| | Potassium (K) (%) | | 0.27 | 0.39 | 0.27 | 0.27 | 0.21 |
| | Rhenium (Re) (ppm) | | 0.001 | <0.001 | <0.001 | <0.001 | 0.002 |
| | Rubidium (Rb) (ppm) | | 14.6 | 19.6 | 14.0 | 14.0 | 12.8 |
| | Scandium (Sc) (ppm) | | 5.7 | 5.5 | 6.7 | 7.0 | 5.8 |
| | Selenium (Se) (ppm) | | 0.6 | 0.8 | 0.7 | 0.7 | 1.0 |
| | Silver (Ag) (ppm) | | 0.11 | 0.21 | 0.17 | 0.10 | 0.15 |
| | Sodium (Na) (%) | | 0.04 | 0.05 | 0.04 | 0.04 | 0.04 |
| | Strontium (Sr) (ppm) | | 62.1 | 41.1 | 40.7 | 57.2 | 67.5 |
| | Sulfur (S) (%) | | 0.02 | 0.01 | 0.01 | <0.01 | 0.04 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.02 | 0.05 | 0.04 | 0.03 | 0.03 |
| | Thallium (Tl) (ppm) | | 0.10 | 0.13 | 0.11 | 0.08 | 0.12 |
| | Thorium (Th) (ppm) | | 4.5 | 3.0 | 3.2 | 3.7 | 3.9 |
| | Tin (Sn) (ppm) | | 0.6 | 0.6 | 0.6 | 0.6 | 0.5 |
| | Titanium (Ti) (%) | | 0.057 | 0.065 | 0.051 | 0.029 | 0.068 |
| | Tungsten (W) (ppm) | | 0.97 | 0.53 | 0.88 | 0.28 | 0.80 |
| | Uranium (U) (ppm) | | 0.44 | 0.31 | 0.45 | 0.30 | 0.80 |
| | Vanadium (V) (ppm) | | 56 | 53 | 54 | 50 | 54 |
| | Yttrium (Y) (ppm) | | 9.95 | 9.67 | 10.30 | 11.55 | 10.75 |
| | Zinc (Zn) (ppm) | | 76 | 67 | 70 | 66 | 68 |
| | Zirconium (Zr) (ppm) | | 4.0 | 3.1 | 5.3 | 1.4 | 8.3 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.9 | 0.5 | 0.3 | 1.9 | 1.0 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1914704-6 | L1914704-7 | L1914704-8 | L1914704-9 | L1914704-10 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|-------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 13-APR-17 | 13-APR-17 | 13-APR-17 | 13-APR-17 | 13-APR-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 132283 | 132284 | 132286 | 132288 | 132289 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | 0.03 | 0.04 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | | 0.98 | 1.30 | 1.51 | 1.94 | 32.1 |
| | Nickel (Ni) (ppm) | | 7.1 | 31.7 | 32.8 | 3.1 | 2.5 |
| | Niobium (Nb) (ppm) | | 0.27 | 0.79 | 0.68 | 0.20 | 0.06 |
| | Phosphorus (P) (ppm) | | 560 | 870 | 910 | 720 | 810 |
| | Potassium (K) (%) | | 0.31 | 0.22 | 0.25 | 0.47 | 0.25 |
| | Rhenium (Re) (ppm) | | <0.001 | 0.001 | 0.001 | <0.001 | 0.146 |
| | Rubidium (Rb) (ppm) | | 15.1 | 13.8 | 14.7 | 22.1 | 12.9 |
| | Scandium (Sc) (ppm) | | 6.1 | 6.3 | 6.5 | 7.8 | 4.9 |
| | Selenium (Se) (ppm) | | 0.4 | 0.8 | 1.1 | 0.9 | 3.2 |
| | Silver (Ag) (ppm) | | 0.08 | 0.12 | 0.26 | 0.24 | 0.63 |
| | Sodium (Na) (%) | | 0.04 | 0.04 | 0.05 | 0.07 | 0.04 |
| | Strontium (Sr) (ppm) | | 43.5 | 56.8 | 65.6 | 43.3 | 63.3 |
| | Sulfur (S) (%) | | 0.01 | 0.02 | 0.03 | 0.02 | 0.39 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.02 | 0.02 | 0.06 | 0.03 | 0.11 |
| | Thallium (Tl) (ppm) | | 0.09 | 0.13 | 0.14 | 0.14 | 0.07 |
| | Thorium (Th) (ppm) | | 1.9 | 4.5 | 4.7 | 6.3 | 2.6 |
| | Tin (Sn) (ppm) | | 0.8 | 0.5 | 0.6 | 0.8 | 1.1 |
| | Titanium (Ti) (%) | | 0.040 | 0.073 | 0.073 | 0.071 | 0.026 |
| | Tungsten (W) (ppm) | | 0.65 | 1.30 | 0.50 | 0.43 | 0.55 |
| | Uranium (U) (ppm) | | 0.20 | 0.84 | 1.02 | 0.25 | 0.47 |
| | Vanadium (V) (ppm) | | 48 | 58 | 58 | 56 | 55 |
| | Yttrium (Y) (ppm) | | 8.54 | 11.00 | 11.80 | 7.69 | 7.54 |
| | Zinc (Zn) (ppm) | | 61 | 74 | 79 | 68 | 88 |
| | Zirconium (Zr) (ppm) | | 3.5 | 10.0 | 9.9 | 0.9 | 1.0 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.4 | 0.6 | 1.0 | 0.7 | 2.5 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1914704-11 | | | | |
|------------------------|--------------------------|--------------|-------------|--|--|--|--|
| | | Description | WASTE | | | | |
| | | Sampled Date | 13-APR-17 | | | | |
| | | Sampled Time | | | | | |
| | | Client ID | 132290 | | | | |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.02 | | | | |
| | Molybdenum (Mo) (ppm) | | 1.20 | | | | |
| | Nickel (Ni) (ppm) | | 21.7 | | | | |
| | Niobium (Nb) (ppm) | | 1.04 | | | | |
| | Phosphorus (P) (ppm) | | 790 | | | | |
| | Potassium (K) (%) | | 0.20 | | | | |
| | Rhenium (Re) (ppm) | | <0.001 | | | | |
| | Rubidium (Rb) (ppm) | | 12.8 | | | | |
| | Scandium (Sc) (ppm) | | 5.6 | | | | |
| | Selenium (Se) (ppm) | | 0.7 | | | | |
| | Silver (Ag) (ppm) | | 0.10 | | | | |
| | Sodium (Na) (%) | | 0.05 | | | | |
| | Strontium (Sr) (ppm) | | 58.4 | | | | |
| | Sulfur (S) (%) | | 0.02 | | | | |
| | Tantalum (Ta) (ppm) | | <0.01 | | | | |
| | Tellurium (Te) (ppm) | | 0.02 | | | | |
| | Thallium (Tl) (ppm) | | 0.11 | | | | |
| | Thorium (Th) (ppm) | | 3.8 | | | | |
| | Tin (Sn) (ppm) | | 0.5 | | | | |
| | Titanium (Ti) (%) | | 0.075 | | | | |
| | Tungsten (W) (ppm) | | 0.80 | | | | |
| | Uranium (U) (ppm) | | 0.74 | | | | |
| | Vanadium (V) (ppm) | | 53 | | | | |
| | Yttrium (Y) (ppm) | | 9.83 | | | | |
| | Zinc (Zn) (ppm) | | 59 | | | | |
| | Zirconium (Zr) (ppm) | | 8.7 | | | | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.6 | | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|-----------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| <p>A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.</p> | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06-AX | Soil | Sulfide Sulfur Calc from Carbonate Leach | ALS Minerals S-CAL06 |
| <p>Sulfide Sulfur (as S) is calculated by subtracting the Carbonate Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.</p> | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| <p>A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| <p>A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| <p>The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

15-16

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page: 1
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 Plus Appendix Pages
 Finalized Date: 8-MAY-2017
 Account: APN

CERTIFICATE VA17077364

Project: L1914704
 P.O. No.: ALSM-CW16-102-APN
 This report is for 11 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 21-APR-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| SPL-21 | Split sample - riffle splitter |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: ALS ENVIRONMENTAL
 ATTN: SHANE STACK
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 BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 8-MAY-2017
 Account: APN

Project: L1914704

CERTIFICATE OF ANALYSIS VA17077364

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | S-CAL06 S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % |
|--------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|-------------|---------------|----------------|--------------|
| L1914704-1 132276 | | 0.02 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 |
| L1914704-2 133648 | | 1.14 | 0.9 | 1 | 22 | 23 | 8.1 | 24.53 | 0.03 | 0.02 | <0.01 | 0.01 | 0.24 | 0.9 | 0.11 | 1.20 |
| L1914704-3 132277 | | 1.12 | 0.6 | 1 | 15 | 16 | 8.3 | 25.60 | 0.02 | 0.02 | <0.01 | <0.01 | 0.14 | 0.5 | 0.21 | 1.04 |
| L1914704-4 132279 | | 1.12 | 0.6 | 1 | 9 | 10 | 8.1 | 16.00 | 0.02 | 0.02 | <0.01 | <0.01 | 0.07 | 0.3 | 0.17 | 0.97 |
| L1914704-5 132280 | | 1.12 | 0.3 | 2 | 49 | 49 | 8.5 | 156.80 | 0.01 | 0.01 | 0.02 | <0.01 | 0.52 | 1.9 | 0.10 | 0.77 |
| L1914704-6 132283 | | 1.14 | 1.6 | 1 | 21 | 23 | 8.0 | 14.72 | 0.05 | 0.01 | <0.01 | 0.04 | 0.27 | 1.0 | 0.15 | 1.30 |
| L1914704-7 132284 | | 1.14 | 0.6 | 1 | 11 | 12 | 8.5 | 19.20 | 0.02 | 0.01 | <0.01 | 0.01 | 0.11 | 0.4 | 0.08 | 0.83 |
| L1914704-8 132286 | | 1.12 | 0.9 | 1 | 17 | 18 | 7.9 | 19.20 | 0.03 | 0.01 | <0.01 | 0.02 | 0.15 | 0.6 | 0.12 | 1.53 |
| L1914704-9 132288 | | 1.12 | 1.3 | 1 | 25 | 26 | 8.0 | 20.80 | 0.04 | 0.01 | <0.01 | 0.03 | 0.28 | 1.0 | 0.26 | 1.48 |
| L1914704-10 132289 | | 0.98 | 0.9 | 1 | 19 | 20 | 8.6 | 21.33 | 0.03 | 0.01 | <0.01 | 0.02 | 0.19 | 0.7 | 0.24 | 1.12 |
| L1914704-11 132290 | | 1.06 | 10.9 | 2 | 44 | 55 | 8.4 | 5.03 | 0.35 | 0.01 | <0.01 | 0.34 | 0.69 | 2.5 | 0.63 | 1.19 |

***** See Appendix Page for comments regarding this certificate *****



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 Account: APN

Project: L1914704

CERTIFICATE OF ANALYSIS VA17077364

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|-----------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga |
| | | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| | | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 |
| L1914704-1 132276 | | 3.2 | 0.04 | <10 | 240 | 0.44 | 0.06 | 1.14 | 0.14 | 34.2 | 8.8 | 13 | 0.80 | 334 | 2.78 | 5.78 |
| L1914704-2 133648 | | 5.0 | 0.02 | <10 | 300 | 0.43 | 0.10 | 0.80 | 0.16 | 25.0 | 7.9 | 12 | 0.67 | 1310 | 2.43 | 5.24 |
| L1914704-3 132277 | | 6.4 | 0.07 | <10 | 260 | 0.56 | 0.12 | 0.58 | 0.19 | 23.5 | 8.3 | 16 | 0.76 | 747 | 2.55 | 5.32 |
| L1914704-4 132279 | | 1.3 | <0.02 | <10 | 140 | 0.46 | 0.08 | 2.14 | 0.06 | 28.1 | 6.7 | 5 | 0.69 | 352 | 2.51 | 4.16 |
| L1914704-5 132280 | | 6.6 | <0.02 | <10 | 310 | 0.57 | 0.12 | 1.20 | 0.22 | 29.5 | 10.4 | 28 | 0.93 | 317 | 2.57 | 4.85 |
| L1914704-6 132283 | | 5.3 | <0.02 | <10 | 340 | 0.43 | 0.05 | 0.62 | 0.11 | 15.95 | 6.2 | 10 | 0.61 | 183.0 | 2.34 | 5.34 |
| L1914704-7 132284 | | 7.7 | <0.02 | <10 | 340 | 0.62 | 0.13 | 1.04 | 0.28 | 32.1 | 11.7 | 36 | 1.25 | 62.1 | 2.83 | 5.12 |
| L1914704-8 132286 | | 8.0 | <0.02 | <10 | 340 | 0.68 | 0.26 | 1.32 | 0.32 | 33.0 | 12.3 | 33 | 1.28 | 686 | 2.91 | 5.28 |
| L1914704-9 132288 | | 1.0 | 0.09 | <10 | 280 | 0.26 | 0.03 | 0.87 | 0.10 | 43.1 | 7.2 | 7 | 0.37 | 1300 | 2.74 | 6.02 |
| L1914704-10 132289 | | 1.0 | 0.04 | <10 | 290 | 0.37 | 0.13 | 2.39 | 0.42 | 23.3 | 8.4 | 5 | 0.32 | 3740 | 3.24 | 7.47 |
| L1914704-11 132290 | | 6.2 | <0.02 | <10 | 310 | 0.48 | 0.10 | 0.88 | 0.22 | 27.5 | 9.8 | 26 | 0.80 | 101.5 | 2.42 | 4.53 |



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CERTIFICATE OF ANALYSIS VA17077364

| Sample Description | Method Analyte Units LOR | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 | ME-MS41 Hg ppm 0.01 | ME-MS41 In ppm 0.005 | ME-MS41 K % 0.01 | ME-MS41 La ppm 0.2 | ME-MS41 Li ppm 0.1 | ME-MS41 Mg % 0.01 | ME-MS41 Mn ppm 5 | ME-MS41 Mo ppm 0.05 | ME-MS41 Na % 0.01 | ME-MS41 Nb ppm 0.05 | ME-MS41 Ni ppm 0.2 | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 |
|--------------------|-----------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|---------------------------|-----------------------------|-----------------------------|----------------------------|---------------------------|------------------------------|----------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|
| L1914704-1 132276 | | 0.06 | 0.12 | <0.01 | 0.035 | 0.27 | 17.4 | 7.3 | 0.60 | 587 | 1.13 | 0.04 | 0.25 | 10.9 | 860 | 5.2 |
| L1914704-2 133648 | | 0.06 | 0.10 | <0.01 | 0.038 | 0.39 | 12.5 | 6.8 | 0.46 | 554 | 1.40 | 0.05 | 0.36 | 8.7 | 800 | 3.3 |
| L1914704-3 132277 | | 0.05 | 0.15 | 0.01 | 0.043 | 0.27 | 12.1 | 6.1 | 0.35 | 497 | 1.31 | 0.04 | 0.53 | 13.2 | 700 | 5.3 |
| L1914704-4 132279 | | 0.05 | 0.05 | <0.01 | 0.040 | 0.27 | 14.6 | 2.7 | 0.25 | 683 | 1.65 | 0.04 | 0.07 | 2.1 | 750 | 3.3 |
| L1914704-5 132280 | | 0.06 | 0.21 | 0.02 | 0.031 | 0.21 | 14.8 | 8.4 | 0.62 | 526 | 1.68 | 0.04 | 0.78 | 24.3 | 820 | 6.7 |
| L1914704-6 132283 | | 0.05 | 0.10 | <0.01 | 0.043 | 0.31 | 7.7 | 4.7 | 0.25 | 389 | 0.98 | 0.04 | 0.27 | 7.1 | 560 | 4.2 |
| L1914704-7 132284 | | 0.05 | 0.27 | 0.03 | 0.028 | 0.22 | 16.2 | 10.3 | 0.70 | 532 | 1.30 | 0.04 | 0.79 | 31.7 | 870 | 7.6 |
| L1914704-8 132286 | | 0.06 | 0.27 | 0.04 | 0.037 | 0.25 | 16.2 | 10.6 | 0.76 | 573 | 1.51 | 0.05 | 0.68 | 32.8 | 910 | 7.8 |
| L1914704-9 132288 | | 0.07 | 0.03 | <0.01 | 0.048 | 0.47 | 22.0 | 5.6 | 0.55 | 628 | 1.94 | 0.07 | 0.20 | 3.1 | 720 | 3.2 |
| L1914704-10 132289 | | 0.05 | 0.03 | <0.01 | 0.075 | 0.25 | 12.7 | 7.2 | 0.65 | 1120 | 32.1 | 0.04 | 0.06 | 2.5 | 810 | 4.0 |
| L1914704-11 132290 | | 0.05 | 0.23 | 0.02 | 0.023 | 0.20 | 14.2 | 8.6 | 0.58 | 521 | 1.20 | 0.05 | 1.04 | 21.7 | 790 | 5.8 |

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CERTIFICATE OF ANALYSIS VA17077364

| Sample Description | Method Analyte Units LOR | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm |
|--------------------|--------------------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|
| L1914704-1 132276 | | 14.6 | 0.001 | 0.02 | 0.29 | 5.7 | 0.6 | 0.6 | 62.1 | <0.01 | 0.02 | 4.5 | 0.057 | 0.10 | 0.44 | 56 |
| L1914704-2 133648 | | 19.6 | <0.001 | 0.01 | 0.25 | 5.5 | 0.8 | 0.6 | 41.1 | <0.01 | 0.05 | 3.0 | 0.065 | 0.13 | 0.31 | 53 |
| L1914704-3 132277 | | 14.0 | <0.001 | 0.01 | 0.40 | 6.7 | 0.7 | 0.6 | 40.7 | <0.01 | 0.04 | 3.2 | 0.051 | 0.11 | 0.45 | 54 |
| L1914704-4 132279 | | 14.0 | <0.001 | <0.01 | <0.05 | 7.0 | 0.7 | 0.6 | 57.2 | <0.01 | 0.03 | 3.7 | 0.029 | 0.08 | 0.30 | 50 |
| L1914704-5 132280 | | 12.8 | 0.002 | 0.04 | 0.66 | 5.8 | 1.0 | 0.5 | 67.5 | <0.01 | 0.03 | 3.9 | 0.068 | 0.12 | 0.80 | 54 |
| L1914704-6 132283 | | 15.1 | <0.001 | 0.01 | 0.22 | 6.1 | 0.4 | 0.8 | 43.5 | <0.01 | 0.02 | 1.9 | 0.040 | 0.09 | 0.20 | 48 |
| L1914704-7 132284 | | 13.8 | 0.001 | 0.02 | 0.79 | 6.3 | 0.8 | 0.5 | 56.8 | <0.01 | 0.02 | 4.5 | 0.073 | 0.13 | 0.84 | 58 |
| L1914704-8 132286 | | 14.7 | 0.001 | 0.03 | 0.81 | 6.5 | 1.1 | 0.6 | 65.6 | <0.01 | 0.06 | 4.7 | 0.073 | 0.14 | 1.02 | 58 |
| L1914704-9 132288 | | 22.1 | <0.001 | 0.02 | <0.05 | 7.8 | 0.9 | 0.8 | 43.3 | <0.01 | 0.03 | 6.3 | 0.071 | 0.14 | 0.25 | 56 |
| L1914704-10 132289 | | 12.9 | 0.146 | 0.39 | <0.05 | 4.9 | 3.2 | 1.1 | 63.3 | <0.01 | 0.11 | 2.6 | 0.026 | 0.07 | 0.47 | 55 |
| L1914704-11 132290 | | 12.8 | <0.001 | 0.02 | 0.56 | 5.6 | 0.7 | 0.5 | 58.4 | <0.01 | 0.02 | 3.8 | 0.075 | 0.11 | 0.74 | 53 |



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CERTIFICATE OF ANALYSIS VA17077364

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------|-----------------------------------|------------------|------------------|----------------|------------------|
| | | W ppm 0.05 | Y ppm 0.05 | Zn ppm 2 | Zr ppm 0.5 |
| L1914704-1 132276 | | 0.97 | 9.95 | 76 | 4.0 |
| L1914704-2 133648 | | 0.53 | 9.67 | 67 | 3.1 |
| L1914704-3 132277 | | 0.88 | 10.30 | 70 | 5.3 |
| L1914704-4 132279 | | 0.28 | 11.55 | 66 | 1.4 |
| L1914704-5 132280 | | 0.80 | 10.75 | 68 | 8.3 |
| L1914704-6 132283 | | 0.65 | 8.54 | 61 | 3.5 |
| L1914704-7 132284 | | 1.30 | 11.00 | 74 | 10.0 |
| L1914704-8 132286 | | 0.50 | 11.80 | 79 | 9.9 |
| L1914704-9 132288 | | 0.43 | 7.69 | 68 | 0.9 |
| L1914704-10 132289 | | 0.55 | 7.54 | 88 | 1.0 |
| L1914704-11 132290 | | 0.80 | 9.83 | 59 | 8.7 |



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CERTIFICATE OF ANALYSIS VA17077364

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
 ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|-----------|----------|---------|----------|
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



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QC CERTIFICATE VA17077364

Project: L1914704
 P.O. No.: ALSM-CW16-102-APN
 This report is for 11 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 21-APR-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| SPL-21 | Split sample - riffle splitter |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: ALS ENVIRONMENTAL
 ATTN: SHANE STACK
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17077364

| Method Analyte Units LOR | OA-VOL08m MPA | OA-VOL08m FIZZ RAT | OA-VOL08m NNP | OA-VOL08m NP | OA-ELE07 pH | OA-VOL08m Ratio (N) | S-IR08 S | S-GRA06 S | S-GRA06a S | S-CAL06 S | C-GAS05 C | C-GAS05 CO2 | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As | |
|----------------------------|---------------|--------------------|---------------|--------------|-------------|---------------------|----------|-----------|------------|-----------|-----------|-------------|------------|------------|------------|--|
| Sample Description | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | % | ppm | % | ppm | |
| | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | 6.0 | | | | | | | | | | | |
| Buffer pH6 | | | | | 6.0 | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.3 | | | | | | | | | | | |
| Upper Bound | | | | | 6.7 | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | 0.52 | 1.9 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | 0.42 | 1.5 | | | | |
| Upper Bound | | | | | | | | | | | 0.64 | 2.4 | | | | |
| GS313-8 | | | | | | | | 1.24 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.19 | | | | | | | | |
| Upper Bound | | | | | | | | 1.29 | | | | | | | | |
| KZK-1 | 25.0 | 2 | 32 | 57 | | 2.28 | | | | | | | | | | |
| Target Range - Lower Bound | 22.9 | <1 | 30 | 54 | | 2.18 | | | | | | | | | | |
| Upper Bound | 27.1 | >4 | 38 | 64 | | 2.53 | | | | | | | | | | |
| MA-2c | | | | | | | | | | | 1.66 | 6.1 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | 1.50 | 5.5 | | | | |
| Upper Bound | | | | | | | | | | | 1.84 | 6.8 | | | | |
| NBM-1 | 9.3 | 2 | 38 | 47 | | 5.05 | | | | | | | | | | |
| Target Range - Lower Bound | 8.4 | <1 | 33 | 42 | | 4.64 | | | | | | | | | | |
| Upper Bound | 10.3 | >4 | 42 | 51 | | 5.37 | | | | | | | | | | |
| OGGeo08 | | | | | | | | | | | | | 20.8 | 2.33 | 123.5 | |
| Target Range - Lower Bound | | | | | | | | | | | | | 18.15 | 2.05 | 107.0 | |
| Upper Bound | | | | | | | | | | | | | 22.2 | 2.53 | 131.0 | |
| OREAS 920 | | | | | | | | | | | | | 0.11 | 2.43 | 4.7 | |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.07 | 2.18 | 3.8 | |
| Upper Bound | | | | | | | | | | | | | 0.12 | 2.68 | 4.9 | |
| UTS-1 | | | | | | | | 0.87 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.83 | | | | | | | | |
| Upper Bound | | | | | | | | 0.93 | | | | | | | | |
| UTS-1 | | | | | | | | | 0.89 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.81 | | | | | | | |
| Upper Bound | | | | | | | | | 0.95 | | | | | | | |
| UTS-2 | | | | | | | | 3.30 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 3.11 | | | | | | | | |
| Upper Bound | | | | | | | | 3.35 | | | | | | | | |
| UTS-4 | | | | | | | | | 1.73 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 1.64 | | | | | | | |
| Upper Bound | | | | | | | | | 1.84 | | | | | | | |
| UTS-4 | | | | | | | | | | 1.73 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 1.61 | | | | | | |
| Upper Bound | | | | | | | | | | 1.87 | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17077364

| Method Analyte Units LOR | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm |
|----------------------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| NBM-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OGGeo08 | 0.07 | <10 | 50 | 0.82 | 11.80 | 0.97 | 19.80 | 65.0 | 103.5 | 84 | 9.95 | 8660 | 5.22 | 9.29 | 0.16 |
| Target Range - Lower Bound | 0.03 | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | 4.51 | 8.05 | 0.21 |
| Upper Bound | 0.11 | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | 5.53 | 9.95 | 0.45 |
| OREAS 920 | <0.02 | <10 | 80 | 0.76 | 0.63 | 0.34 | 0.05 | 76.7 | 15.3 | 43 | 2.10 | 111.5 | 3.64 | 6.97 | 0.09 |
| Target Range - Lower Bound | <0.02 | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | 3.26 | 6.12 | <0.05 |
| Upper Bound | 0.04 | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | 4.00 | 7.60 | 0.22 |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-2 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17077364

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | | |
|----------------------------|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|------|-------|--|
| | | | | | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P | Pb | Rb | |
| | | | | | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | |
| | | | | | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | |
| STANDARDS | | | | | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| NBM-1 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| OGGeo08 | | | | | 0.85 | 0.47 | 1.545 | 1.11 | 31.4 | 31.4 | 1.01 | 398 | 911 | 0.32 | 1.08 | 9270 | 820 | 7460 | 130.5 | |
| Target Range - Lower Bound | | | | | 0.72 | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 | 700 | 6520 | 109.5 | |
| Upper Bound | | | | | 0.92 | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 | 880 | 7970 | 134.5 | |
| OREAS 920 | | | | | 0.56 | <0.01 | 0.031 | 0.44 | 38.6 | 22.1 | 1.12 | 523 | 0.35 | 0.02 | 0.34 | 40.1 | 730 | 23.0 | 25.1 | |
| Target Range - Lower Bound | | | | | 0.53 | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 | | 19.2 | 22.2 | |
| Upper Bound | | | | | 0.69 | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 | | 23.9 | 27.4 | |
| UTS-1 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| UTS-2 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |



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Project: L1914704

QC CERTIFICATE OF ANALYSIS VA17077364

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | | |
|----------------------------|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|------|-----|------|
| | | | | | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U | V | W |
| | | | | | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm |
| | | | | | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| NBM-1 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| OGGeo08 | | | | | 1.465 | 2.87 | 22.6 | 7.5 | 12.2 | 13.7 | 72.1 | 0.01 | 0.16 | 16.8 | 0.319 | 1.42 | 4.92 | 83 | 3.31 |
| Target Range - Lower Bound | | | | | 1.295 | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | 4.45 | 70 | 2.58 |
| Upper Bound | | | | | 1.585 | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | 5.55 | 88 | 3.60 |
| OREAS 920 | | | | | <0.001 | 0.03 | 0.71 | 2.9 | 1.1 | 1.1 | 17.8 | 0.01 | 0.02 | 16.0 | 0.131 | 0.16 | 2.06 | 26 | 0.52 |
| Target Range - Lower Bound | | | | | <0.001 | <0.01 | 0.45 | 2.5 | 0.4 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | 1.89 | 23 | 0.31 |
| Upper Bound | | | | | 0.002 | 0.05 | 0.77 | 3.3 | 1.3 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | 2.42 | 30 | 0.61 |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| UTS-2 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17077364

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|--------------------------|--------------------|------------------|--------------------|
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| CO-ASSAY | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS313-8 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-2c | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| NBM-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OGGeo08 | | 18.40 | 7210 | 26.0 |
| Target Range - Lower Bound | | 15.35 | 6500 | 19.5 |
| Upper Bound | | 18.85 | 7950 | 27.5 |
| OREAS 920 | | 18.80 | 104 | 22.8 |
| Target Range - Lower Bound | | 16.85 | 93 | 17.6 |
| Upper Bound | | 20.7 | 119 | 25.0 |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-2 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

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QC CERTIFICATE OF ANALYSIS VA17077364

| Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | S-CAL06 S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|-------------|---------------|----------------|--------------|----------------|
| Sample Description | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | <0.05 | <0.2 | | | |
| Target Range - Lower Bound | | | | | | | | | | | <0.05 | <0.2 | | | |
| Upper Bound | | | | | | | | | | | 0.10 | 0.4 | | | |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 |
| Upper Bound | | | | | | | | | | | | | 0.02 | 0.02 | 0.2 |
| BLANK | | | | 6.3 | | | | | | | | | | | |
| Target Range - Lower Bound | | | | 5.5 | | | | | | | | | | | |
| Upper Bound | | | | 6.9 | | | | | | | | | | | |
| BLANK | | | | | | | | <0.01 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.01 | | | | | | | |
| Upper Bound | | | | | | | | 0.02 | | | | | | | |
| BLANK | | | | | | | | | | <0.01 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.01 | | | | | |
| Upper Bound | | | | | | | | | | 0.02 | | | | | |
| BLANK | | | | | | | | 0.02 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.01 | | | | | | | |
| Upper Bound | | | | | | | | 0.02 | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| L1914704-4 132279 | | | | | | | | | | | | | 0.10 | 0.77 | 1.3 |
| DUP | | | | | | | | | | | | | 0.10 | 0.80 | 1.4 |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.09 | 0.74 | 1.2 |
| Upper Bound | | | | | | | | | | | | | 0.12 | 0.83 | 1.5 |
| L1914704-10 132289 | 10.9 | 2 | 44 | 55 | 8.4 | 5.03 | 0.35 | 0.01 | <0.01 | 0.34 | 0.69 | 2.5 | | | |
| DUP | 10.6 | 2 | 44 | 55 | 8.4 | 5.18 | 0.34 | 0.01 | <0.01 | 0.33 | 0.70 | 2.6 | | | |
| Target Range - Lower Bound | 9.9 | <1 | 41 | 51 | 7.9 | 4.84 | 0.33 | <0.01 | <0.01 | 0.32 | 0.61 | 2.2 | | | |
| Upper Bound | 11.6 | 3 | 47 | 59 | 8.9 | 5.37 | 0.36 | 0.02 | 0.02 | 0.35 | 0.78 | 2.9 | | | |

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QC CERTIFICATE OF ANALYSIS VA17077364

| Sample Description | Method Analyte Units LOR | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm |
|--------------------|----------------------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|
| | | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 |
| | Upper Bound | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L1914704-4 132279 | Target Range - Lower Bound | <0.02 | <10 | 140 | 0.46 | 0.08 | 2.14 | 0.06 | 28.1 | 6.7 | 5 | 0.69 | 352 | 2.51 | 4.16 | 0.05 |
| DUP | Upper Bound | <0.02 | <10 | 140 | 0.47 | 0.08 | 2.13 | 0.07 | 28.4 | 6.8 | 5 | 0.71 | 352 | 2.56 | 4.38 | 0.05 |
| L1914704-4 132279 | Target Range - Lower Bound | <0.02 | <10 | 120 | 0.39 | 0.07 | 2.02 | 0.05 | 26.8 | 6.3 | 4 | 0.62 | 339 | 2.40 | 4.01 | <0.05 |
| | Upper Bound | 0.04 | 20 | 160 | 0.54 | 0.09 | 2.25 | 0.08 | 29.7 | 7.2 | 6 | 0.79 | 365 | 2.67 | 4.53 | 0.10 |
| L1914704-10 132289 | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| DUP | Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17077364

| Method Analyte Units LOR | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm |
|----------------------------|----------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|
| Sample Description | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | 0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 |
| Target Range - Lower Bound | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 |
| Upper Bound | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| L1914704-4 132279 | 0.05 | <0.01 | 0.040 | 0.27 | 14.6 | 2.7 | 0.25 | 683 | 1.65 | 0.04 | 0.07 | 2.1 | 750 | 3.3 | 14.0 |
| DUP | 0.05 | <0.01 | 0.045 | 0.27 | 14.9 | 2.5 | 0.25 | 683 | 1.71 | 0.05 | 0.07 | 2.4 | 750 | 3.4 | 14.2 |
| Target Range - Lower Bound | 0.03 | <0.01 | 0.035 | 0.25 | 13.8 | 2.4 | 0.23 | 644 | 1.55 | 0.03 | <0.05 | 1.9 | 700 | 3.0 | 13.3 |
| Upper Bound | 0.07 | 0.02 | 0.050 | 0.29 | 15.7 | 2.8 | 0.27 | 722 | 1.81 | 0.06 | 0.10 | 2.6 | 800 | 3.7 | 14.9 |
| L1914704-10 132289 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17077364

| Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|----------------------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|
| Sample Description | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Target Range - Lower Bound | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Upper Bound | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| L1914704-4 132279 | <0.001 | <0.01 | <0.05 | 7.0 | 0.7 | 0.6 | 57.2 | <0.01 | 0.03 | 3.7 | 0.029 | 0.08 | 0.30 | 50 | 0.28 |
| DUP | <0.001 | <0.01 | 0.05 | 7.1 | 0.8 | 0.7 | 58.8 | <0.01 | 0.02 | 3.7 | 0.029 | 0.08 | 0.30 | 51 | 0.26 |
| Target Range - Lower Bound | <0.001 | <0.01 | <0.05 | 6.6 | 0.5 | 0.4 | 54.9 | <0.01 | <0.01 | 3.3 | 0.023 | 0.05 | 0.24 | 47 | 0.20 |
| Upper Bound | 0.002 | 0.02 | 0.10 | 7.5 | 1.0 | 0.9 | 61.1 | 0.02 | 0.04 | 4.1 | 0.035 | 0.11 | 0.37 | 54 | 0.34 |
| L1914704-10 132289 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

***** See Appendix Page for comments regarding this certificate *****



ALS Canada Ltd.
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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 3 - E
 Total # Pages: 3 (A - E)
 Plus Appendix Pages
 Finalized Date: 8-MAY-2017
 Account: APN

Project: L1914704

QC CERTIFICATE OF ANALYSIS VA17077364

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|-----------------------------------|-----------------------------|---------------------------|-----------------------------|
| BLANKS | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | <0.05 | <2 | <0.5 |
| Target Range - Lower Bound | | <0.05 | <2 | <0.5 |
| Upper Bound | | 0.10 | 4 | 1.0 |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DUPLICATES | | | | |
| L1914704-4 132279 | | 11.55 | 66 | 1.4 |
| DUP | | 11.70 | 67 | 1.5 |
| Target Range - Lower Bound | | 11.00 | 61 | 0.8 |
| Upper Bound | | 12.25 | 72 | 2.1 |
| L1914704-10 132289 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

***** See Appendix Page for comments regarding this certificate *****



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: Appendix 1
 Total # Appendix Pages: 1
 Finalized Date: 8-MAY-2017
 Account: APN

Project: L1914704

QC CERTIFICATE OF ANALYSIS VA17077364

| CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | | |
|-----------------------------|---|---------|----------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|--|--|
| Applies to Method: | <p style="text-align: center;">ANALYTICAL COMMENTS</p> <p>Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41</p> | | | | | | | | | | | | | | | | |
| Applies to Method: | <p style="text-align: center;">LABORATORY ADDRESSES</p> <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> <td style="width: 33%;">OA-ELE07</td> </tr> <tr> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> <td>S-CAL06</td> </tr> <tr> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> <td>SPL-21</td> </tr> <tr> <td>WEI-21</td> <td></td> <td></td> <td></td> </tr> </table> | C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | | |
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | | | | | | | | | | | | | | |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | | | | | | | | | | | | | | |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | | | | | | | | | | | | | | |
| WEI-21 | | | | | | | | | | | | | | | | | |

| Report To | | Report For | | confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | |
|---|--------|--|--|---|--|--|--|-------------------------------------|---|--|---|----------|---|---|--|--|--|--|--|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | EMERGENCY | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | |
| Company address below will appear on the final report | | | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | For tests that cannot be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | Analysis Request | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | Number of Containers | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | Total Metals- Aqua regia digestion (ICP) | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | pH | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | % Inorganic Carbonate | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | Total Carbon/Sulphur (Leao) | | | | | | | | | | | | | | | | |
| Project Information | | | | AP - determination by % sulphide sulphur | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | | Modified NP - (MEND 1991) | | | | | | | | | | | | | | | | |
| Job #: | | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | |
| PO / AFE: TBD | | | | AFE/Cost Center: PO# | | | | | | | | | | | | | | | | |
| LSD: | | | | Major/Minor Code: Routing Code: | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | Requisitioner: Location: | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on the report) | | Date (dd-mmm-yy) | | Time (hh:mm) | | Sample Type | | ALS Contact: | | Sampler: | | | | | | | | |
| 1 | 132276 | | | 28-Mar-17 | | | | Composite | R | R | R | R | R | R | | | | | | |
| 2 | 133648 | | | 01-Apr-17 | | | | WASTE | X | X | X | X | X | X | | | | | | |
| 3 | 130077 | | | 13-Apr-17 | | | | WASTE | X | X | X | X | X | X | | | | | | |
| 4 | 132279 | | | 13-Apr-17 | | | | WASTE | X | X | X | X | X | X | | | | | | |
| 5 | 132280 | | | 13-Apr-17 | | | | WASTE | X | X | X | X | X | X | | | | | | |
| 6 | 132283 | | | 13-Apr-17 | | | | WASTE | X | X | X | X | X | X | | | | | | |
| 7 | 132284 | | | 13-Apr-17 | | | | WASTE | X | X | X | X | X | X | | | | | | |
| 8 | 132286 | | | 13-Apr-17 | | | | WASTE | X | X | X | X | X | X | | | | | | |
| 9 | 132288 | | | 13-Apr-17 | | | | WASTE | X | X | X | X | X | X | | | | | | |
| 10 | 132289 | | | 13-Apr-17 | | | | WASTE | X | X | X | X | X | X | | | | | | |
| 11 | 132290 | | | 13-Apr-17 | | | | WASTE | X | X | X | X | X | X | | | | | | |

| | | | | | | | | | | | | | | | |
|--|--|--|--|---|--|--|--|--|--|------------------------------|--|--|--|--|--|
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | |
| | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | |
| | | | | 16.0 | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|-------------------------------|-----------------------------------|---|------------------|-------------------|-------------|--------------|-------|---|--|--|--|--|--|
| SHIPPING RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | |
| Released by: Chad Bushn | Date: April 13 th 2017 | Time: 17:00 | Received by: ENE | Date: 18 Apr 2017 | Time: 14:40 | Received by: | Date: | Time: | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 28-APR-17
Report Date: 26-MAY-17 21:27 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1919526
Project P.O. #: 220826
Job Reference:
C of C Numbers: 17-16
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1919526-1 WASTE 07-APR-17 132287 | L1919526-2 WASTE 04-APR-17 132285 | L1919526-3 WASTE 02-APR-17 132282 | L1919526-4 WASTE 02-APR-17 132281 | L1919526-5 WASTE 28-MAR-17 132278 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.5 | 8.2 | 8.8 | 8.7 | 8.5 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.13 | 0.06 | 0.25 | 0.23 | 0.32 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 1 | 1 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 0.6 | 0.6 | 0.6 | 1.3 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 18 | 11 | 26 | 27 | 33 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 17 | 10 | 25 | 26 | 33 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 28.80 | 17.60 | 41.60 | 21.60 | 105.60 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | 0.02 | 0.01 | 0.04 | 0.04 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | 0.02 | 0.02 | 0.02 | 0.04 | 0.01 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.02 | 0.02 | 0.02 | 0.04 | 0.01 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.22 | 1.38 | 1.27 | 1.32 | 0.95 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.05 | 0.30 | <0.05 | <0.05 | 0.06 |
| | Arsenic (As) (ppm) | | | | |
| | 1.5 | 3.3 | 2.0 | 2.2 | 5.8 |
| | Barium (Ba) (ppm) | | | | |
| | 260 | 330 | 400 | 200 | 290 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.30 | 0.47 | 0.23 | 0.34 | 0.44 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.03 | 0.05 | 0.05 | 0.09 | 0.13 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | 10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.10 | 0.12 | 0.08 | 0.08 | 0.15 |
| | Calcium (Ca) (%) | | | | |
| | 0.77 | 0.66 | 1.09 | 1.18 | 1.47 |
| | Cerium (Ce) (ppm) | | | | |
| | 29.1 | 28.8 | 24.5 | 31.4 | 22.0 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.49 | 0.77 | 0.55 | 0.44 | 0.55 |
| | Chromium (Cr) (ppm) | | | | |
| | 6 | 15 | 7 | 5 | 5 |
| | Cobalt (Co) (ppm) | | | | |
| | 6.7 | 7.5 | 7.6 | 6.4 | 6.4 |
| | Copper (Cu) (ppm) | | | | |
| | 488 | 596 | 779 | 1390 | 927 |
| | Gallium (Ga) (ppm) | | | | |
| | 5.74 | 5.68 | 6.81 | 6.28 | 5.43 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.07 | 0.07 | 0.08 | 0.05 | 0.07 |
| | Gold (Au) (ppm) | | | | |
| | <0.02 | <0.02 | 0.03 | 0.04 | 0.02 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.05 | 0.14 | 0.03 | 0.04 | 0.06 |
| | Indium (In) (ppm) | | | | |
| | 0.024 | 0.029 | 0.041 | 0.042 | 0.050 |
| | Iron (Fe) (%) | | | | |
| | 2.60 | 2.72 | 3.82 | 2.77 | 2.67 |
| | Lanthanum (La) (ppm) | | | | |
| | 15.2 | 14.7 | 12.8 | 16.2 | 11.2 |
| | Lead (Pb) (ppm) | | | | |
| | 2.5 | 4.2 | 2.4 | 2.7 | 3.4 |
| | Lithium (Li) (ppm) | | | | |
| | 6.5 | 8.5 | 5.6 | 7.6 | 5.3 |
| | Magnesium (Mg) (%) | | | | |
| | 0.58 | 0.59 | 0.60 | 0.67 | 0.32 |
| | Manganese (Mn) (ppm) | | | | |
| | 610 | 553 | 636 | 603 | 664 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1919526-6 WASTE 14-APR-17 132292 | L1919526-7 WASTE 12-APR-17 132291 | L1919526-8 WASTE 12-APR-17 132293 | L1919526-9 TAILS 22-APR-17 MARCH TAL 2017 | L1919526-10 WASTE 13-APR-17 132294 | |
|---|--|--|--|--|---|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.2 | 7.9 | 8.6 | 8.0 | 8.2 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.05 | 0.22 | 0.26 | 0.19 | 0.13 |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.3 | 0.9 | 2.8 | 2.8 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 10 | 24 | 27 | 21 | 17 |
| | NNP (tCaCO3/1Kt) | 10 | 23 | 24 | 18 | 16 |
| | Ratio (NP/MPA) (Unity) | 32.00 | 25.60 | 9.60 | 7.47 | 27.20 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | <0.01 | <0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.03 | 0.02 | 0.01 | 0.05 | 0.02 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | <0.01 | 0.03 | 0.09 | 0.08 | 0.02 |
| | Total Sulfur (combustion) (%) | 0.01 | 0.03 | 0.09 | 0.09 | 0.02 |
| Total Metals | Aluminum (Al) (%) | 1.29 | 1.77 | 1.06 | 1.34 | 1.48 |
| | Antimony (Sb) (ppm) | 0.30 | 0.68 | <0.05 | <0.05 | 0.39 |
| | Arsenic (As) (ppm) | 3.7 | 7.7 | 1.0 | 1.6 | 4.1 |
| | Barium (Ba) (ppm) | 360 | 320 | 240 | 220 | 280 |
| | Beryllium (Be) (ppm) | 0.37 | 0.67 | 0.23 | 0.25 | 0.44 |
| | Bismuth (Bi) (ppm) | 0.07 | 0.16 | 0.07 | 0.24 | 0.06 |
| | Boron (B) (ppm) | 10 | 10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.13 | 0.36 | 0.24 | 0.27 | 0.16 |
| | Calcium (Ca) (%) | 0.54 | 1.25 | 1.14 | 1.02 | 0.92 |
| | Cerium (Ce) (ppm) | 28.3 | 39.3 | 23.2 | 18.75 | 30.2 |
| | Cesium (Cs) (ppm) | 0.70 | 1.47 | 0.40 | 0.46 | 0.92 |
| | Chromium (Cr) (ppm) | 13 | 31 | 5 | 7 | 18 |
| | Cobalt (Co) (ppm) | 7.4 | 11.7 | 6.2 | 7.4 | 8.9 |
| | Copper (Cu) (ppm) | 653 | 900 | 3580 | 2080 | 110.5 |
| | Gallium (Ga) (ppm) | 5.35 | 6.13 | 4.97 | 8.44 | 5.90 |
| | Germanium (Ge) (ppm) | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| | Gold (Au) (ppm) | <0.02 | <0.02 | 0.04 | 0.08 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.12 | 0.23 | 0.05 | 0.04 | 0.17 |
| | Indium (In) (ppm) | 0.030 | 0.049 | 0.108 | 0.093 | 0.026 |
| | Iron (Fe) (%) | 2.62 | 3.06 | 2.76 | 4.50 | 2.76 |
| | Lanthanum (La) (ppm) | 14.9 | 20.2 | 12.1 | 9.4 | 15.4 |
| | Lead (Pb) (ppm) | 3.6 | 8.4 | 2.6 | 2.9 | 4.9 |
| | Lithium (Li) (ppm) | 8.5 | 11.7 | 5.0 | 6.6 | 9.4 |
| | Magnesium (Mg) (%) | 0.55 | 0.81 | 0.50 | 0.68 | 0.77 |
| | Manganese (Mn) (ppm) | 509 | 616 | 617 | 656 | 615 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1919526-11 WASTE 14-APR-17 132295 | L1919526-12 WASTE 15-APR-17 132296 | L1919526-13 WASTE 15-APR-17 132297 | L1919526-14 WASTE 16-APR-17 132298 | L1919526-15 WASTE 17-APR-17 132299 |
|---|---|---|---|---|---|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.8 | 8.7 | 8.5 | 8.5 | 7.8 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.10 | 0.30 | 0.29 | 0.07 | 0.20 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 1 | 2 | 2 | 1 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 0.6 | 0.3 | 0.3 | 0.3 | 1.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 16 | 30 | 31 | 13 | 18 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 15 | 30 | 31 | 13 | 17 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 25.60 | 96.00 | 99.20 | 41.60 | 14.40 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | <0.01 | <0.01 | 0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | 0.03 | 0.02 | 0.02 | <0.01 | 0.04 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | 0.02 | 0.01 | <0.01 | 0.01 | 0.04 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.02 | 0.01 | 0.01 | 0.01 | 0.04 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.27 | 1.09 | 1.11 | 1.23 | 1.21 |
| | Antimony (Sb) (ppm) | | | | |
| | <0.05 | <0.05 | 0.06 | <0.05 | 0.63 |
| | Arsenic (As) (ppm) | | | | |
| | 0.6 | 0.9 | 4.0 | 1.4 | 6.8 |
| | Barium (Ba) (ppm) | | | | |
| | 320 | 130 | 250 | 310 | 300 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.36 | 0.38 | 0.37 | 0.32 | 0.43 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.07 | 0.02 | 0.10 | 0.04 | 0.10 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.09 | 0.04 | 0.10 | 0.08 | 0.23 |
| | Calcium (Ca) (%) | | | | |
| | 0.76 | 1.43 | 1.40 | 0.66 | 1.01 |
| | Cerium (Ce) (ppm) | | | | |
| | 25.0 | 23.6 | 24.1 | 27.1 | 27.5 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.54 | 0.41 | 0.55 | 0.54 | 0.83 |
| | Chromium (Cr) (ppm) | | | | |
| | 6 | 4 | 5 | 5 | 27 |
| | Cobalt (Co) (ppm) | | | | |
| | 6.3 | 5.8 | 6.7 | 6.7 | 8.3 |
| | Copper (Cu) (ppm) | | | | |
| | 1225 | 75.8 | 679 | 318 | 93.4 |
| | Gallium (Ga) (ppm) | | | | |
| | 5.40 | 5.32 | 5.56 | 5.83 | 4.01 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.09 | 0.08 | 0.07 | 0.08 | 0.06 |
| | Gold (Au) (ppm) | | | | |
| | 0.02 | <0.02 | 0.02 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.09 | 0.07 | 0.07 | 0.07 | 0.23 |
| | Indium (In) (ppm) | | | | |
| | 0.042 | 0.028 | 0.036 | 0.029 | 0.019 |
| | Iron (Fe) (%) | | | | |
| | 2.60 | 2.36 | 2.72 | 2.70 | 2.47 |
| | Lanthanum (La) (ppm) | | | | |
| | 12.4 | 11.8 | 12.2 | 14.2 | 13.6 |
| | Lead (Pb) (ppm) | | | | |
| | 1.7 | 3.3 | 2.9 | 2.5 | 5.5 |
| | Lithium (Li) (ppm) | | | | |
| | 6.0 | 5.5 | 6.3 | 6.5 | 8.5 |
| | Magnesium (Mg) (%) | | | | |
| | 0.65 | 0.52 | 0.51 | 0.56 | 0.54 |
| | Manganese (Mn) (ppm) | | | | |
| | 606 | 576 | 682 | 625 | 542 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1919526-16 WASTE 18-APR-17 132300 | | | | |
|---|---|--------|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | 8.5 | | | |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.34 | | | |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | | | |
| | MPA (tCaCO3/1Kt) | 0.3 | | | |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 35 | | | |
| | NNP (tCaCO3/1Kt) | 35 | | | |
| | Ratio (NP/MPA) (Unity) | 112.00 | | | |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | | | |
| | Sulfate Sulfur (HCl leach) (%) | 0.02 | | | |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.01 | | | |
| | Total Sulfur (combustion) (%) | 0.01 | | | |
| Total Metals | Aluminum (Al) (%) | 1.19 | | | |
| | Antimony (Sb) (ppm) | <0.05 | | | |
| | Arsenic (As) (ppm) | 1.0 | | | |
| | Barium (Ba) (ppm) | 180 | | | |
| | Beryllium (Be) (ppm) | 0.35 | | | |
| | Bismuth (Bi) (ppm) | 0.15 | | | |
| | Boron (B) (ppm) | <10 | | | |
| | Cadmium (Cd) (ppm) | 0.10 | | | |
| | Calcium (Ca) (%) | 1.52 | | | |
| | Cerium (Ce) (ppm) | 25.7 | | | |
| | Cesium (Cs) (ppm) | 0.46 | | | |
| | Chromium (Cr) (ppm) | 5 | | | |
| | Cobalt (Co) (ppm) | 7.0 | | | |
| | Copper (Cu) (ppm) | 1465 | | | |
| | Gallium (Ga) (ppm) | 5.97 | | | |
| | Germanium (Ge) (ppm) | 0.06 | | | |
| | Gold (Au) (ppm) | 0.03 | | | |
| | Hafnium (Hf) (ppm) | 0.06 | | | |
| | Indium (In) (ppm) | 0.052 | | | |
| | Iron (Fe) (%) | 2.81 | | | |
| | Lanthanum (La) (ppm) | 13.0 | | | |
| | Lead (Pb) (ppm) | 3.2 | | | |
| | Lithium (Li) (ppm) | 6.3 | | | |
| | Magnesium (Mg) (%) | 0.58 | | | |
| | Manganese (Mn) (ppm) | 753 | | | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1919526-1 WASTE 07-APR-17 132287 | L1919526-2 WASTE 04-APR-17 132285 | L1919526-3 WASTE 02-APR-17 132282 | L1919526-4 WASTE 02-APR-17 132281 | L1919526-5 WASTE 28-MAR-17 132278 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | 0.01 | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | 0.97 | 1.45 | 1.35 | 0.90 | 1.22 |
| | Nickel (Ni) (ppm) | 2.7 | 11.0 | 2.7 | 2.4 | 2.5 |
| | Niobium (Nb) (ppm) | 0.16 | 0.61 | 0.20 | 0.09 | 0.07 |
| | Phosphorus (P) (ppm) | 740 | 830 | 640 | 760 | 710 |
| | Potassium (K) (%) | 0.53 | 0.46 | 0.73 | 0.50 | 0.35 |
| | Rhenium (Re) (ppm) | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 |
| | Rubidium (Rb) (ppm) | 24.7 | 22.4 | 34.5 | 22.3 | 15.8 |
| | Scandium (Sc) (ppm) | 4.4 | 5.2 | 4.4 | 3.9 | 5.5 |
| | Selenium (Se) (ppm) | 0.4 | 0.4 | 0.5 | 0.9 | 0.4 |
| | Silver (Ag) (ppm) | 0.06 | 0.08 | 0.13 | 0.30 | 0.22 |
| | Sodium (Na) (%) | 0.05 | 0.07 | 0.06 | 0.07 | 0.06 |
| | Strontium (Sr) (ppm) | 38.2 | 45.7 | 41.2 | 57.9 | 61.1 |
| | Sulfur (S) (%) | <0.01 | <0.01 | 0.01 | 0.05 | <0.01 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | <0.01 | 0.03 | 0.02 | 0.09 | 0.05 |
| | Thallium (Tl) (ppm) | 0.14 | 0.16 | 0.23 | 0.13 | 0.09 |
| | Thorium (Th) (ppm) | 3.7 | 3.6 | 3.0 | 3.4 | 2.1 |
| | Tin (Sn) (ppm) | 0.7 | 0.8 | 1.0 | 0.7 | 0.8 |
| | Titanium (Ti) (%) | 0.083 | 0.097 | 0.128 | 0.069 | 0.044 |
| | Tungsten (W) (ppm) | 0.20 | 0.36 | 0.27 | 0.20 | 0.17 |
| | Uranium (U) (ppm) | 0.22 | 0.46 | 0.21 | 0.25 | 0.19 |
| | Vanadium (V) (ppm) | 54 | 58 | 87 | 55 | 55 |
| | Yttrium (Y) (ppm) | 8.07 | 9.70 | 5.15 | 7.60 | 9.52 |
| | Zinc (Zn) (ppm) | 74 | 75 | 83 | 75 | 77 |
| | Zirconium (Zr) (ppm) | 1.1 | 4.4 | 0.8 | 0.7 | 1.2 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.5 | 0.2 | 0.9 | 0.8 | 1.2 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1919526-6 WASTE 14-APR-17 132292 | L1919526-7 WASTE 12-APR-17 132291 | L1919526-8 WASTE 12-APR-17 132293 | L1919526-9 TAILS 22-APR-17 MARCH TAL 2017 | L1919526-10 WASTE 13-APR-17 132294 |
|------------------------|--------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.02 | 0.04 | 0.01 | 0.01 | 0.01 | 0.02 |
| | Molybdenum (Mo) (ppm) | 1.11 | 2.72 | 14.75 | 1.08 | 1.08 | 1.47 |
| | Nickel (Ni) (ppm) | 11.0 | 30.3 | 3.3 | 3.5 | 3.5 | 16.1 |
| | Niobium (Nb) (ppm) | 0.48 | 0.40 | 0.13 | 0.19 | 0.19 | 0.73 |
| | Phosphorus (P) (ppm) | 740 | 940 | 730 | 810 | 810 | 820 |
| | Potassium (K) (%) | 0.47 | 0.35 | 0.48 | 0.57 | 0.57 | 0.43 |
| | Rhenium (Re) (ppm) | <0.001 | 0.002 | 0.007 | 0.001 | 0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | 21.6 | 20.0 | 21.7 | 30.2 | 30.2 | 21.3 |
| | Scandium (Sc) (ppm) | 5.1 | 6.4 | 4.4 | 4.0 | 4.0 | 5.3 |
| | Selenium (Se) (ppm) | 0.6 | 0.8 | 1.4 | 1.3 | 1.3 | 0.8 |
| | Silver (Ag) (ppm) | 0.12 | 0.27 | 0.51 | 0.72 | 0.72 | 0.08 |
| | Sodium (Na) (%) | 0.06 | 0.04 | 0.06 | 0.06 | 0.06 | 0.07 |
| | Strontium (Sr) (ppm) | 38.3 | 65.0 | 54.5 | 78.9 | 78.9 | 56.0 |
| | Sulfur (S) (%) | 0.01 | 0.02 | 0.11 | 0.11 | 0.11 | 0.02 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.02 | 0.05 | 0.08 | 0.27 | 0.27 | 0.02 |
| | Thallium (Tl) (ppm) | 0.15 | 0.18 | 0.13 | 0.19 | 0.19 | 0.15 |
| | Thorium (Th) (ppm) | 3.2 | 5.0 | 2.4 | 3.6 | 3.6 | 3.7 |
| | Tin (Sn) (ppm) | 0.7 | 0.9 | 0.9 | 1.0 | 1.0 | 0.6 |
| | Titanium (Ti) (%) | 0.087 | 0.081 | 0.078 | 0.109 | 0.109 | 0.114 |
| | Tungsten (W) (ppm) | 0.45 | 0.25 | 0.39 | 0.06 | 0.06 | 0.43 |
| | Uranium (U) (ppm) | 0.31 | 0.81 | 0.34 | 0.30 | 0.30 | 0.53 |
| | Vanadium (V) (ppm) | 54 | 64 | 56 | 76 | 76 | 59 |
| | Yttrium (Y) (ppm) | 8.72 | 12.15 | 7.57 | 5.94 | 5.94 | 9.27 |
| | Zinc (Zn) (ppm) | 70 | 97 | 77 | 113 | 113 | 77 |
| | Zirconium (Zr) (ppm) | 3.7 | 8.1 | 0.9 | 1.1 | 1.1 | 5.3 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.2 | 0.8 | 1.0 | 0.7 | 0.7 | 0.5 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1919526-11 | L1919526-12 | L1919526-13 | L1919526-14 | L1919526-15 |
|------------------------|--------------------------|--------------|-------------|-------------|-------------|-------------|-------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 14-APR-17 | 15-APR-17 | 15-APR-17 | 16-APR-17 | 17-APR-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 132295 | 132296 | 132297 | 132298 | 132299 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 |
| | Molybdenum (Mo) (ppm) | | 0.81 | 0.54 | 1.15 | 1.05 | 1.03 |
| | Nickel (Ni) (ppm) | | 2.8 | 2.2 | 2.6 | 3.0 | 21.8 |
| | Niobium (Nb) (ppm) | | 0.20 | 0.16 | 0.11 | 0.16 | 1.09 |
| | Phosphorus (P) (ppm) | | 740 | 650 | 780 | 850 | 830 |
| | Potassium (K) (%) | | 0.72 | 0.29 | 0.34 | 0.50 | 0.19 |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 |
| | Rubidium (Rb) (ppm) | | 33.5 | 13.3 | 15.7 | 22.4 | 11.5 |
| | Scandium (Sc) (ppm) | | 5.2 | 4.9 | 5.3 | 5.4 | 4.9 |
| | Selenium (Se) (ppm) | | 0.7 | 0.2 | 0.7 | 0.5 | 0.4 |
| | Silver (Ag) (ppm) | | 0.23 | 0.05 | 0.20 | 0.06 | 0.10 |
| | Sodium (Na) (%) | | 0.09 | 0.06 | 0.06 | 0.07 | 0.05 |
| | Strontium (Sr) (ppm) | | 45.8 | 62.7 | 56.9 | 38.5 | 57.5 |
| | Sulfur (S) (%) | | 0.01 | <0.01 | <0.01 | <0.01 | 0.04 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.05 | 0.01 | 0.03 | 0.01 | 0.03 |
| | Thallium (Tl) (ppm) | | 0.19 | 0.06 | 0.08 | 0.13 | 0.11 |
| | Thorium (Th) (ppm) | | 2.9 | 2.3 | 2.1 | 2.9 | 3.6 |
| | Tin (Sn) (ppm) | | 0.8 | 0.6 | 0.7 | 0.7 | 0.5 |
| | Titanium (Ti) (%) | | 0.132 | 0.061 | 0.058 | 0.080 | 0.075 |
| | Tungsten (W) (ppm) | | 0.50 | 0.25 | 0.22 | 0.41 | 0.71 |
| | Uranium (U) (ppm) | | 0.27 | 0.30 | 0.21 | 0.21 | 0.69 |
| | Vanadium (V) (ppm) | | 56 | 45 | 55 | 56 | 51 |
| | Yttrium (Y) (ppm) | | 11.30 | 8.86 | 10.35 | 11.10 | 9.14 |
| | Zinc (Zn) (ppm) | | 73 | 61 | 73 | 72 | 58 |
| | Zirconium (Zr) (ppm) | | 1.4 | 1.1 | 1.2 | 1.3 | 7.1 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.4 | 1.1 | 1.1 | 0.3 | 0.7 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1919526-16 WASTE 18-APR-17 132300 | | | |
|------------------------|--|---|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | | | |
| | Molybdenum (Mo) (ppm) | 0.70 | | | |
| | Nickel (Ni) (ppm) | 2.5 | | | |
| | Niobium (Nb) (ppm) | 0.07 | | | |
| | Phosphorus (P) (ppm) | 830 | | | |
| | Potassium (K) (%) | 0.37 | | | |
| | Rhenium (Re) (ppm) | <0.001 | | | |
| | Rubidium (Rb) (ppm) | 17.4 | | | |
| | Scandium (Sc) (ppm) | 4.9 | | | |
| | Selenium (Se) (ppm) | 0.8 | | | |
| | Silver (Ag) (ppm) | 0.34 | | | |
| | Sodium (Na) (%) | 0.05 | | | |
| | Strontium (Sr) (ppm) | 63.0 | | | |
| | Sulfur (S) (%) | <0.01 | | | |
| | Tantalum (Ta) (ppm) | <0.01 | | | |
| | Tellurium (Te) (ppm) | 0.10 | | | |
| | Thallium (Tl) (ppm) | 0.10 | | | |
| | Thorium (Th) (ppm) | 3.3 | | | |
| | Tin (Sn) (ppm) | 0.6 | | | |
| | Titanium (Ti) (%) | 0.051 | | | |
| | Tungsten (W) (ppm) | 0.18 | | | |
| | Uranium (U) (ppm) | 0.31 | | | |
| | Vanadium (V) (ppm) | 54 | | | |
| | Yttrium (Y) (ppm) | 10.50 | | | |
| | Zinc (Zn) (ppm) | 83 | | | |
| | Zirconium (Zr) (ppm) | 1.2 | | | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.2 | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|-----------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| <p>A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.</p> | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06-AX | Soil | Sulfide Sulfur Calc from Carbonate Leach | ALS Minerals S-CAL06 |
| <p>Sulfide Sulfur (as S) is calculated by subtracting the Carbonate Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.</p> | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| <p>A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| <p>A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| <p>The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-16

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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To: ALS ENVIRONMENTAL
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 BURNABY BC V5A 1W9

Page: 1
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 25-MAY-2017
 Account: APN

CERTIFICATE VA17088037

Project: L1919526
 P.O. No.: ALSM-CW16-102-APN
 This report is for 16 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 4-MAY-2017.
 The following have access to data associated with this certificate:

| | | |
|--------------------------|----------------------------|-------------|
| ELSE VANCOUVER WEBTRIEVE | SOFTWARE DEVELOPMENT GROUP | SHANE STACK |
|--------------------------|----------------------------|-------------|

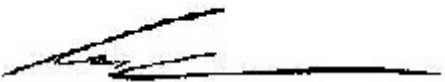
| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| SPL-21 | Split sample - riffle splitter |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: ALS ENVIRONMENTAL
 ATTN: SHANE STACK
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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Page: 2 - A
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 25-MAY-2017
 Account: APN

Project: L1919526

CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method | WEI-21 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | OA-VOL08m | S-IR08 | S-GRA06 | S-GRA06a | S-CAL06 | C-GAS05 | C-GAS05 | ME-MS41 | ME-MS41 |
|---------------------------|---------|-----------|------------|-----------|------------|------------|----------|-----------|--------|---------|----------|---------|---------|---------|---------|---------|
| | Analyte | Recvd Wt. | MPA | FIZZ RAT | NNP | NP | pH | Ratio (N | S | S | S | S | C | CO2 | Ag | Al |
| | Units | kg | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | % | ppm | % |
| | LOR | 0.02 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 |
| L1919526-1 132287 | | 1.14 | 0.6 | 1 | 17 | 18 | 8.5 | 28.80 | 0.02 | <0.01 | 0.02 | 0.02 | 0.13 | 0.5 | 0.06 | 1.22 |
| L1919526-2 132285 | | 1.12 | 0.6 | 1 | 10 | 11 | 8.2 | 17.60 | 0.02 | <0.01 | 0.01 | 0.02 | 0.06 | 0.2 | 0.08 | 1.38 |
| L1919526-3 132282 | | 1.12 | 0.6 | 2 | 25 | 26 | 8.8 | 41.60 | 0.02 | <0.01 | 0.04 | 0.02 | 0.25 | 0.9 | 0.13 | 1.27 |
| L1919526-4 132281 | | 1.10 | 1.3 | 2 | 26 | 27 | 8.7 | 21.60 | 0.04 | <0.01 | 0.04 | 0.04 | 0.23 | 0.8 | 0.30 | 1.32 |
| L1919526-5 132278 | | 1.12 | 0.3 | 2 | 33 | 33 | 8.5 | 105.60 | 0.01 | <0.01 | <0.01 | 0.01 | 0.32 | 1.2 | 0.22 | 0.95 |
| L1919526-6 132292 | | 1.12 | 0.3 | 1 | 10 | 10 | 8.2 | 32.00 | 0.01 | 0.01 | 0.03 | <0.01 | 0.05 | 0.2 | 0.12 | 1.29 |
| L1919526-7 132291 | | 1.12 | 0.9 | 2 | 23 | 24 | 7.9 | 25.60 | 0.03 | <0.01 | 0.02 | 0.03 | 0.22 | 0.8 | 0.27 | 1.77 |
| L1919526-8 132293 | | 1.10 | 2.8 | 2 | 24 | 27 | 8.6 | 9.60 | 0.09 | <0.01 | 0.01 | 0.09 | 0.26 | 1.0 | 0.51 | 1.06 |
| L1919526-9 MARCH TAL 2017 | | 1.16 | 2.8 | 2 | 18 | 21 | 8.0 | 7.47 | 0.09 | 0.01 | 0.05 | 0.08 | 0.19 | 0.7 | 0.72 | 1.34 |
| L1919526-10 132294 | | 1.10 | 0.6 | 2 | 16 | 17 | 8.2 | 27.20 | 0.02 | <0.01 | 0.02 | 0.02 | 0.13 | 0.5 | 0.08 | 1.48 |
| L1919526-11 132295 | | 0.98 | 0.6 | 1 | 15 | 16 | 8.8 | 25.60 | 0.02 | <0.01 | 0.03 | 0.02 | 0.10 | 0.4 | 0.23 | 1.27 |
| L1919526-12 132296 | | 1.12 | 0.3 | 2 | 30 | 30 | 8.7 | 96.00 | 0.01 | <0.01 | 0.02 | 0.01 | 0.30 | 1.1 | 0.05 | 1.09 |
| L1919526-13 132297 | | 1.14 | 0.3 | 2 | 31 | 31 | 8.5 | 99.20 | 0.01 | 0.01 | 0.02 | <0.01 | 0.29 | 1.1 | 0.20 | 1.11 |
| L1919526-14 132298 | | 1.12 | 0.3 | 1 | 13 | 13 | 8.5 | 41.60 | 0.01 | <0.01 | <0.01 | 0.01 | 0.07 | 0.3 | 0.06 | 1.23 |
| L1919526-15 132299 | | 1.14 | 1.3 | 2 | 17 | 18 | 7.8 | 14.40 | 0.04 | <0.01 | 0.04 | 0.04 | 0.20 | 0.7 | 0.10 | 1.21 |
| L1919526-16 132300 | | 1.12 | 0.3 | 2 | 35 | 35 | 8.5 | 112.00 | 0.01 | <0.01 | 0.02 | 0.01 | 0.34 | 1.2 | 0.34 | 1.19 |

***** See Appendix Page for comments regarding this certificate *****



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CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|---------------------------|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga |
| | | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| L1919526-1 132287 | | 1.5 | <0.02 | <10 | 260 | 0.30 | 0.03 | 0.77 | 0.10 | 29.1 | 6.7 | 6 | 0.49 | 488 | 2.60 | 5.74 |
| L1919526-2 132285 | | 3.3 | <0.02 | <10 | 330 | 0.47 | 0.05 | 0.66 | 0.12 | 28.8 | 7.5 | 15 | 0.77 | 596 | 2.72 | 5.68 |
| L1919526-3 132282 | | 2.0 | 0.03 | <10 | 400 | 0.23 | 0.05 | 1.09 | 0.08 | 24.5 | 7.6 | 7 | 0.55 | 779 | 3.82 | 6.81 |
| L1919526-4 132281 | | 2.2 | 0.04 | <10 | 200 | 0.34 | 0.09 | 1.18 | 0.08 | 31.4 | 6.4 | 5 | 0.44 | 1390 | 2.77 | 6.28 |
| L1919526-5 132278 | | 5.8 | 0.02 | 10 | 290 | 0.44 | 0.13 | 1.47 | 0.15 | 22.0 | 6.4 | 5 | 0.55 | 927 | 2.67 | 5.43 |
| L1919526-6 132292 | | 3.7 | <0.02 | 10 | 360 | 0.37 | 0.07 | 0.54 | 0.13 | 28.3 | 7.4 | 13 | 0.70 | 653 | 2.62 | 5.35 |
| L1919526-7 132291 | | 7.7 | <0.02 | 10 | 320 | 0.67 | 0.16 | 1.25 | 0.36 | 39.3 | 11.7 | 31 | 1.47 | 900 | 3.06 | 6.13 |
| L1919526-8 132293 | | 1.0 | 0.04 | <10 | 240 | 0.23 | 0.07 | 1.14 | 0.24 | 23.2 | 6.2 | 5 | 0.40 | 3580 | 2.76 | 4.97 |
| L1919526-9 MARCH TAL 2017 | | 1.6 | 0.08 | <10 | 220 | 0.25 | 0.24 | 1.02 | 0.27 | 18.75 | 7.4 | 7 | 0.46 | 2080 | 4.50 | 8.44 |
| L1919526-10 132294 | | 4.1 | <0.02 | <10 | 280 | 0.44 | 0.06 | 0.92 | 0.16 | 30.2 | 8.9 | 18 | 0.92 | 110.5 | 2.76 | 5.90 |
| L1919526-11 132295 | | 0.6 | 0.02 | <10 | 320 | 0.36 | 0.07 | 0.76 | 0.09 | 25.0 | 6.3 | 6 | 0.54 | 1225 | 2.60 | 5.40 |
| L1919526-12 132296 | | 0.9 | <0.02 | <10 | 130 | 0.38 | 0.02 | 1.43 | 0.04 | 23.6 | 5.8 | 4 | 0.41 | 75.8 | 2.36 | 5.32 |
| L1919526-13 132297 | | 4.0 | 0.02 | <10 | 250 | 0.37 | 0.10 | 1.40 | 0.10 | 24.1 | 6.7 | 5 | 0.55 | 679 | 2.72 | 5.56 |
| L1919526-14 132298 | | 1.4 | <0.02 | <10 | 310 | 0.32 | 0.04 | 0.66 | 0.08 | 27.1 | 6.7 | 5 | 0.54 | 318 | 2.70 | 5.83 |
| L1919526-15 132299 | | 6.8 | <0.02 | <10 | 300 | 0.43 | 0.10 | 1.01 | 0.23 | 27.5 | 8.3 | 27 | 0.83 | 93.4 | 2.47 | 4.01 |
| L1919526-16 132300 | | 1.0 | 0.03 | <10 | 180 | 0.35 | 0.15 | 1.52 | 0.10 | 25.7 | 7.0 | 5 | 0.46 | 1465 | 2.81 | 5.97 |

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CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P | Pb |
| Units | | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm | ppm |
| LOR | | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 |
| L1919526-1 132287 | | 0.07 | 0.05 | 0.01 | 0.024 | 0.53 | 15.2 | 6.5 | 0.58 | 610 | 0.97 | 0.05 | 0.16 | 2.7 | 740 | 2.5 |
| L1919526-2 132285 | | 0.07 | 0.14 | 0.01 | 0.029 | 0.46 | 14.7 | 8.5 | 0.59 | 553 | 1.45 | 0.07 | 0.61 | 11.0 | 830 | 4.2 |
| L1919526-3 132282 | | 0.08 | 0.03 | <0.01 | 0.041 | 0.73 | 12.8 | 5.6 | 0.60 | 636 | 1.35 | 0.06 | 0.20 | 2.7 | 640 | 2.4 |
| L1919526-4 132281 | | 0.05 | 0.04 | <0.01 | 0.042 | 0.50 | 16.2 | 7.6 | 0.67 | 603 | 0.90 | 0.07 | 0.09 | 2.4 | 760 | 2.7 |
| L1919526-5 132278 | | 0.07 | 0.06 | <0.01 | 0.050 | 0.35 | 11.2 | 5.3 | 0.32 | 664 | 1.22 | 0.06 | 0.07 | 2.5 | 710 | 3.4 |
| L1919526-6 132292 | | 0.06 | 0.12 | 0.02 | 0.030 | 0.47 | 14.9 | 8.5 | 0.55 | 509 | 1.11 | 0.06 | 0.48 | 11.0 | 740 | 3.6 |
| L1919526-7 132291 | | 0.06 | 0.23 | 0.04 | 0.049 | 0.35 | 20.2 | 11.7 | 0.81 | 616 | 2.72 | 0.04 | 0.40 | 30.3 | 940 | 8.4 |
| L1919526-8 132293 | | 0.06 | 0.05 | 0.01 | 0.108 | 0.48 | 12.1 | 5.0 | 0.50 | 617 | 14.75 | 0.06 | 0.13 | 3.3 | 730 | 2.6 |
| L1919526-9 MARCH TAL 2017 | | 0.06 | 0.04 | 0.01 | 0.093 | 0.57 | 9.4 | 6.6 | 0.68 | 656 | 1.08 | 0.06 | 0.19 | 3.5 | 810 | 2.9 |
| L1919526-10 132294 | | 0.06 | 0.17 | 0.02 | 0.026 | 0.43 | 15.4 | 9.4 | 0.77 | 615 | 1.47 | 0.07 | 0.73 | 16.1 | 820 | 4.9 |
| L1919526-11 132295 | | 0.09 | 0.09 | <0.01 | 0.042 | 0.72 | 12.4 | 6.0 | 0.65 | 606 | 0.81 | 0.09 | 0.20 | 2.8 | 740 | 1.7 |
| L1919526-12 132296 | | 0.08 | 0.07 | <0.01 | 0.028 | 0.29 | 11.8 | 5.5 | 0.52 | 576 | 0.54 | 0.06 | 0.16 | 2.2 | 650 | 3.3 |
| L1919526-13 132297 | | 0.07 | 0.07 | <0.01 | 0.036 | 0.34 | 12.2 | 6.3 | 0.51 | 682 | 1.15 | 0.06 | 0.11 | 2.6 | 780 | 2.9 |
| L1919526-14 132298 | | 0.08 | 0.07 | <0.01 | 0.029 | 0.50 | 14.2 | 6.5 | 0.56 | 625 | 1.05 | 0.07 | 0.16 | 3.0 | 850 | 2.5 |
| L1919526-15 132299 | | 0.06 | 0.23 | 0.02 | 0.019 | 0.19 | 13.6 | 8.5 | 0.54 | 542 | 1.03 | 0.05 | 1.09 | 21.8 | 830 | 5.5 |
| L1919526-16 132300 | | 0.06 | 0.06 | <0.01 | 0.052 | 0.37 | 13.0 | 6.3 | 0.58 | 753 | 0.70 | 0.05 | 0.07 | 2.5 | 830 | 3.2 |

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CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method Analyte Units LOR | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm |
|---------------------------|--------------------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|
| L1919526-1 132287 | | 24.7 | <0.001 | <0.01 | 0.05 | 4.4 | 0.4 | 0.7 | 38.2 | <0.01 | <0.01 | 3.7 | 0.083 | 0.14 | 0.22 | 54 |
| L1919526-2 132285 | | 22.4 | <0.001 | <0.01 | 0.30 | 5.2 | 0.4 | 0.8 | 45.7 | <0.01 | 0.03 | 3.6 | 0.097 | 0.16 | 0.46 | 58 |
| L1919526-3 132282 | | 34.5 | <0.001 | 0.01 | <0.05 | 4.4 | 0.5 | 1.0 | 41.2 | <0.01 | 0.02 | 3.0 | 0.128 | 0.23 | 0.21 | 87 |
| L1919526-4 132281 | | 22.3 | 0.002 | 0.05 | <0.05 | 3.9 | 0.9 | 0.7 | 57.9 | <0.01 | 0.09 | 3.4 | 0.069 | 0.13 | 0.25 | 55 |
| L1919526-5 132278 | | 15.8 | <0.001 | <0.01 | 0.06 | 5.5 | 0.4 | 0.8 | 61.1 | <0.01 | 0.05 | 2.1 | 0.044 | 0.09 | 0.19 | 55 |
| L1919526-6 132292 | | 21.6 | <0.001 | 0.01 | 0.30 | 5.1 | 0.6 | 0.7 | 38.3 | <0.01 | 0.02 | 3.2 | 0.087 | 0.15 | 0.31 | 54 |
| L1919526-7 132291 | | 20.0 | 0.002 | 0.02 | 0.68 | 6.4 | 0.8 | 0.9 | 65.0 | <0.01 | 0.05 | 5.0 | 0.081 | 0.18 | 0.81 | 64 |
| L1919526-8 132293 | | 21.7 | 0.007 | 0.11 | <0.05 | 4.4 | 1.4 | 0.9 | 54.5 | <0.01 | 0.08 | 2.4 | 0.078 | 0.13 | 0.34 | 56 |
| L1919526-9 MARCH TAL 2017 | | 30.2 | 0.001 | 0.11 | <0.05 | 4.0 | 1.3 | 1.0 | 78.9 | <0.01 | 0.27 | 3.6 | 0.109 | 0.19 | 0.30 | 76 |
| L1919526-10 132294 | | 21.3 | 0.001 | 0.02 | 0.39 | 5.3 | 0.8 | 0.6 | 56.0 | <0.01 | 0.02 | 3.7 | 0.114 | 0.15 | 0.53 | 59 |
| L1919526-11 132295 | | 33.5 | <0.001 | 0.01 | <0.05 | 5.2 | 0.7 | 0.8 | 45.8 | <0.01 | 0.05 | 2.9 | 0.132 | 0.19 | 0.27 | 56 |
| L1919526-12 132296 | | 13.3 | <0.001 | <0.01 | <0.05 | 4.9 | 0.2 | 0.6 | 62.7 | <0.01 | 0.01 | 2.3 | 0.061 | 0.06 | 0.30 | 45 |
| L1919526-13 132297 | | 15.7 | <0.001 | <0.01 | 0.06 | 5.3 | 0.7 | 0.7 | 56.9 | <0.01 | 0.03 | 2.1 | 0.058 | 0.08 | 0.21 | 55 |
| L1919526-14 132298 | | 22.4 | <0.001 | <0.01 | <0.05 | 5.4 | 0.5 | 0.7 | 38.5 | <0.01 | 0.01 | 2.9 | 0.080 | 0.13 | 0.21 | 56 |
| L1919526-15 132299 | | 11.5 | 0.002 | 0.04 | 0.63 | 4.9 | 0.4 | 0.5 | 57.5 | <0.01 | 0.03 | 3.6 | 0.075 | 0.11 | 0.69 | 51 |
| L1919526-16 132300 | | 17.4 | <0.001 | <0.01 | <0.05 | 4.9 | 0.8 | 0.6 | 63.0 | <0.01 | 0.10 | 3.3 | 0.051 | 0.10 | 0.31 | 54 |

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CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|---------------------------|---------|---------|---------|---------|---------|
| | Analyte | W | Y | Zn | Zr |
| Units | | ppm | ppm | ppm | ppm |
| LOR | | 0.05 | 0.05 | 2 | 0.5 |
| L1919526-1 132287 | | 0.20 | 8.07 | 74 | 1.1 |
| L1919526-2 132285 | | 0.36 | 9.70 | 75 | 4.4 |
| L1919526-3 132282 | | 0.27 | 5.15 | 83 | 0.8 |
| L1919526-4 132281 | | 0.20 | 7.60 | 75 | 0.7 |
| L1919526-5 132278 | | 0.17 | 9.52 | 77 | 1.2 |
| L1919526-6 132292 | | 0.45 | 8.72 | 70 | 3.7 |
| L1919526-7 132291 | | 0.25 | 12.15 | 97 | 8.1 |
| L1919526-8 132293 | | 0.39 | 7.57 | 77 | 0.9 |
| L1919526-9 MARCH TAL 2017 | | 0.06 | 5.94 | 113 | 1.1 |
| L1919526-10 132294 | | 0.43 | 9.27 | 77 | 5.3 |
| L1919526-11 132295 | | 0.50 | 11.30 | 73 | 1.4 |
| L1919526-12 132296 | | 0.25 | 8.86 | 61 | 1.1 |
| L1919526-13 132297 | | 0.22 | 10.35 | 73 | 1.2 |
| L1919526-14 132298 | | 0.41 | 11.10 | 72 | 1.3 |
| L1919526-15 132299 | | 0.71 | 9.14 | 58 | 7.1 |
| L1919526-16 132300 | | 0.18 | 10.50 | 83 | 1.2 |



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CERTIFICATE OF ANALYSIS VA17088037

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
 ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|-----------|----------|---------|----------|
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



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QC CERTIFICATE VA17088037

Project: L1919526
 P.O. No.: ALSM-CW16-102-APN
 This report is for 16 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 4-MAY-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| SPL-21 | Split sample - riffle splitter |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: ALS ENVIRONMENTAL
 ATTN: SHANE STACK
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17088037

| Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | |
|----------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|-------------------------|---------------------------------|------------------|-------------------|--------------------|-------------------|---------------------|----------------------|--------------------|----------------------|----------------------|--|
| Sample Description | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | 6.0 | | | | | | | | | | | |
| Buffer pH6 | | | | | 6.0 | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.3 | | | | | | | | | | | |
| Upper Bound | | | | | 6.7 | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | 0.48 | 1.8 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.42 | 1.5 | | | | | |
| Upper Bound | | | | | | | | | | 0.64 | 2.4 | | | | | |
| DS-1 | | | | | | | | 2.67 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 2.51 | | | | | | | | |
| Upper Bound | | | | | | | | 2.71 | | | | | | | | |
| GS310-10 | | | | | | | | 0.26 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.25 | | | | | | | | |
| Upper Bound | | | | | | | | 0.29 | | | | | | | | |
| KZK-1 | 25.0 | 2 | 32 | 57 | | 2.28 | | | | | | | | | | |
| KZK-1 | 25.0 | 2 | 31 | 56 | | 2.24 | | | | | | | | | | |
| Target Range - Lower Bound | 22.9 | <1 | 30 | 54 | | 2.18 | | | | | | | | | | |
| Upper Bound | 27.1 | >4 | 38 | 64 | | 2.53 | | | | | | | | | | |
| MA-2c | | | | | | | | | | 1.55 | 5.7 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 1.50 | 5.5 | | | | | |
| Upper Bound | | | | | | | | | | 1.84 | 6.8 | | | | | |
| MGeo08 | | | | | | | | | | | | 4.48 | 2.76 | 34.4 | <0.02 | |
| Target Range - Lower Bound | | | | | | | | | | | | 4.00 | 2.44 | 29.6 | <0.02 | |
| Upper Bound | | | | | | | | | | | | 4.92 | 3.00 | 36.4 | 0.04 | |
| OREAS 905 | | | | | | | | | | | | 0.54 | 0.90 | 36.8 | 0.41 | |
| Target Range - Lower Bound | | | | | | | | | | | | 0.45 | 0.73 | 28.4 | 0.33 | |
| Upper Bound | | | | | | | | | | | | 0.58 | 0.91 | 35.0 | 0.45 | |
| UTS-1 | | | | | | | | 0.88 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.83 | | | | | | | | |
| Upper Bound | | | | | | | | 0.93 | | | | | | | | |
| UTS-1 | | | | | | | | | | 0.91 | | | | | | |
| UTS-1 | | | | | | | | | | 0.92 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.81 | | | | | | |
| Upper Bound | | | | | | | | | | 0.95 | | | | | | |
| UTS-4 | | | | | | | | 1.74 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.64 | | | | | | | | |
| Upper Bound | | | | | | | | 1.84 | | | | | | | | |
| UTS-4 | | | | | | | | | | 1.78 | | | | | | |



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Project: L1919526

QC CERTIFICATE OF ANALYSIS VA17088037

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % | Ga ppm | Ge ppm | Hf ppm | |
| | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 10 | 450 | 0.76 | 0.64 | 1.13 | 2.31 | 75.8 | 18.5 | 92 | 10.55 | 651 | 3.59 | 9.35 | 0.15 | 0.81 | |
| Target Range - Lower Bound | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 | 3.22 | 8.73 | 0.07 | 0.64 | |
| Upper Bound | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 | 3.96 | 10.80 | 0.29 | 0.83 | |
| OREAS 905 | <10 | 260 | 1.01 | 5.55 | 0.35 | 0.37 | 82.4 | 14.8 | 20 | 1.31 | 1640 | 3.53 | 6.69 | 0.11 | 1.18 | |
| Target Range - Lower Bound | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 | 3.14 | 5.74 | <0.05 | 1.08 | |
| Upper Bound | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 | 3.86 | 7.12 | 0.22 | 1.36 | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17088037

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | Re ppm | |
| | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 0.06 | 0.159 | 1.30 | 37.7 | 32.0 | 1.17 | 419 | 14.95 | 0.35 | 0.83 | 723 | 1040 | 1095 | 142.5 | 0.009 | |
| Target Range - Lower Bound | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 | 900 | 959 | 132.0 | 0.006 | |
| Upper Bound | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 | 1130 | 1175 | 162.0 | 0.010 | |
| OREAS 905 | 0.01 | 0.614 | 0.34 | 41.0 | 5.2 | 0.16 | 350 | 3.28 | 0.09 | 0.31 | 10.7 | 250 | 16.0 | 21.0 | <0.001 | |
| Target Range - Lower Bound | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 | | 15.2 | 17.3 | <0.001 | |
| Upper Bound | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 | | 19.0 | 21.3 | 0.002 | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17088037

| Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|----------------------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|---------------|
| Sample Description | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 0.31 | 3.41 | 7.6 | 1.1 | 3.6 | 82.4 | 0.01 | 0.02 | 21.4 | 0.388 | 0.78 | 5.35 | 101 | 2.91 | 20.6 |
| Target Range - Lower Bound | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 | 4.93 | 90 | 2.44 | 17.50 |
| Upper Bound | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 | 6.13 | 112 | 3.42 | 21.5 |
| OREAS 905 | 0.07 | 1.10 | 2.0 | 2.6 | 1.4 | 13.6 | <0.01 | 0.06 | 8.9 | 0.022 | 0.11 | 2.25 | 6 | 0.62 | 7.74 |
| Target Range - Lower Bound | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 | 2.08 | 4 | 0.44 | 6.32 |
| Upper Bound | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 | 2.66 | 8 | 0.76 | 7.84 |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|--------------------------|------------------|--------------------|
| STANDARDS | | | |
| Buffer pH6 | | | |
| Buffer pH6 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| CO-ASSAY | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| DS-1 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| GS310-10 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| KZK-1 | | | |
| KZK-1 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| MA-2c | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| MGeo08 | | 791 | 22.5 |
| Target Range - Lower Bound | | 708 | 18.1 |
| Upper Bound | | 870 | 25.7 |
| OREAS 905 | | 68 | 48.3 |
| Target Range - Lower Bound | | 58 | 39.9 |
| Upper Bound | | 76 | 55.1 |
| UTS-1 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-1 | | | |
| UTS-1 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-4 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| UTS-4 | | | |

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QC CERTIFICATE OF ANALYSIS VA17088037

| Method Analyte Units LOR | OA-VOL08m MPA | OA-VOL08m FIZZ RAT | OA-VOL08m NNP | OA-VOL08m NP | OA-ELE07 pH | OA-VOL08m Ratio (N) | S-IR08 S | S-GRA06 S | S-GRA06a S | C-GAS05 C | C-GAS05 CO2 | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As | ME-MS41 Au | |
|----------------------------|---------------|--------------------|---------------|--------------|-------------|---------------------|----------|-----------|------------|-----------|-------------|------------|------------|------------|------------|------|
| Sample Description | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | ppm | % | ppm | ppm | |
| | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | 1.76 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 1.61 |
| Upper Bound | | | | | | | | | | | | | | | | 1.87 |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | <0.05 | <0.2 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.05 | <0.2 | | | | | |
| Upper Bound | | | | | | | | | | 0.10 | 0.4 | | | | | |
| BLANK | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | <0.02 | |
| Target Range - Lower Bound | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | <0.02 | |
| Upper Bound | | | | | | | | | | | | 0.02 | 0.02 | 0.2 | 0.04 | |
| BLANK | | | | | 6.1 | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.5 | | | | | | | | | | | |
| Upper Bound | | | | | 6.9 | | | | | | | | | | | |
| BLANK | | | | | | | | <0.01 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.01 | | | | | | | | |
| Upper Bound | | | | | | | | 0.02 | | | | | | | | |
| BLANK | | | | | | | | | <0.01 | | | | | | | |
| BLANK | | | | | | | | | <0.01 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | <0.01 | | | | | | | |
| Upper Bound | | | | | | | | | 0.02 | | | | | | | |
| BLANK | | | | | | | | | | 0.01 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.01 | | | | | | |
| Upper Bound | | | | | | | | | | 0.02 | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | 1.95 | 0.38 | 504 | 0.40 |
| DUP | | | | | | | | | | | | | 1.98 | 0.36 | 492 | 0.40 |
| Target Range - Lower Bound | | | | | | | | | | | | | 1.86 | 0.34 | 473 | 0.36 |
| Upper Bound | | | | | | | | | | | | | 2.07 | 0.40 | 523 | 0.44 |

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| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % | Ga ppm | Ge ppm | Hf ppm |
| | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 |
| STANDARDS | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | <0.02 |
| Target Range - Lower Bound | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | <0.02 |
| Upper Bound | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 | 0.04 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | <10 | 60 | 0.20 | 0.25 | 0.10 | <0.01 | 48.7 | 0.4 | 4 | 4.35 | 4.5 | 0.98 | 1.44 | 0.05 | 0.08 |
| DUP | <10 | 60 | 0.16 | 0.24 | 0.10 | 0.01 | 50.4 | 0.4 | 5 | 4.36 | 4.0 | 0.94 | 1.35 | <0.05 | 0.07 |
| Target Range - Lower Bound | <10 | 50 | 0.12 | 0.22 | 0.09 | <0.01 | 47.1 | 0.3 | 3 | 4.09 | 3.9 | 0.90 | 1.28 | <0.05 | 0.05 |
| Upper Bound | 20 | 70 | 0.24 | 0.27 | 0.12 | 0.02 | 52.0 | 0.5 | 6 | 4.62 | 4.6 | 1.02 | 1.51 | 0.10 | 0.10 |



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QC CERTIFICATE OF ANALYSIS VA17088037

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | Re ppm | |
| | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.005 | <0.01 | <0.2 | 0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | <0.001 | |
| Target Range - Lower Bound | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | <0.001 | |
| Upper Bound | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 | 0.002 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | 0.45 | 0.013 | 0.33 | 25.9 | 1.0 | 0.03 | 48 | 3.02 | 0.01 | 0.13 | 0.8 | 140 | 15.5 | 16.0 | <0.001 | |
| DUP | 0.45 | 0.013 | 0.32 | 26.9 | 1.0 | 0.03 | 46 | 3.09 | 0.01 | 0.13 | 0.7 | 140 | 15.5 | 15.4 | <0.001 | |
| Target Range - Lower Bound | 0.41 | 0.007 | 0.30 | 24.9 | 0.9 | 0.02 | 40 | 2.85 | <0.01 | 0.07 | 0.5 | 120 | 14.5 | 14.8 | <0.001 | |
| Upper Bound | 0.49 | 0.019 | 0.35 | 27.9 | 1.2 | 0.04 | 54 | 3.26 | 0.02 | 0.19 | 1.0 | 160 | 16.5 | 16.6 | 0.002 | |

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QC CERTIFICATE OF ANALYSIS VA17088037

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | S % | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm | V ppm | W ppm | Y ppm | |
| | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 | |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 | |
| Upper Bound | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | 0.10 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | 0.25 | 5.08 | 0.6 | <0.2 | 2.5 | 20.1 | <0.01 | 0.04 | 8.6 | <0.005 | 0.37 | 1.07 | 2 | 0.20 | 3.56 | |
| DUP | 0.24 | 5.29 | 0.5 | 0.2 | 2.5 | 20.1 | <0.01 | 0.04 | 8.2 | <0.005 | 0.37 | 1.06 | 2 | 0.19 | 3.44 | |
| Target Range - Lower Bound | 0.22 | 4.75 | 0.4 | <0.2 | 2.2 | 18.9 | <0.01 | 0.03 | 7.8 | <0.005 | 0.32 | 0.96 | <1 | 0.13 | 3.28 | |
| Upper Bound | 0.27 | 5.62 | 0.7 | 0.4 | 2.8 | 21.3 | 0.02 | 0.05 | 9.0 | 0.010 | 0.42 | 1.17 | 3 | 0.26 | 3.73 | |

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QC CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm | ME-MS41 Zr ppm |
|----------------------------|--------------------------|----------------|----------------|
| | | 2 | 0.5 |
| STANDARDS | | | |
| UTS-4 | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANKS | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | <2 | <0.5 |
| Target Range - Lower Bound | | <2 | <0.5 |
| Upper Bound | | 4 | 1.0 |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| DUPLICATES | | | |
| ORIGINAL | | 6 | 2.0 |
| DUP | | 6 | 1.9 |
| Target Range - Lower Bound | | 4 | 1.3 |
| Upper Bound | | 8 | 2.6 |

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QC CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm |
|----------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|---------------|----------------|--------------|----------------|----------------|
| L1919526-3 132282 DUP | | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L1919526-7 132291 DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1919526-9 MARCH TAL 2017 DUP | | | | | | 8.0 | | 0.09 | | | | | | | | |
| Target Range - Lower Bound | | | | | | 7.5 | | 0.08 | | | | | | | | |
| Upper Bound | | | | | | 8.5 | | 0.10 | | | | | | | | |
| L1919526-10 132294 DUP | | 0.6 | 2 | 16 | 17 | | 27.20 | | | | 0.13 | 0.5 | | | | |
| Target Range - Lower Bound | | <0.3 | <1 | 14 | 15 | | 25.83 | | | | 0.07 | <0.2 | | | | |
| Upper Bound | | 0.9 | 3 | 18 | 19 | | 28.57 | | | | 0.18 | 0.7 | | | | |
| L1919526-14 132298 DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | | |
|---|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|------|------|------|
| | | | | | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga | Ge | Hf |
| | | | | | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm |
| | | | | | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| L1919526-3 132282 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1919526-7 132291 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1919526-9 MARCH TAL 2017 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1919526-10 132294 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1919526-14 132298 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | |
|---|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|-----|-------|
| | | | | | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P | Pb | Rb | Re |
| | | | | | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| L1919526-3 132282 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1919526-7 132291 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1919526-9 MARCH TAL 2017 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1919526-10 132294 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1919526-14 132298 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|---|-----------------------------------|-------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|---------------------|---------------------|---------------------|---------------------|
| | | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| L1919526-3 132282 DUP Target Range - Lower Bound Upper Bound | | DUPLICATES | | | | | | | | | | | | | | |
| L1919526-7 132291 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1919526-9 MARCH TAL 2017 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1919526-10 132294 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1919526-14 132298 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17088037

| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | |
|---|-----------------------------------|---------------------------|-----------------------------|--|
| DUPLICATES | | | | |
| L1919526-3 132282 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1919526-7 132291 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1919526-9 MARCH TAL 2017 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1919526-10 132294 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1919526-14 132298 DUP Target Range - Lower Bound Upper Bound | | | | |
| | | | | |

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| | CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | |
|--------------------|---|---------|----------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|--|--|
| Applies to Method: | <p style="text-align: center;">ANALYTICAL COMMENTS</p> <p>Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41</p> | | | | | | | | | | | | | | | | |
| Applies to Method: | <p style="text-align: center;">LABORATORY ADDRESSES</p> <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> <td style="width: 33%;">OA-ELE07</td> </tr> <tr> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> <td>S-CAL06</td> </tr> <tr> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> <td>SPL-21</td> </tr> <tr> <td>WEI-21</td> <td></td> <td></td> <td></td> </tr> </table> | C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | | |
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | | | | | | | | | | | | | | |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | | | | | | | | | | | | | | |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | | | | | | | | | | | | | | |
| WEI-21 | | | | | | | | | | | | | | | | | |

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L1919526-COFC

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| Report To Contact and company name below will appear on the final report Company: Minto Explorations Ltd. Contact: Minto Environment - Coordinator Phone: 1-604-759-4659 Street: 2100-510 West Georgia St. City/Province: Vancouver, British Columbia Postal Code: V6B 0M3 Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Company: Minto Explorations Ltd. Contact: Ruth Cayetano | | | Report Format / Distribution Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: minto_environment@mintomine.com Email 2 Email 3 | | | Select Service Level below - please confirm all E&P TATs with your AM - surcharges will apply Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply Priority (Business Day): 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> EMERGENCY: 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|-----------------------|--|--|---------------------------|--|----------------------|--|--|---|--|--|--|--|--|----------------------|----------|-----------------------|------------------------------|--|---------------------------|--|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|--|----|---|---|---|---|---|---|--|----|---|---|---|---|---|---|--|
| Project Information ALS Account # / Quote #: _____ Job #: _____ PO / AFE: TBD LSD: _____ ALS Lab Work Order # (lab use only): _____ | | | Oil and Gas Required Fields (client use) AFE/Cost Center: _____ PO#: _____ Major/Minor Code: _____ Routing Code: _____ Requisitioner: _____ Location: _____ ALS Contact: _____ Sampler: _____ | | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th rowspan="2"></th> <th colspan="6">Total Metals - Aqua regia digestion (ICP)</th> <th rowspan="2">Number of Containers</th> </tr> <tr> <th>Paste pH</th> <th>% Inorganic Carbonate</th> <th>Total Carbon/Sulphur (t.eco)</th> <th>AP - determination by % sulphide sulphur</th> <th>Modified NP - (MEND 1991)</th> <th></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td></td> </tr> <tr> <td>2</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>3</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>4</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>5</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>6</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>7</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>8</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>9</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>10</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>11</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> </tbody> </table> | | | | Total Metals - Aqua regia digestion (ICP) | | | | | | Number of Containers | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (t.eco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | | 1 | R | R | R | R | R | R | | 2 | X | X | X | X | X | X | | 3 | X | X | X | X | X | X | | 4 | X | X | X | X | X | X | | 5 | X | X | X | X | X | X | | 6 | X | X | X | X | X | X | | 7 | X | X | X | X | X | X | | 8 | X | X | X | X | X | X | | 9 | X | X | X | X | X | X | | 10 | X | X | X | X | X | X | | 11 | X | X | X | X | X | X | |
| | Total Metals - Aqua regia digestion (ICP) | | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (t.eco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | R | R | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples (client use) Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) _____ _____ _____ | | | SAMPLE CONDITION AS RECEIVED (lab use only) Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input type="checkbox"/> INITIAL COOLER TEMPERATURES °C: _____ FINAL COOLER TEMPERATURES °C: _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) Released by: <u>Kate Joe</u> Date: <u>April 24, 2017</u> Time: _____ | | | INITIAL SHIPMENT RECEPTION (lab use only) Received by: <u>VD</u> Date: <u>April 28/17</u> Time: <u>15:45</u> | | | FINAL SHIPMENT RECEPTION (lab use only) Received by: _____ Date: _____ Time: _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form.
 JK May 2 15:00 12,12,12,12,12,10,10,10,10

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1919526-COFC

COC Number: 15 ~~XXXX~~

Page of

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| | | | | | | |
|--|---|--|------------------------|--|--|----------------------|
| Report To Contact and company name below will appear on the final report | | Report Format: | | <small>All E&P TATs with your AM - surcharges will apply</small> | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | 4 day [P4] <input type="checkbox"/> | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | 3 day [P3] <input type="checkbox"/> | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | 2 day [P2] <input type="checkbox"/> | | |
| Street: 2100-510 West Georgia St | | Email 1 or Fax: minto_environment@mintomine.com | | EMERGENCY: 1 Business day [E1] <input type="checkbox"/> | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | |
| Postal Code: V6B 0M3 | | Email 3 | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | For tests that can not be performed according to the service level selected, you will be contacted. | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | Analysis Request | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax: ap@mintomine.com | | <small>Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below</small> | | |
| Contact: Ruth Cayetano | | Email 2 | | <small>Number of Containers</small> | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | |
| ALS Account # / Quote #: | | AFB/Cost Center: | | PO# | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | |
| PO / AFE: TBD | | Requisitioner: | | | | |
| LSD: | | Location: | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals - Aqua regia digestion (ICP) | Number of Containers |
| 12 | 132296 | | | Composite | Paste pH % Inorganic Carbonate Total Carbon/Sulphur (t sec) AP - determination by % sulphide sulphur Modified NP - (MEND 1991) | |
| 13 | 132297 | 15-APR-17 | | WASTE | | |
| 14 | 132298 | 15-APR-17 | | WASTE | | |
| 15 | 132299 | 16-APR-17 | | WASTE | | |
| 16 | 132300 | 17-APR-17 | | WASTE | | |
| | | 18-APR-17 | | WASTE | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | |
| | | | | Cooling Initiated <input type="checkbox"/> | | |
| | | | | INITIAL COOLER TEMPERATURES °C | | |
| | | | | FINAL COOLER TEMPERATURES °C | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | FINAL SHIPMENT RECEPTION (lab use only) | | |
| Released by: <i>KARA JOE</i> | Date: <i>APR 26 2017</i> | Time: | Received by: <i>VO</i> | Date: <i>APR 28 17</i> | Time: <i>15:45</i> | Received by: |
| Date: <i>APR 26 2017</i> | | Date: <i>APR 28 17</i> | | Date: | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.
1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form

WHITE - LABORATORY COPY YELLOW - CLIENT COPY



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 23-MAY-17
Report Date: 23-JUN-17 18:02 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1929673
Project P.O. #: 220826
Job Reference:
C of C Numbers: 17-17
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1929673-1 WASTE 19-APR-17 135351 | L1929673-2 WASTE 19-APR-17 135352 | L1929673-3 WASTE 20-APR-17 135353 | L1929673-4 WASTE 21-APR-17 135354 | L1929673-5 WASTE 21-APR-17 135355 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.1 | 8.8 | 8.5 | 8.2 | 8.6 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.22 | 0.36 | 0.24 | 0.06 | 0.05 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 2 | 2 | 1 | 1 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 0.6 | 0.3 | 0.6 | 0.3 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 23 | 35 | 27 | 12 | 10 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 22 | 35 | 26 | 12 | 10 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 36.80 | 112.00 | 43.20 | 38.40 | 32.00 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | 0.02 | <0.01 | <0.01 | 0.02 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | 0.02 | 0.01 | 0.02 | 0.01 | <0.01 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.02 | 0.01 | 0.02 | 0.01 | 0.01 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.08 | 0.70 | 1.05 | 0.95 | 0.89 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.52 | 0.10 | <0.05 | 0.17 | <0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 6.2 | 6.8 | 1.2 | 3.2 | 3.9 |
| | Barium (Ba) (ppm) | | | | |
| | 300 | 260 | 220 | 260 | 190 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.44 | 0.36 | 0.27 | 0.30 | 0.24 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.32 | 0.02 | 0.03 | 0.07 | 0.24 |
| | Boron (B) (ppm) | | | | |
| | <10 | 10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.27 | 0.11 | 0.08 | 0.13 | 0.24 |
| | Calcium (Ca) (%) | | | | |
| | 1.01 | 1.46 | 1.10 | 0.51 | 0.31 |
| | Cerium (Ce) (ppm) | | | | |
| | 26.6 | 14.50 | 28.5 | 22.4 | 26.3 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.75 | 0.45 | 0.48 | 0.48 | 0.77 |
| | Chromium (Cr) (ppm) | | | | |
| | 24 | 4 | 5 | 11 | 6 |
| | Cobalt (Co) (ppm) | | | | |
| | 7.9 | 4.0 | 6.0 | 5.7 | 6.1 |
| | Copper (Cu) (ppm) | | | | |
| | 1730 | 331 | 593 | 577 | 4470 |
| | Gallium (Ga) (ppm) | | | | |
| | 4.10 | 4.79 | 5.32 | 4.45 | 4.41 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.10 | 0.08 | 0.11 | 0.09 | 0.11 |
| | Gold (Au) (ppm) | | | | |
| | 0.03 | <0.02 | <0.02 | <0.02 | 0.08 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.22 | 0.05 | 0.04 | 0.10 | 0.04 |
| | Indium (In) (ppm) | | | | |
| | 0.045 | 0.045 | 0.027 | 0.025 | 0.045 |
| | Iron (Fe) (%) | | | | |
| | 2.46 | 1.90 | 2.44 | 2.08 | 2.11 |
| | Lanthanum (La) (ppm) | | | | |
| | 13.5 | 6.7 | 14.8 | 11.3 | 14.1 |
| | Lead (Pb) (ppm) | | | | |
| | 5.0 | 3.8 | 2.4 | 3.4 | 3.4 |
| | Lithium (Li) (ppm) | | | | |
| | 7.0 | 4.1 | 5.6 | 6.5 | 4.0 |
| | Magnesium (Mg) (%) | | | | |
| | 0.46 | 0.16 | 0.63 | 0.39 | 0.42 |
| | Manganese (Mn) (ppm) | | | | |
| | 541 | 452 | 624 | 512 | 550 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1929673-6 WASTE 23-APR-17 135356 | L1929673-7 WASTE 02-MAY-17 135359 | L1929673-8 WASTE 26-APR-17 135361 | L1929673-9 WASTE 26-APR-17 135362 | L1929673-10 WASTE 28-APR-17 135363 |
|-------------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.6 | 7.8 | 8.8 | 8.4 | 8.6 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.33 | 0.30 | 0.23 | 0.43 | 0.33 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.6 | 0.3 | 0.3 | 2.2 | 2.2 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 31 | 13 | 29 | 44 | 34 |
| | NNP (tCaCO3/1Kt) | 30 | 13 | 29 | 42 | 32 |
| | Ratio (NP/MPA) (Unity) | 49.60 | 41.60 | 92.80 | 20.11 | 15.54 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | 0.01 | <0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | <0.01 | 0.01 | <0.01 | 0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.02 | <0.01 | 0.01 | 0.06 | 0.07 |
| | Total Sulfur (combustion) (%) | 0.02 | 0.01 | 0.01 | 0.07 | 0.07 |
| Total Metals | Aluminum (Al) (%) | 0.61 | 0.75 | 1.19 | 0.74 | 1.09 |
| | Antimony (Sb) (ppm) | 0.12 | 0.17 | <0.05 | 0.14 | <0.05 |
| | Arsenic (As) (ppm) | 7.3 | 10.0 | 1.3 | 2.7 | 0.8 |
| | Barium (Ba) (ppm) | 510 | 420 | 330 | 250 | 210 |
| | Beryllium (Be) (ppm) | 0.47 | 0.42 | 0.32 | 0.36 | 0.30 |
| | Bismuth (Bi) (ppm) | 0.03 | 10.10 | 0.09 | 1.12 | 0.21 |
| | Boron (B) (ppm) | 10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.14 | 0.81 | 0.05 | 0.21 | 0.17 |
| | Calcium (Ca) (%) | 1.30 | 0.23 | 1.16 | 1.64 | 1.33 |
| | Cerium (Ce) (ppm) | 19.95 | 14.70 | 22.6 | 25.4 | 25.9 |
| | Cesium (Cs) (ppm) | 0.52 | 0.51 | 0.43 | 0.50 | 0.47 |
| | Chromium (Cr) (ppm) | 4 | 7 | 6 | 4 | 5 |
| | Cobalt (Co) (ppm) | 5.6 | 7.1 | 6.2 | 7.8 | 5.7 |
| | Copper (Cu) (ppm) | 407 | >10000 | 1250 | 4650 | 1360 |
| | Gallium (Ga) (ppm) | 4.95 | 3.58 | 5.87 | 4.15 | 5.51 |
| | Germanium (Ge) (ppm) | 0.09 | 0.11 | 0.11 | 0.10 | 0.08 |
| | Gold (Au) (ppm) | <0.02 | 1.13 | 0.02 | 0.13 | 0.03 |
| | Hafnium (Hf) (ppm) | 0.06 | 0.09 | 0.06 | 0.04 | 0.05 |
| | Indium (In) (ppm) | 0.050 | 0.226 | 0.030 | 0.045 | 0.049 |
| | Iron (Fe) (%) | 2.30 | 3.75 | 2.55 | 2.72 | 2.45 |
| | Lanthanum (La) (ppm) | 9.3 | 7.7 | 11.4 | 13.9 | 13.6 |
| | Lead (Pb) (ppm) | 4.7 | 6.6 | 2.4 | 4.6 | 2.8 |
| | Lithium (Li) (ppm) | 3.3 | 3.1 | 6.3 | 3.3 | 5.5 |
| | Magnesium (Mg) (%) | 0.16 | 0.17 | 0.67 | 0.28 | 0.55 |
| | Manganese (Mn) (ppm) | 534 | 326 | 604 | 725 | 616 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1929673-11 WASTE 29-APR-17 135364 | L1929673-12 WASTE 29-APR-17 135365 | L1929673-13 WASTE 30-APR-17 135366 | L1929673-14 WASTE 30-APR-17 135367 | L1929673-15 WASTE 30-APR-17 135368 |
|-----------------------------------|---|---|---|---|---|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.3 | 8.7 | 8.7 | 8.7 | 8.5 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.13 | 0.43 | 0.32 | 0.39 | 0.54 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.3 | 0.3 | 1.3 | 7.8 | 10.9 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 16 | 14 | 35 | 31 | 51 |
| | NNP (tCaCO3/1Kt) | 16 | 14 | 34 | 23 | 40 |
| | Ratio (NP/MPA) (Unity) | 51.20 | 44.80 | 28.00 | 3.97 | 4.66 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.02 | 0.01 | 0.02 | 0.02 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.02 | 0.01 | 0.02 | 0.02 | 0.03 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | <0.01 | <0.01 | 0.02 | 0.23 | 0.34 |
| | Total Sulfur (combustion) (%) | 0.01 | 0.01 | 0.04 | 0.25 | 0.35 |
| Total Metals | Aluminum (Al) (%) | 1.14 | 0.71 | 1.51 | 1.21 | 1.30 |
| | Antimony (Sb) (ppm) | 0.24 | 0.09 | 0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 5.0 | 9.5 | 1.4 | 0.4 | 0.7 |
| | Barium (Ba) (ppm) | 270 | 250 | 280 | 300 | 290 |
| | Beryllium (Be) (ppm) | 0.37 | 0.41 | 0.44 | 0.21 | 0.26 |
| | Bismuth (Bi) (ppm) | 0.41 | 0.05 | 0.11 | 0.06 | 0.08 |
| | Boron (B) (ppm) | <10 | 10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.19 | 0.15 | 0.07 | 0.10 | 0.37 |
| | Calcium (Ca) (%) | 0.69 | 1.68 | 1.40 | 1.22 | 1.90 |
| | Cerium (Ce) (ppm) | 24.5 | 22.8 | 27.6 | 19.10 | 25.0 |
| | Cesium (Cs) (ppm) | 0.71 | 0.57 | 0.43 | 0.52 | 0.48 |
| | Chromium (Cr) (ppm) | 17 | 5 | 6 | 5 | 5 |
| | Cobalt (Co) (ppm) | 6.9 | 5.3 | 6.1 | 5.9 | 6.5 |
| | Copper (Cu) (ppm) | 2860 | 636 | 717 | 1620 | 3050 |
| | Gallium (Ga) (ppm) | 5.02 | 5.13 | 7.52 | 5.49 | 7.20 |
| | Germanium (Ge) (ppm) | 0.09 | 0.10 | 0.10 | 0.09 | 0.11 |
| | Gold (Au) (ppm) | 0.11 | 0.02 | 0.05 | 0.02 | 0.05 |
| | Hafnium (Hf) (ppm) | 0.17 | 0.04 | 0.03 | 0.03 | 0.03 |
| | Indium (In) (ppm) | 0.072 | 0.057 | 0.034 | 0.082 | 0.101 |
| | Iron (Fe) (%) | 2.48 | 2.26 | 2.64 | 2.60 | 3.06 |
| | Lanthanum (La) (ppm) | 12.2 | 10.8 | 14.9 | 9.3 | 12.9 |
| | Lead (Pb) (ppm) | 4.8 | 4.0 | 4.0 | 2.5 | 3.5 |
| | Lithium (Li) (ppm) | 7.0 | 4.0 | 8.8 | 5.1 | 6.5 |
| | Magnesium (Mg) (%) | 0.46 | 0.19 | 0.78 | 0.67 | 0.65 |
| | Manganese (Mn) (ppm) | 384 | 540 | 626 | 417 | 642 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1929673-16 WASTE 05-MAY-17 140902 | | | | |
|---|---|-------|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | 8.2 | | | |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.26 | | | |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | | | |
| | MPA (tCaCO3/1Kt) | 0.6 | | | |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 29 | | | |
| | NNP (tCaCO3/1Kt) | 28 | | | |
| | Ratio (NP/MPA) (Unity) | 46.40 | | | |
| | Sulfate Sulfur (carbonate leach) (%) | 0.02 | | | |
| | Sulfate Sulfur (HCl leach) (%) | 0.04 | | | |
| | Sulfide Sulfur (T minus carbonate leach) (%) | <0.01 | | | |
| | Total Sulfur (combustion) (%) | 0.02 | | | |
| Total Metals | Aluminum (Al) (%) | 1.06 | | | |
| | Antimony (Sb) (ppm) | 0.49 | | | |
| | Arsenic (As) (ppm) | 6.1 | | | |
| | Barium (Ba) (ppm) | 260 | | | |
| | Beryllium (Be) (ppm) | 0.40 | | | |
| | Bismuth (Bi) (ppm) | 0.10 | | | |
| | Boron (B) (ppm) | <10 | | | |
| | Cadmium (Cd) (ppm) | 0.24 | | | |
| | Calcium (Ca) (%) | 1.25 | | | |
| | Cerium (Ce) (ppm) | 25.5 | | | |
| | Cesium (Cs) (ppm) | 0.78 | | | |
| | Chromium (Cr) (ppm) | 26 | | | |
| | Cobalt (Co) (ppm) | 7.9 | | | |
| | Copper (Cu) (ppm) | 141.5 | | | |
| | Gallium (Ga) (ppm) | 3.91 | | | |
| | Germanium (Ge) (ppm) | 0.09 | | | |
| | Gold (Au) (ppm) | <0.02 | | | |
| | Hafnium (Hf) (ppm) | 0.24 | | | |
| | Indium (In) (ppm) | 0.023 | | | |
| | Iron (Fe) (%) | 2.18 | | | |
| | Lanthanum (La) (ppm) | 13.1 | | | |
| | Lead (Pb) (ppm) | 5.7 | | | |
| | Lithium (Li) (ppm) | 7.7 | | | |
| | Magnesium (Mg) (%) | 0.51 | | | |
| | Manganese (Mn) (ppm) | 445 | | | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1929673-1 | L1929673-2 | L1929673-3 | L1929673-4 | L1929673-5 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 19-APR-17 | 19-APR-17 | 20-APR-17 | 21-APR-17 | 21-APR-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 135351 | 135352 | 135353 | 135354 | 135355 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.04 | <0.01 | 0.01 | 0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | | 1.09 | 0.44 | 1.15 | 1.17 | 2.90 |
| | Nickel (Ni) (ppm) | | 19.3 | 1.6 | 2.3 | 8.3 | 3.1 |
| | Niobium (Nb) (ppm) | | 0.73 | 0.06 | 0.11 | 0.30 | 0.23 |
| | Phosphorus (P) (ppm) | | 860 | 460 | 760 | 640 | 790 |
| | Potassium (K) (%) | | 0.22 | 0.31 | 0.49 | 0.25 | 0.61 |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Rubidium (Rb) (ppm) | | 12.4 | 9.3 | 22.7 | 11.4 | 34.5 |
| | Scandium (Sc) (ppm) | | 5.2 | 5.3 | 4.5 | 4.3 | 4.9 |
| | Selenium (Se) (ppm) | | 0.9 | 0.2 | 0.5 | 0.4 | 1.2 |
| | Silver (Ag) (ppm) | | 0.67 | 0.05 | 0.07 | 0.09 | 0.45 |
| | Sodium (Na) (%) | | 0.05 | 0.07 | 0.03 | 0.04 | 0.04 |
| | Strontium (Sr) (ppm) | | 54.7 | 67.7 | 51.2 | 32.7 | 22.6 |
| | Sulfur (S) (%) | | 0.01 | <0.01 | 0.01 | <0.01 | <0.01 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.15 | 0.02 | 0.03 | 0.03 | 0.08 |
| | Thallium (Tl) (ppm) | | 0.12 | 0.06 | 0.15 | 0.09 | 0.30 |
| | Thorium (Th) (ppm) | | 3.4 | 1.7 | 3.5 | 2.8 | 4.0 |
| | Tin (Sn) (ppm) | | 0.5 | 0.7 | 0.5 | 0.5 | 0.5 |
| | Titanium (Ti) (%) | | 0.065 | 0.019 | 0.077 | 0.043 | 0.093 |
| | Tungsten (W) (ppm) | | 0.43 | 0.08 | 0.42 | 0.53 | 0.53 |
| | Uranium (U) (ppm) | | 0.51 | 0.12 | 0.22 | 0.26 | 0.24 |
| | Vanadium (V) (ppm) | | 51 | 39 | 50 | 42 | 53 |
| | Yttrium (Y) (ppm) | | 8.98 | 8.00 | 7.49 | 7.51 | 8.25 |
| | Zinc (Zn) (ppm) | | 64 | 54 | 67 | 56 | 69 |
| | Zirconium (Zr) (ppm) | | 6.9 | 1.1 | 0.7 | 3.1 | 1.3 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.8 | 1.3 | 0.9 | 0.2 | 0.2 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1929673-6 WASTE 23-APR-17 135356 | L1929673-7 WASTE 02-MAY-17 135359 | L1929673-8 WASTE 26-APR-17 135361 | L1929673-9 WASTE 26-APR-17 135362 | L1929673-10 WASTE 28-APR-17 135363 |
|------------------------|--------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | 0.22 | 0.01 | 0.01 | 0.01 | |
| | Molybdenum (Mo) (ppm) | 0.69 | 2.17 | 0.72 | 1.34 | 1.15 | |
| | Nickel (Ni) (ppm) | 2.9 | 6.2 | 2.4 | 2.3 | 2.1 | |
| | Niobium (Nb) (ppm) | <0.05 | 0.24 | 0.11 | 0.06 | 0.10 | |
| | Phosphorus (P) (ppm) | 630 | 600 | 760 | 800 | 700 | |
| | Potassium (K) (%) | 0.28 | 0.22 | 0.53 | 0.31 | 0.44 | |
| | Rhenium (Re) (ppm) | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 | |
| | Rubidium (Rb) (ppm) | 10.1 | 12.4 | 23.4 | 14.4 | 21.3 | |
| | Scandium (Sc) (ppm) | 7.6 | 5.3 | 4.3 | 5.1 | 4.3 | |
| | Selenium (Se) (ppm) | 0.5 | 11.4 | 0.6 | 3.5 | 0.7 | |
| | Silver (Ag) (ppm) | 0.10 | 13.85 | 0.14 | 2.37 | 0.43 | |
| | Sodium (Na) (%) | 0.04 | 0.03 | 0.08 | 0.03 | 0.05 | |
| | Strontium (Sr) (ppm) | 47.1 | 55.8 | 64.9 | 60.9 | 63.8 | |
| | Sulfur (S) (%) | 0.01 | 0.01 | 0.01 | 0.07 | 0.07 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.01 | 2.77 | 0.11 | 0.41 | 0.08 | |
| | Thallium (Tl) (ppm) | 0.05 | 0.11 | 0.15 | 0.09 | 0.17 | |
| | Thorium (Th) (ppm) | 2.5 | 2.9 | 2.2 | 2.8 | 4.1 | |
| | Tin (Sn) (ppm) | 0.8 | 0.7 | 0.5 | 0.5 | 0.5 | |
| | Titanium (Ti) (%) | 0.017 | 0.032 | 0.104 | 0.037 | 0.058 | |
| | Tungsten (W) (ppm) | 0.13 | 0.30 | 0.42 | 0.14 | 0.29 | |
| | Uranium (U) (ppm) | 0.15 | 0.72 | 0.23 | 0.26 | 0.32 | |
| | Vanadium (V) (ppm) | 51 | 64 | 60 | 55 | 50 | |
| | Yttrium (Y) (ppm) | 9.22 | 9.10 | 8.38 | 9.25 | 7.77 | |
| | Zinc (Zn) (ppm) | 68 | 121 | 66 | 66 | 64 | |
| | Zirconium (Zr) (ppm) | 1.5 | 3.2 | 1.1 | 1.0 | 1.1 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.2 | 1.1 | 0.9 | 1.6 | 1.2 | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1929673-11 | L1929673-12 | L1929673-13 | L1929673-14 | L1929673-15 |
|------------------------|--------------------------|--------------|-------------|-------------|-------------|-------------|-------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 29-APR-17 | 29-APR-17 | 30-APR-17 | 30-APR-17 | 30-APR-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 135364 | 135365 | 135366 | 135367 | 135368 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.03 | 0.01 | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | | 1.17 | 0.72 | 1.09 | 6.93 | 9.27 |
| | Nickel (Ni) (ppm) | | 11.0 | 2.3 | 2.6 | 2.1 | 2.1 |
| | Niobium (Nb) (ppm) | | 0.95 | 0.07 | 0.15 | 0.19 | 0.17 |
| | Phosphorus (P) (ppm) | | 700 | 640 | 740 | 840 | 840 |
| | Potassium (K) (%) | | 0.42 | 0.33 | 0.54 | 0.69 | 0.57 |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | 0.001 | 0.031 | 0.025 |
| | Rubidium (Rb) (ppm) | | 24.5 | 15.0 | 24.7 | 32.6 | 27.8 |
| | Scandium (Sc) (ppm) | | 5.7 | 7.3 | 4.8 | 4.6 | 5.4 |
| | Selenium (Se) (ppm) | | 1.2 | 0.4 | 1.1 | 1.7 | 2.6 |
| | Silver (Ag) (ppm) | | 0.63 | 0.12 | 0.35 | 0.33 | 0.67 |
| | Sodium (Na) (%) | | 0.05 | 0.05 | 0.07 | 0.07 | 0.06 |
| | Strontium (Sr) (ppm) | | 43.9 | 64.6 | 70.6 | 63.2 | 96.3 |
| | Sulfur (S) (%) | | <0.01 | <0.01 | 0.04 | 0.29 | 0.35 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.17 | 0.02 | 0.04 | 0.07 | 0.13 |
| | Thallium (Tl) (ppm) | | 0.20 | 0.08 | 0.15 | 0.24 | 0.21 |
| | Thorium (Th) (ppm) | | 4.2 | 2.7 | 3.1 | 1.6 | 1.9 |
| | Tin (Sn) (ppm) | | 0.6 | 0.8 | 0.6 | 1.1 | 1.1 |
| | Titanium (Ti) (%) | | 0.093 | 0.032 | 0.077 | 0.115 | 0.089 |
| | Tungsten (W) (ppm) | | 0.60 | 0.21 | 0.41 | 0.44 | 0.29 |
| | Uranium (U) (ppm) | | 0.48 | 0.18 | 0.20 | 0.26 | 0.68 |
| | Vanadium (V) (ppm) | | 57 | 54 | 57 | 58 | 64 |
| | Yttrium (Y) (ppm) | | 8.37 | 8.54 | 6.53 | 6.32 | 8.10 |
| | Zinc (Zn) (ppm) | | 58 | 67 | 79 | 65 | 82 |
| | Zirconium (Zr) (ppm) | | 5.8 | 1.1 | 0.8 | 0.8 | 0.9 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.5 | 1.6 | 1.2 | 1.4 | 2.0 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1929673-16 WASTE 05-MAY-17 140902 | | | |
|------------------------|--|---|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.04 | | | |
| | Molybdenum (Mo) (ppm) | 0.92 | | | |
| | Nickel (Ni) (ppm) | 20.6 | | | |
| | Niobium (Nb) (ppm) | 0.73 | | | |
| | Phosphorus (P) (ppm) | 790 | | | |
| | Potassium (K) (%) | 0.18 | | | |
| | Rhenium (Re) (ppm) | 0.001 | | | |
| | Rubidium (Rb) (ppm) | 10.5 | | | |
| | Scandium (Sc) (ppm) | 5.0 | | | |
| | Selenium (Se) (ppm) | 0.7 | | | |
| | Silver (Ag) (ppm) | 0.09 | | | |
| | Sodium (Na) (%) | 0.04 | | | |
| | Strontium (Sr) (ppm) | 63.9 | | | |
| | Sulfur (S) (%) | 0.01 | | | |
| | Tantalum (Ta) (ppm) | <0.01 | | | |
| | Tellurium (Te) (ppm) | 0.02 | | | |
| | Thallium (Tl) (ppm) | 0.12 | | | |
| | Thorium (Th) (ppm) | 3.5 | | | |
| | Tin (Sn) (ppm) | 0.4 | | | |
| | Titanium (Ti) (%) | 0.066 | | | |
| | Tungsten (W) (ppm) | 0.31 | | | |
| | Uranium (U) (ppm) | 0.72 | | | |
| | Vanadium (V) (ppm) | 49 | | | |
| | Yttrium (Y) (ppm) | 8.54 | | | |
| | Zinc (Zn) (ppm) | 55 | | | |
| | Zirconium (Zr) (ppm) | 7.5 | | | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.0 | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06-AX | Soil | Sulfide Sulfur Calc from Carbonate Leach | ALS Minerals S-CAL06 |
| Sulfide Sulfur (as S) is calculated by subtracting the Carbonate Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-17

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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 Finalized Date: 22-JUN-2017
 Account: APN

CERTIFICATE VA17104646

Project: L1929673
 P.O. No.: ALSM-CW16-102-APN
 This report is for 16 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 26-MAY-2017.
 The following have access to data associated with this certificate:

| | | |
|--------------------------|----------------------------|-------------|
| ELSE VANCOUVER WEBTRIEVE | SOFTWARE DEVELOPMENT GROUP | SHANE STACK |
|--------------------------|----------------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| ME-OG46 | Ore Grade Elements - AquaRegia | ICP-AES |
| Cu-OG46 | Ore Grade Cu - Aqua Regia | ICP-AES |
| OA-VOL08m | Modified NP | |
| S-IRO8 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17104646

| Sample Description | Method | WEI-21 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | OA-VOL08m | S-IR08 | S-GRA06 | S-GRA06a | S-CAL06 | C-GAS05 | C-GAS05 | ME-MS41 | ME-MS41 |
|--------------------|---------|-----------|------------|-----------|------------|------------|----------|-----------|--------|---------|----------|---------|---------|---------|---------|---------|
| | Analyte | Recvd Wt. | MPA | FIZZ RAT | NNP | NP | pH | Ratio (N | S | S | S | S | C | CO2 | Ag | Al |
| | Units | kg | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | % | ppm | % |
| | LOR | 0.02 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 |
| L1929673-1 135351 | | 1.16 | 0.6 | 2 | 22 | 23 | 8.1 | 36.80 | 0.02 | <0.01 | 0.02 | 0.02 | 0.22 | 0.8 | 0.67 | 1.08 |
| L1929673-2 135352 | | 1.08 | 0.3 | 2 | 35 | 35 | 8.8 | 112.00 | 0.01 | <0.01 | <0.01 | 0.01 | 0.36 | 1.3 | 0.05 | 0.70 |
| L1929673-3 135353 | | 1.16 | 0.6 | 2 | 26 | 27 | 8.5 | 43.20 | 0.02 | <0.01 | <0.01 | 0.02 | 0.24 | 0.9 | 0.07 | 1.05 |
| L1929673-4 135354 | | 1.16 | 0.3 | 1 | 12 | 12 | 8.2 | 38.40 | 0.01 | <0.01 | 0.02 | 0.01 | 0.06 | 0.2 | 0.09 | 0.95 |
| L1929673-5 135355 | | 1.06 | 0.3 | 1 | 10 | 10 | 8.6 | 32.00 | 0.01 | 0.01 | <0.01 | <0.01 | 0.05 | 0.2 | 0.45 | 0.89 |
| L1929673-6 135356 | | 1.14 | 0.6 | 2 | 30 | 31 | 8.6 | 49.60 | 0.02 | <0.01 | 0.01 | 0.02 | 0.33 | 1.2 | 0.10 | 0.61 |
| L1929673-7 135359 | | 2.00 | 0.3 | 2 | 13 | 13 | 7.8 | 41.60 | 0.01 | 0.01 | <0.01 | <0.01 | 0.30 | 1.1 | 13.85 | 0.75 |
| L1929673-8 135361 | | 1.12 | 0.3 | 2 | 29 | 29 | 8.8 | 92.80 | 0.01 | <0.01 | 0.01 | 0.01 | 0.23 | 0.9 | 0.14 | 1.19 |
| L1929673-9 135362 | | 1.04 | 2.2 | 2 | 42 | 44 | 8.4 | 20.11 | 0.07 | 0.01 | <0.01 | 0.06 | 0.43 | 1.6 | 2.37 | 0.74 |
| L1929673-10 135363 | | 1.16 | 2.2 | 2 | 32 | 34 | 8.6 | 15.54 | 0.07 | <0.01 | 0.01 | 0.07 | 0.33 | 1.2 | 0.43 | 1.09 |
| L1929673-11 135364 | | 1.38 | 0.3 | 2 | 16 | 16 | 8.3 | 51.20 | 0.01 | 0.02 | 0.02 | <0.01 | 0.13 | 0.5 | 0.63 | 1.14 |
| L1929673-12 135365 | | 1.04 | 0.3 | 2 | 14 | 14 | 8.7 | 44.80 | 0.01 | 0.01 | 0.01 | <0.01 | 0.43 | 1.6 | 0.12 | 0.71 |
| L1929673-13 135366 | | 1.16 | 1.3 | 2 | 34 | 35 | 8.7 | 28.00 | 0.04 | 0.02 | 0.02 | 0.02 | 0.32 | 1.2 | 0.35 | 1.51 |
| L1929673-14 135367 | | 0.92 | 7.8 | 2 | 23 | 31 | 8.7 | 3.97 | 0.25 | 0.02 | 0.02 | 0.23 | 0.39 | 1.4 | 0.33 | 1.21 |
| L1929673-15 135368 | | 1.08 | 10.9 | 2 | 40 | 51 | 8.5 | 4.66 | 0.35 | 0.01 | 0.03 | 0.34 | 0.54 | 2.0 | 0.67 | 1.30 |
| L1929673-16 140902 | | 1.08 | 0.6 | 2 | 28 | 29 | 8.2 | 46.40 | 0.02 | 0.02 | 0.04 | <0.01 | 0.26 | 1.0 | 0.09 | 1.06 |

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CERTIFICATE OF ANALYSIS VA17104646

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga |
| | | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| L1929673-1 135351 | | 6.2 | 0.03 | <10 | 300 | 0.44 | 0.32 | 1.01 | 0.27 | 26.6 | 7.9 | 24 | 0.75 | 1730 | 2.46 | 4.10 |
| L1929673-2 135352 | | 6.8 | <0.02 | 10 | 260 | 0.36 | 0.02 | 1.46 | 0.11 | 14.50 | 4.0 | 4 | 0.45 | 331 | 1.90 | 4.79 |
| L1929673-3 135353 | | 1.2 | <0.02 | <10 | 220 | 0.27 | 0.03 | 1.10 | 0.08 | 28.5 | 6.0 | 5 | 0.48 | 593 | 2.44 | 5.32 |
| L1929673-4 135354 | | 3.2 | <0.02 | <10 | 260 | 0.30 | 0.07 | 0.51 | 0.13 | 22.4 | 5.7 | 11 | 0.48 | 577 | 2.08 | 4.45 |
| L1929673-5 135355 | | 3.9 | 0.08 | <10 | 190 | 0.24 | 0.24 | 0.31 | 0.24 | 26.3 | 6.1 | 6 | 0.77 | 4470 | 2.11 | 4.41 |
| L1929673-6 135356 | | 7.3 | <0.02 | 10 | 510 | 0.47 | 0.03 | 1.30 | 0.14 | 19.95 | 5.6 | 4 | 0.52 | 407 | 2.30 | 4.95 |
| L1929673-7 135359 | | 10.0 | 1.13 | <10 | 420 | 0.42 | 10.10 | 0.23 | 0.81 | 14.70 | 7.1 | 7 | 0.51 | >10000 | 3.75 | 3.58 |
| L1929673-8 135361 | | 1.3 | 0.02 | <10 | 330 | 0.32 | 0.09 | 1.16 | 0.05 | 22.6 | 6.2 | 6 | 0.43 | 1250 | 2.55 | 5.87 |
| L1929673-9 135362 | | 2.7 | 0.13 | <10 | 250 | 0.36 | 1.12 | 1.64 | 0.21 | 25.4 | 7.8 | 4 | 0.50 | 4650 | 2.72 | 4.15 |
| L1929673-10 135363 | | 0.8 | 0.03 | <10 | 210 | 0.30 | 0.21 | 1.33 | 0.17 | 25.9 | 5.7 | 5 | 0.47 | 1360 | 2.45 | 5.51 |
| L1929673-11 135364 | | 5.0 | 0.11 | <10 | 270 | 0.37 | 0.41 | 0.69 | 0.19 | 24.5 | 6.9 | 17 | 0.71 | 2860 | 2.48 | 5.02 |
| L1929673-12 135365 | | 9.5 | 0.02 | 10 | 250 | 0.41 | 0.05 | 1.68 | 0.15 | 22.8 | 5.3 | 5 | 0.57 | 636 | 2.26 | 5.13 |
| L1929673-13 135366 | | 1.4 | 0.05 | <10 | 280 | 0.44 | 0.11 | 1.40 | 0.07 | 27.6 | 6.1 | 6 | 0.43 | 717 | 2.64 | 7.52 |
| L1929673-14 135367 | | 0.4 | 0.02 | <10 | 300 | 0.21 | 0.06 | 1.22 | 0.10 | 19.10 | 5.9 | 5 | 0.52 | 1620 | 2.60 | 5.49 |
| L1929673-15 135368 | | 0.7 | 0.05 | <10 | 290 | 0.26 | 0.08 | 1.90 | 0.37 | 25.0 | 6.5 | 5 | 0.48 | 3050 | 3.06 | 7.20 |
| L1929673-16 140902 | | 6.1 | <0.02 | <10 | 260 | 0.40 | 0.10 | 1.25 | 0.24 | 25.5 | 7.9 | 26 | 0.78 | 141.5 | 2.18 | 3.91 |



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Project: L1929673

CERTIFICATE OF ANALYSIS VA17104646

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P | Pb |
| | Units | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm | ppm |
| | LOR | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 |
| L1929673-1 135351 | | 0.10 | 0.22 | 0.04 | 0.045 | 0.22 | 13.5 | 7.0 | 0.46 | 541 | 1.09 | 0.05 | 0.73 | 19.3 | 860 | 5.0 |
| L1929673-2 135352 | | 0.08 | 0.05 | <0.01 | 0.045 | 0.31 | 6.7 | 4.1 | 0.16 | 452 | 0.44 | 0.07 | 0.06 | 1.6 | 460 | 3.8 |
| L1929673-3 135353 | | 0.11 | 0.04 | 0.01 | 0.027 | 0.49 | 14.8 | 5.6 | 0.63 | 624 | 1.15 | 0.03 | 0.11 | 2.3 | 760 | 2.4 |
| L1929673-4 135354 | | 0.09 | 0.10 | 0.01 | 0.025 | 0.25 | 11.3 | 6.5 | 0.39 | 512 | 1.17 | 0.04 | 0.30 | 8.3 | 640 | 3.4 |
| L1929673-5 135355 | | 0.11 | 0.04 | 0.01 | 0.045 | 0.61 | 14.1 | 4.0 | 0.42 | 550 | 2.90 | 0.04 | 0.23 | 3.1 | 790 | 3.4 |
| L1929673-6 135356 | | 0.09 | 0.06 | 0.01 | 0.050 | 0.28 | 9.3 | 3.3 | 0.16 | 534 | 0.69 | 0.04 | <0.05 | 2.9 | 630 | 4.7 |
| L1929673-7 135359 | | 0.11 | 0.09 | 0.22 | 0.226 | 0.22 | 7.7 | 3.1 | 0.17 | 326 | 2.17 | 0.03 | 0.24 | 6.2 | 600 | 6.6 |
| L1929673-8 135361 | | 0.11 | 0.06 | 0.01 | 0.030 | 0.53 | 11.4 | 6.3 | 0.67 | 604 | 0.72 | 0.08 | 0.11 | 2.4 | 760 | 2.4 |
| L1929673-9 135362 | | 0.10 | 0.04 | 0.01 | 0.045 | 0.31 | 13.9 | 3.3 | 0.28 | 725 | 1.34 | 0.03 | 0.06 | 2.3 | 800 | 4.6 |
| L1929673-10 135363 | | 0.08 | 0.05 | 0.01 | 0.049 | 0.44 | 13.6 | 5.5 | 0.55 | 616 | 1.15 | 0.05 | 0.10 | 2.1 | 700 | 2.8 |
| L1929673-11 135364 | | 0.09 | 0.17 | 0.03 | 0.072 | 0.42 | 12.2 | 7.0 | 0.46 | 384 | 1.17 | 0.05 | 0.95 | 11.0 | 700 | 4.8 |
| L1929673-12 135365 | | 0.10 | 0.04 | 0.01 | 0.057 | 0.33 | 10.8 | 4.0 | 0.19 | 540 | 0.72 | 0.05 | 0.07 | 2.3 | 640 | 4.0 |
| L1929673-13 135366 | | 0.10 | 0.03 | <0.01 | 0.034 | 0.54 | 14.9 | 8.8 | 0.78 | 626 | 1.09 | 0.07 | 0.15 | 2.6 | 740 | 4.0 |
| L1929673-14 135367 | | 0.09 | 0.03 | <0.01 | 0.082 | 0.69 | 9.3 | 5.1 | 0.67 | 417 | 6.93 | 0.07 | 0.19 | 2.1 | 840 | 2.5 |
| L1929673-15 135368 | | 0.11 | 0.03 | <0.01 | 0.101 | 0.57 | 12.9 | 6.5 | 0.65 | 642 | 9.27 | 0.06 | 0.17 | 2.1 | 840 | 3.5 |
| L1929673-16 140902 | | 0.09 | 0.24 | 0.04 | 0.023 | 0.18 | 13.1 | 7.7 | 0.51 | 445 | 0.92 | 0.04 | 0.73 | 20.6 | 790 | 5.7 |

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CERTIFICATE OF ANALYSIS VA17104646

| Sample Description | Method Analyte Units LOR | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm |
|--------------------|--------------------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|
| L1929673-1 135351 | | 12.4 | <0.001 | 0.01 | 0.52 | 5.2 | 0.9 | 0.5 | 54.7 | <0.01 | 0.15 | 3.4 | 0.065 | 0.12 | 0.51 | 51 |
| L1929673-2 135352 | | 9.3 | <0.001 | <0.01 | 0.10 | 5.3 | 0.2 | 0.7 | 67.7 | <0.01 | 0.02 | 1.7 | 0.019 | 0.06 | 0.12 | 39 |
| L1929673-3 135353 | | 22.7 | <0.001 | 0.01 | <0.05 | 4.5 | 0.5 | 0.5 | 51.2 | <0.01 | 0.03 | 3.5 | 0.077 | 0.15 | 0.22 | 50 |
| L1929673-4 135354 | | 11.4 | <0.001 | <0.01 | 0.17 | 4.3 | 0.4 | 0.5 | 32.7 | <0.01 | 0.03 | 2.8 | 0.043 | 0.09 | 0.26 | 42 |
| L1929673-5 135355 | | 34.5 | <0.001 | <0.01 | <0.05 | 4.9 | 1.2 | 0.5 | 22.6 | <0.01 | 0.08 | 4.0 | 0.093 | 0.30 | 0.24 | 53 |
| L1929673-6 135356 | | 10.1 | <0.001 | 0.01 | 0.12 | 7.6 | 0.5 | 0.8 | 47.1 | <0.01 | 0.01 | 2.5 | 0.017 | 0.05 | 0.15 | 51 |
| L1929673-7 135359 | | 12.4 | <0.001 | 0.01 | 0.17 | 5.3 | 11.4 | 0.7 | 55.8 | <0.01 | 2.77 | 2.9 | 0.032 | 0.11 | 0.72 | 64 |
| L1929673-8 135361 | | 23.4 | <0.001 | 0.01 | <0.05 | 4.3 | 0.6 | 0.5 | 64.9 | <0.01 | 0.11 | 2.2 | 0.104 | 0.15 | 0.23 | 60 |
| L1929673-9 135362 | | 14.4 | <0.001 | 0.07 | 0.14 | 5.1 | 3.5 | 0.5 | 60.9 | <0.01 | 0.41 | 2.8 | 0.037 | 0.09 | 0.26 | 55 |
| L1929673-10 135363 | | 21.3 | 0.002 | 0.07 | <0.05 | 4.3 | 0.7 | 0.5 | 63.8 | <0.01 | 0.08 | 4.1 | 0.058 | 0.17 | 0.32 | 50 |
| L1929673-11 135364 | | 24.5 | <0.001 | <0.01 | 0.24 | 5.7 | 1.2 | 0.6 | 43.9 | <0.01 | 0.17 | 4.2 | 0.093 | 0.20 | 0.48 | 57 |
| L1929673-12 135365 | | 15.0 | <0.001 | <0.01 | 0.09 | 7.3 | 0.4 | 0.8 | 64.6 | <0.01 | 0.02 | 2.7 | 0.032 | 0.08 | 0.18 | 54 |
| L1929673-13 135366 | | 24.7 | 0.001 | 0.04 | 0.05 | 4.8 | 1.1 | 0.6 | 70.6 | <0.01 | 0.04 | 3.1 | 0.077 | 0.15 | 0.20 | 57 |
| L1929673-14 135367 | | 32.6 | 0.031 | 0.29 | <0.05 | 4.6 | 1.7 | 1.1 | 63.2 | <0.01 | 0.07 | 1.6 | 0.115 | 0.24 | 0.26 | 58 |
| L1929673-15 135368 | | 27.8 | 0.025 | 0.35 | <0.05 | 5.4 | 2.6 | 1.1 | 96.3 | <0.01 | 0.13 | 1.9 | 0.089 | 0.21 | 0.68 | 64 |
| L1929673-16 140902 | | 10.5 | 0.001 | 0.01 | 0.49 | 5.0 | 0.7 | 0.4 | 63.9 | <0.01 | 0.02 | 3.5 | 0.066 | 0.12 | 0.72 | 49 |



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CERTIFICATE OF ANALYSIS VA17104646

| Sample Description | Method Analyte Units LOR | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | Cu-OG46 Cu % 0.001 |
|--------------------|-----------------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|-----------------------------|
| L1929673-1 135351 | | 0.43 | 8.98 | 64 | 6.9 | |
| L1929673-2 135352 | | 0.08 | 8.00 | 54 | 1.1 | |
| L1929673-3 135353 | | 0.42 | 7.49 | 67 | 0.7 | |
| L1929673-4 135354 | | 0.53 | 7.51 | 56 | 3.1 | |
| L1929673-5 135355 | | 0.53 | 8.25 | 69 | 1.3 | |
| L1929673-6 135356 | | 0.13 | 9.22 | 68 | 1.5 | |
| L1929673-7 135359 | | 0.30 | 9.10 | 121 | 3.2 | 3.54 |
| L1929673-8 135361 | | 0.42 | 8.38 | 66 | 1.1 | |
| L1929673-9 135362 | | 0.14 | 9.25 | 66 | 1.0 | |
| L1929673-10 135363 | | 0.29 | 7.77 | 64 | 1.1 | |
| L1929673-11 135364 | | 0.60 | 8.37 | 58 | 5.8 | |
| L1929673-12 135365 | | 0.21 | 8.54 | 67 | 1.1 | |
| L1929673-13 135366 | | 0.41 | 6.53 | 79 | 0.8 | |
| L1929673-14 135367 | | 0.44 | 6.32 | 65 | 0.8 | |
| L1929673-15 135368 | | 0.29 | 8.10 | 82 | 0.9 | |
| L1929673-16 140902 | | 0.31 | 8.54 | 55 | 7.5 | |

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CERTIFICATE OF ANALYSIS VA17104646

CERTIFICATE COMMENTS

| | | | | | | | | | | | | | | | | | |
|--------------------|--|-----------|----------|--------|---------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|
| | ANALYTICAL COMMENTS | | | | | | | | | | | | | | | | |
| Applies to Method: | Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41 | | | | | | | | | | | | | | | | |
| | LABORATORY ADDRESSES | | | | | | | | | | | | | | | | |
| Applies to Method: | <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">Cu-OG46</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> </tr> <tr> <td>ME-OG46</td> <td>OA-ELE07</td> <td>OA-VOL08m</td> <td>PUL-31</td> </tr> <tr> <td>PUL-QC</td> <td>S-CAL06</td> <td>S-GRA06</td> <td>S-GRA06a</td> </tr> <tr> <td>S-IR08</td> <td>SPL-21</td> <td>WEI-21</td> <td></td> </tr> </table> | C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | |
| C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | | | | | | | | | | | | | | |
| ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | | | | | | | | | | | | | | |
| PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | | | | | | | | | | | | | | |
| S-IR08 | SPL-21 | WEI-21 | | | | | | | | | | | | | | | |



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QC CERTIFICATE VA17104646

Project: L1929673
 P.O. No.: ALSM-CW16-102-APN
 This report is for 16 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 26-MAY-2017.
 The following have access to data associated with this certificate:

| | | |
|--------------------------|----------------------------|-------------|
| ELSE VANCOUVER WEBTRIEVE | SOFTWARE DEVELOPMENT GROUP | SHANE STACK |
|--------------------------|----------------------------|-------------|

| SAMPLE PREPARATION | |
|---------------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|------------------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| ME-OG46 | Ore Grade Elements - AquaRegia | ICP-AES |
| Cu-OG46 | Ore Grade Cu - Aqua Regia | ICP-AES |
| OA-VOL08m | Modified NP | |
| S-IRO8 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17104646

| Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | |
|----------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|---------------|----------------|--------------|----------------|----------------|--|
| Sample Description | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.3 | | | | | | | | | | |
| Upper Bound | | | | | | 6.7 | | | | | | | | | | |
| CCU-1e | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | 0.50 | 1.9 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | 0.42 | 1.5 | | | | |
| Upper Bound | | | | | | | | | | | 0.64 | 2.4 | | | | |
| DS-1 | | | | | | | 2.63 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 2.51 | | | | | | | | | |
| Upper Bound | | | | | | | 2.71 | | | | | | | | | |
| GBM903-13 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | 0.27 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 0.25 | | | | | | | | | |
| Upper Bound | | | | | | | 0.29 | | | | | | | | | |
| KZK-1 | 25.0 | 2 | 31 | 56 | | | 2.24 | | | | | | | | | |
| KZK-1 | 25.0 | 2 | 32 | 57 | | | 2.28 | | | | | | | | | |
| Target Range - Lower Bound | 22.9 | <1 | 30 | 54 | | | 2.18 | | | | | | | | | |
| Upper Bound | 27.1 | >4 | 38 | 64 | | | 2.53 | | | | | | | | | |
| MA-2c | | | | | | | | | | | 1.61 | 5.9 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | 1.50 | 5.5 | | | | |
| Upper Bound | | | | | | | | | | | 1.84 | 6.8 | | | | |
| MA-3a | | | | | | | | | | | 2.40 | 8.8 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | 2.31 | 8.4 | | | | |
| Upper Bound | | | | | | | | | | | 2.77 | 10.2 | | | | |
| OGGeo08 | | | | | | | | | | | | 19.40 | 2.25 | 125.0 | 0.07 | |
| Target Range - Lower Bound | | | | | | | | | | | | 18.15 | 2.05 | 107.0 | 0.03 | |
| Upper Bound | | | | | | | | | | | | 22.2 | 2.53 | 131.0 | 0.11 | |



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QC CERTIFICATE OF ANALYSIS VA17104646

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | | | |
|----------------------------|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|------|------|------|--|
| | | | | | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga | Ge | Hf | |
| | | | | | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | |
| | | | | | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | |
| STANDARDS | | | | | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| CCU-1e | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| GBM903-13 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| OGGeo08 | | | | | <10 | 70 | 0.75 | 10.55 | 0.90 | 19.70 | 60.1 | 94.4 | 84 | 9.35 | 8430 | 5.08 | 8.27 | 0.18 | 0.79 | |
| Target Range - Lower Bound | | | | | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | 4.51 | 8.05 | 0.21 | 0.72 | |
| Upper Bound | | | | | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | 5.53 | 9.95 | 0.45 | 0.92 | |

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Project: L1929673

QC CERTIFICATE OF ANALYSIS VA17104646

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | Re ppm | |
| | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CCU-1e | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GBM903-13 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | 0.48 | 1.410 | 1.11 | 29.5 | 30.4 | 0.96 | 389 | 889 | 0.29 | 0.82 | 9000 | 830 | 7350 | 120.5 | 1.365 | |
| Target Range - Lower Bound | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 | 700 | 6520 | 109.5 | 1.295 | |
| Upper Bound | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 | 880 | 7970 | 134.5 | 1.585 | |

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QC CERTIFICATE OF ANALYSIS VA17104646

| Sample Description | Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|----------------------------|--------------------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|---------------|
| | | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CCU-1e | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GBM903-13 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | | 2.78 | 19.05 | 6.1 | 12.1 | 12.9 | 64.3 | 0.01 | 0.13 | 16.1 | 0.309 | 1.52 | 4.81 | 82 | 2.96 | 16.20 |
| Target Range - Lower Bound | | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | 4.45 | 70 | 2.58 | 15.35 |
| Upper Bound | | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | 5.55 | 88 | 3.60 | 18.85 |



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QC CERTIFICATE OF ANALYSIS VA17104646

| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm | ME-MS41 Zr ppm | Cu-OG46 Cu % |
|----------------------------|--------------------------|----------------|----------------|--------------|
| | | 2 | 0.5 | 0.001 |
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| CCU-1e | | | | 22.5 |
| Target Range - Lower Bound | | | | 22.1 |
| Upper Bound | | | | 23.7 |
| CO-ASSAY | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GBM903-13 | | | | 2.84 |
| Target Range - Lower Bound | | | | 2.79 |
| Upper Bound | | | | 3.00 |
| GS310-10 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-2c | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-3a | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OGGeo08 | | 7090 | 22.7 | |
| Target Range - Lower Bound | | 6500 | 19.5 | |
| Upper Bound | | 7950 | 27.5 | |

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Project: L1929673

QC CERTIFICATE OF ANALYSIS VA17104646

| Method Analyte Units LOR | OA-VOL08m MPA | OA-VOL08m FIZZ RAT | OA-VOL08m NNP | OA-VOL08m NP | OA-ELE07 pH | OA-VOL08m Ratio (N) | S-IR08 S | S-GRA06 S | S-GRA06a S | C-GAS05 C | C-GAS05 CO2 | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As | ME-MS41 Au |
|--------------------------|---------------|--------------------|---------------|--------------|-------------|---------------------|----------|-----------|------------|-----------|-------------|------------|------------|------------|------------|
| Sample Description | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | ppm | % | ppm | ppm |
| | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 |

STANDARDS

| | | | | | | | | | | | | | | | | |
|----------------------------|--|--|--|--|--|--|------|--|------|------|------|------|------|-----|-------|--|
| OREAS 621 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS 920 | | | | | | | | | | | | 0.09 | 2.31 | 4.9 | <0.02 | |
| Target Range - Lower Bound | | | | | | | | | | | | 0.07 | 2.18 | 3.8 | <0.02 | |
| Upper Bound | | | | | | | | | | | | 0.12 | 2.68 | 4.9 | 0.04 | |
| SY-4 | | | | | | | | | | 0.90 | 3.3 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.84 | 3.0 | | | | | |
| Upper Bound | | | | | | | | | | 1.08 | 4.0 | | | | | |
| UTS-1 | | | | | | | 0.85 | | | | | | | | | |
| UTS-1 | | | | | | | 0.86 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 0.83 | | | | | | | | | |
| Upper Bound | | | | | | | 0.93 | | | | | | | | | |
| UTS-1 | | | | | | | | | 0.84 | | | | | | | |
| UTS-1 | | | | | | | | | 0.90 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.81 | | | | | | | |
| Upper Bound | | | | | | | | | 0.95 | | | | | | | |
| UTS-4 | | | | | | | | | | 1.74 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 1.64 | | | | | | |
| Upper Bound | | | | | | | | | | 1.84 | | | | | | |
| UTS-4 | | | | | | | | | | | 1.75 | | | | | |
| UTS-4 | | | | | | | | | | | 1.76 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | 1.61 | | | | | |
| Upper Bound | | | | | | | | | | | 1.87 | | | | | |

BLANKS

| | | | | | | | | | | | | | | | | |
|----------------------------|--|--|--|--|--|--|--|--|--|--|-------|------|--|--|--|--|
| BLANK | | | | | | | | | | | <0.05 | <0.2 | | | | |
| BLANK | | | | | | | | | | | <0.05 | <0.2 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | <0.05 | <0.2 | | | | |
| Upper Bound | | | | | | | | | | | 0.10 | 0.4 | | | | |



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QC CERTIFICATE OF ANALYSIS VA17104646

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % | Ga ppm | Ge ppm | Hf ppm |
| | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 |
| STANDARDS | | | | | | | | | | | | | | | |
| OREAS 621 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OREAS 920 | <10 | 80 | 0.65 | 0.59 | 0.31 | 0.06 | 70.2 | 13.4 | 44 | 1.94 | 111.5 | 3.42 | 6.34 | 0.12 | 0.57 |
| Target Range - Lower Bound | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | 3.26 | 6.12 | <0.05 | 0.53 |
| Upper Bound | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | 4.00 | 7.60 | 0.22 | 0.69 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17104646

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | Re ppm | |
| | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| OREAS 621 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS 920 | 0.01 | 0.029 | 0.40 | 35.3 | 20.4 | 1.03 | 495 | 0.46 | 0.01 | 0.33 | 38.1 | 710 | 22.0 | 23.3 | <0.001 | |
| Target Range - Lower Bound | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 | | 19.2 | 22.2 | <0.001 | |
| Upper Bound | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 | | 23.9 | 27.4 | 0.002 | |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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| Sample Description | Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|----------------------------|--------------------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|---------------|
| | | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | | |
| OREAS 621 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS 920 | | 0.03 | 0.63 | 2.7 | 0.9 | 1.1 | 17.1 | 0.01 | 0.02 | 14.9 | 0.110 | 0.16 | 1.99 | 24 | 0.41 | 17.30 |
| Target Range - Lower Bound | | <0.01 | 0.45 | 2.5 | 0.4 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | 1.89 | 23 | 0.31 | 16.85 |
| Upper Bound | | 0.05 | 0.77 | 3.3 | 1.3 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | 2.42 | 30 | 0.61 | 20.7 |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm | ME-MS41 Zr ppm | Cu-OG46 Cu % | |
|----------------------------|--------------------------|----------------|----------------|--------------|--|
| | | 2 | 0.5 | 0.001 | |
| STANDARDS | | | | | |
| OREAS 621 | | | | 0.361 | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| OREAS 920 | | 100 | 21.4 | | |
| Target Range - Lower Bound | | 93 | 17.6 | | |
| Upper Bound | | 119 | 25.0 | | |
| SY-4 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| UTS-1 | | | | | |
| UTS-1 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| UTS-1 | | | | | |
| UTS-1 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| UTS-4 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| UTS-4 | | | | | |
| UTS-4 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
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| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |

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| Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | |
|----------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|---------------|----------------|--------------|----------------|----------------|-------|
| Sample Description | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 | |
| BLANKS | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | 0.1 | <0.02 |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | <0.02 |
| Upper Bound | | | | | | | | | | | | | 0.02 | 0.02 | 0.2 | 0.04 |
| BLANK | | | | | 6.0 | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.5 | | | | | | | | | | | |
| Upper Bound | | | | | 6.9 | | | | | | | | | | | |
| BLANK | | | | | | | | <0.01 | | | | | | | | |
| BLANK | | | | | | | | <0.01 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.01 | | | | | | | | |
| Upper Bound | | | | | | | | 0.02 | | | | | | | | |
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| BLANK | | | | | | | | | | <0.01 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.01 | | | | | | |
| Upper Bound | | | | | | | | | | 0.02 | | | | | | |
| BLANK | | | | | | | 0.01 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | <0.01 | | | | | | | | | |
| Upper Bound | | | | | | | 0.02 | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | 2.67 | 1.63 | 27.6 | 0.39 | |
| DUP | | | | | | | | | | | | 2.76 | 1.74 | 29.0 | 0.93 | |
| Target Range - Lower Bound | | | | | | | | | | | | 2.57 | 1.59 | 26.8 | 0.61 | |
| Upper Bound | | | | | | | | | | | | 2.86 | 1.78 | 29.8 | 0.71 | |

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| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % | Ga ppm | Ge ppm | Hf ppm | |
| | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | 0.05 | <0.02 | |
| Target Range - Lower Bound | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | <0.02 | |
| Upper Bound | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 | 0.04 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | 10 | 60 | 0.30 | 0.90 | 0.81 | 2.20 | 8.81 | 9.9 | 29 | 3.57 | 2400 | 4.26 | 4.55 | 0.09 | 0.03 | |
| DUP | 10 | 70 | 0.33 | 0.99 | 0.85 | 2.35 | 9.56 | 10.5 | 31 | 3.83 | 2480 | 4.51 | 4.85 | 0.08 | 0.03 | |
| Target Range - Lower Bound | <10 | 50 | 0.25 | 0.89 | 0.78 | 2.15 | 8.71 | 9.6 | 28 | 3.47 | 2350 | 4.16 | 4.42 | <0.05 | <0.02 | |
| Upper Bound | 20 | 80 | 0.38 | 1.00 | 0.88 | 2.40 | 9.66 | 10.8 | 33 | 3.94 | 2530 | 4.61 | 4.99 | 0.10 | 0.04 | |

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| Method Analyte Units LOR | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm |
|----------------------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|
| Sample Description | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | 0.01 | <0.005 | <0.01 | <0.2 | 0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | <0.001 |
| Target Range - Lower Bound | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | <0.001 |
| Upper Bound | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 | 0.002 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | 0.06 | 0.134 | 0.28 | 4.4 | 16.1 | 0.54 | 722 | 217 | 0.04 | 0.23 | 19.4 | 720 | 74.8 | 13.4 | 0.195 |
| DUP | 0.05 | 0.135 | 0.30 | 4.8 | 17.2 | 0.57 | 757 | 227 | 0.05 | 0.23 | 21.1 | 760 | 79.5 | 14.6 | 0.224 |
| Target Range - Lower Bound | 0.04 | 0.123 | 0.27 | 4.2 | 15.7 | 0.52 | 698 | 211 | 0.03 | 0.17 | 19.0 | 690 | 73.1 | 13.2 | 0.198 |
| Upper Bound | 0.07 | 0.146 | 0.31 | 5.0 | 17.6 | 0.59 | 781 | 233 | 0.06 | 0.29 | 21.5 | 790 | 81.2 | 14.8 | 0.221 |

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QC CERTIFICATE OF ANALYSIS VA17104646

| Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|----------------------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|---------------|
| Sample Description | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Upper Bound | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | 0.10 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | 2.11 | 1.60 | 2.5 | 4.0 | 0.6 | 53.3 | <0.01 | 0.66 | 3.0 | 0.040 | 0.30 | 0.58 | 31 | 1.46 | 4.48 |
| DUP | 2.22 | 1.63 | 2.6 | 4.5 | 0.6 | 57.2 | <0.01 | 0.75 | 3.2 | 0.043 | 0.28 | 0.61 | 33 | 1.49 | 4.73 |
| Target Range - Lower Bound | 2.05 | 1.44 | 2.3 | 3.8 | 0.4 | 52.3 | <0.01 | 0.66 | 2.7 | 0.034 | 0.25 | 0.52 | 29 | 1.31 | 4.32 |
| Upper Bound | 2.28 | 1.79 | 2.8 | 4.7 | 0.8 | 58.2 | 0.02 | 0.75 | 3.5 | 0.049 | 0.33 | 0.67 | 35 | 1.64 | 4.89 |

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QC CERTIFICATE OF ANALYSIS VA17104646

| Method Analyte Units LOR | ME-MS41 Zn ppm | ME-MS41 Zr ppm | Cu-OG46 Cu % |
|-----------------------------------|----------------------|----------------------|--------------------|
| Sample Description | 2 | 0.5 | 0.001 |
| BLANKS | | | |
| BLANK | | | <0.001 |
| Target Range - Lower Bound | | | <0.001 |
| Upper Bound | | | 0.002 |
| BLANK | <2 | <0.5 | |
| Target Range - Lower Bound | <2 | <0.5 | |
| Upper Bound | 4 | 1.0 | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| DUPLICATES | | | |
| ORIGINAL | | | 0.163 |
| DUP | | | 0.165 |
| Target Range - Lower Bound | | | 0.159 |
| Upper Bound | | | 0.169 |
| ORIGINAL | 423 | 0.8 | |
| DUP | 444 | 0.9 | |
| Target Range - Lower Bound | 410 | <0.5 | |
| Upper Bound | 457 | 1.0 | |

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| Sample Description | Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|---------------|----------------|--------------|----------------|----------------|-------|
| | | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 | |
| DUPLICATES | | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | | 0.02 |
| DUP | | | | | | | | | | | | | | | | | 0.01 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | <0.01 |
| Upper Bound | | | | | | | | | | | | | | | | | 0.02 |
| L1929673-3 135353 | | | | | | | | | | | | | | | | | <0.01 |
| DUP | | | | | | | | | | | | | | | | | <0.01 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | <0.01 |
| Upper Bound | | | | | | | | | | | | | | | | | 0.02 |
| L1929673-10 135363 | | 2.2 | 2 | 32 | 34 | 8.6 | 15.54 | 0.07 | | 0.01 | 0.33 | 1.2 | | | | | |
| DUP | | 1.9 | 2 | 32 | 34 | 8.6 | 18.13 | 0.06 | | 0.03 | 0.32 | 1.2 | | | | | |
| Target Range - Lower Bound | | 1.6 | <1 | 29 | 31 | 8.1 | 15.98 | 0.05 | | <0.01 | 0.26 | 0.9 | | | | | |
| Upper Bound | | 2.5 | 3 | 35 | 37 | 9.1 | 17.69 | 0.08 | | 0.03 | 0.39 | 1.5 | | | | | |
| L1929673-12 135365 | | | | | | | | | | | 0.43 | 1.6 | | | | | |
| DUP | | | | | | | | | | | 0.44 | 1.6 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | 0.36 | 1.3 | | | | | |
| Upper Bound | | | | | | | | | | | 0.51 | 1.9 | | | | | |
| L1932378-1 C4 | | | | | | | | | | | <0.01 | | | | | | |
| DUP | | | | | | | | | | | <0.01 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | <0.01 | | | | | | |
| Upper Bound | | | | | | | | | | | 0.02 | | | | | | |

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| Sample Description | Method Analyte Units LOR | ME-MS41 B ppm 10 | ME-MS41 Ba ppm 10 | ME-MS41 Be ppm 0.05 | ME-MS41 Bi ppm 0.01 | ME-MS41 Ca % 0.01 | ME-MS41 Cd ppm 0.01 | ME-MS41 Ce ppm 0.02 | ME-MS41 Co ppm 0.1 | ME-MS41 Cr ppm 1 | ME-MS41 Cs ppm 0.05 | ME-MS41 Cu ppm 0.2 | ME-MS41 Fe % 0.01 | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 |
|--|-----------------------------------|---------------------------|----------------------------|------------------------------|------------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|---------------------------|------------------------------|-----------------------------|----------------------------|------------------------------|------------------------------|------------------------------|
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | DUPLICATES | | | | | | | | | | | | | | |
| L1929673-3 135353 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1929673-10 135363 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1929673-12 135365 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| I1932378-1 C4 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |



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| Sample Description | Method Analyte Units LOR | ME-MS41 Hg ppm 0.01 | ME-MS41 In ppm 0.005 | ME-MS41 K % 0.01 | ME-MS41 La ppm 0.2 | ME-MS41 Li ppm 0.1 | ME-MS41 Mg % 0.01 | ME-MS41 Mn ppm 5 | ME-MS41 Mo ppm 0.05 | ME-MS41 Na % 0.01 | ME-MS41 Nb ppm 0.05 | ME-MS41 Ni ppm 0.2 | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 | ME-MS41 Rb ppm 0.1 | ME-MS41 Re ppm 0.001 |
|--|-----------------------------------|------------------------------|-------------------------------|---------------------------|-----------------------------|-----------------------------|----------------------------|---------------------------|------------------------------|----------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|-----------------------------|-------------------------------|
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1929673-3 135353 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1929673-10 135363 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1929673-12 135365 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| I1932378-1 C4 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

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| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | | |
|--|-------------------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|-----|------|------|
| | | | | | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U | V | W | Y |
| | | | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm |
| | | | LOR | | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | DUPLICATES | | | | | | | | | | | | | | | | | | |
| L1929673-3 135353 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1929673-10 135363 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1929673-12 135365 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| I1932378-1 C4 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

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| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm | ME-MS41 Zr ppm | Cu-OG46 Cu % |
|--|--------------------------|----------------|----------------|--------------|
| | | 2 | 0.5 | 0.001 |
| DUPLICATES | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | |
| L1929673-3 135353 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1929673-10 135363 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1929673-12 135365 DUP Target Range - Lower Bound Upper Bound | | | | |
| I1932378-1 C4 DUP Target Range - Lower Bound Upper Bound | | | | |
| | | | | |

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| | CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | |
|--------------------|---|-----------|----------|--------|---------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|
| Applies to Method: | <p style="text-align: center;">ANALYTICAL COMMENTS</p> <p>Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41</p> | | | | | | | | | | | | | | | | |
| Applies to Method: | <p style="text-align: center;">LABORATORY ADDRESSES</p> <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">Cu-OG46</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> </tr> <tr> <td>ME-OG46</td> <td>OA-ELE07</td> <td>OA-VOL08m</td> <td>PUL-31</td> </tr> <tr> <td>PUL-QC</td> <td>S-CAL06</td> <td>S-GRA06</td> <td>S-GRA06a</td> </tr> <tr> <td>S-IR08</td> <td>SPL-21</td> <td>WEI-21</td> <td></td> </tr> </table> | C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | |
| C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | | | | | | | | | | | | | | |
| ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | | | | | | | | | | | | | | |
| PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | | | | | | | | | | | | | | |
| S-IR08 | SPL-21 | WEI-21 | | | | | | | | | | | | | | | |



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|--|---|--|-----------------------------|---|--|-------------------------------------|-----------------------|--|--|--|--|--------------|--|------------------------------|---|--|--------------|-----------------------|--|--|---------------------------|--|--|---------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--------|-----------|--|-----------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|---|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|---|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|---|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|---|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|---|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|---|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|---|--------|----------|--|-------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|---|--------|----------|--|-------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|---|--------|----------|--|-------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|----|--------|----------|--|-------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|----|--------|----------|--|-------|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDP (DIGITAL) | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2: | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3: | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Metals- Aqua regia digestion (ICP)</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Paste pH</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">% Inorganic Carbonate</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Carbon/Sulphur (Leco)</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">AP - determination by % sulphide sulphur</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Modified NP - (MEND 1991)</td> <td colspan="12" style="text-align: center;">Number of Containers</td> </tr> <tr> <td colspan="12"></td> </tr> <tr> <td colspan="12"></td> </tr> <tr> <td colspan="12"></td> </tr> <tr> <td colspan="12"></td> </tr> <tr> <td colspan="12"></td> </tr> <tr> <td colspan="12"></td> </tr> <tr> <td colspan="12"></td> </tr> <tr> <td colspan="12"></td> </tr> <tr> <td colspan="12"></td> </tr> </table> | | | | | | | | | | | | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Company: Minto Explorations Ltd. | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Email 2: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Email 3: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO#: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: TBD | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>ALS Sample # (lab use only)</th> <th>Sample Identification and/or Coordinates (This description will appear on the report)</th> <th>Date (dd-mmm-yy)</th> <th>Time (hh:mm)</th> <th>Sample Type</th> <th>Total Metals- Aqua regia digestion (ICP)</th> <th>Paste pH</th> <th>% Inorganic Carbonate</th> <th>Total Carbon/Sulphur (Leco)</th> <th>AP - determination by % sulphide sulphur</th> <th>Modified NP - (MEND 1991)</th> <th colspan="12"></th> </tr> </thead> <tbody> <tr> <td></td> <td>135351</td> <td>19-APR-17</td> <td></td> <td>Composite</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td colspan="12"></td> </tr> <tr> <td>1</td> <td>135351</td> <td>19-APR-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td colspan="12"></td> </tr> <tr> <td>2</td> <td>135352</td> <td>19-APR-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td colspan="12"></td> </tr> <tr> <td>3</td> <td>135353</td> <td>20-APR-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td colspan="12"></td> </tr> <tr> <td>4</td> <td>135354</td> <td>21-APR-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td colspan="12"></td> </tr> <tr> <td>5</td> <td>135355</td> <td>21-APR-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td colspan="12"></td> </tr> <tr> <td>6</td> <td>135356</td> <td>23-APR-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td colspan="12"></td> </tr> <tr> <td>7</td> <td>135359</td> <td>2-may-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td colspan="12"></td> </tr> <tr> <td>8</td> <td>135361</td> <td>26/04/17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td colspan="12"></td> </tr> <tr> <td>9</td> <td>135362</td> <td>26/04/17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td colspan="12"></td> </tr> <tr> <td>10</td> <td>135363</td> <td>28/04/17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td colspan="12"></td> </tr> <tr> <td>11</td> <td>135364</td> <td>29/04/17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td colspan="12"></td> </tr> </tbody> </table> | | | | | | | | | | | | | | ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | | | | | | | | | | | | | | 135351 | 19-APR-17 | | Composite | R | R | R | R | R | R | | | | | | | | | | | | | 1 | 135351 | 19-APR-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | 2 | 135352 | 19-APR-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | 3 | 135353 | 20-APR-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | 4 | 135354 | 21-APR-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | 5 | 135355 | 21-APR-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | 6 | 135356 | 23-APR-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | 7 | 135359 | 2-may-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | 8 | 135361 | 26/04/17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | 9 | 135362 | 26/04/17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | 10 | 135363 | 28/04/17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | 11 | 135364 | 29/04/17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | |
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| | 135351 | 19-APR-17 | | Composite | R | R | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 135351 | 19-APR-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 135352 | 19-APR-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 4 | 135354 | 21-APR-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 7 | 135359 | 2-may-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | 135361 | 26/04/17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | 135362 | 26/04/17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | 135363 | 28/04/17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | 135364 | 29/04/17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | 13.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: | | Date: | | Time: | | Received by: VO | | Date: May 23/17 | | Time: 9:00 | | Received by: | | Date: | | Time: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



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|--|---|---|--|---|--|--|---|---|--|--------------------------|-------------|--|--|--|--|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / D | | If E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: | <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | Regular [R] | | <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | PRIORITY (Business Copy) | 4 day [P4] | <input type="checkbox"/> | EMERGENCY | 1 Business day [E1] | | <input type="checkbox"/> | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 3 day [P3] | <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] | | <input type="checkbox"/> | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: | <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | 2 day [P2] | <input type="checkbox"/> | | | | <input type="checkbox"/> | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax | minto_environment@mintomine.com | Date and Time Required for all E&P TATs: | | dd-mmm-yy hh:mm | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | Analysis Request | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: | <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | Total Metals - Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax | ap@mintomine.com | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | PO# | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | Routing Code: | | | | | | | | | | | | | | |
| PO / AFE: | TBD | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Sampler: | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | | | | | | | | Sample Type | | | | | | |
| 12 | 135365 | 29/04/17 | | WASTE | X | X | X | X | X | | | | | | | | |
| 13 | 135366 | 30/04/17 | | WASTE | X | X | X | X | X | | | | | | | | |
| 14 | 135367 | 30/04/17 | | WASTE | X | X | X | X | X | | | | | | | | |
| 15 | 135368 | 30/04/17 | | WASTE | X | X | X | X | X | | | | | | | | |
| 16 | 140902 | 05/05/17 | | WASTE | X | X | X | X | X | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> | | Ice Cubes <input type="checkbox"/> | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | INITIAL COOLER TEMPERATURES °C | | FINAL COOLER TEMPERATURES °C | | | | | | | | |
| | | | | 13.6 | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | |
| Released by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | | | | | | |
| | | | VO | May 23/17 | 9:00 | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRESH

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form, the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form

CEF May 24/17 98/162 1240



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 26-MAY-17
Report Date: 05-JUL-17 17:30 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1932915
Project P.O. #: 226298
Job Reference:
C of C Numbers: 17-18
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1932915-1 Waste 24-APR-17 135357 | L1932915-2 Waste 24-APR-17 135358 | L1932915-3 Waste 02-MAY-17 135369 | L1932915-4 Waste 02-MAY-17 135370 | L1932915-5 Waste 03-MAY-17 135372 | |
|---|--|--|--|--|--|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.7 | 8.5 | 7.9 | 8.6 | 8.0 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.27 | 0.41 | 0.27 | 0.30 | 0.23 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.6 | 27.2 | 0.9 | 0.9 | 0.9 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 28 | 37 | 28 | 32 | 26 |
| | NNP (tCaCO3/1Kt) | 27 | 10 | 27 | 31 | 25 |
| | Ratio (NP/MPA) (Unity) | 44.80 | 1.36 | 29.87 | 34.13 | 27.73 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | 0.02 | 0.01 | 0.02 | 0.03 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.02 | 0.86 | 0.03 | 0.03 | 0.03 |
| | Total Sulfur (combustion) (%) | 0.02 | 0.87 | 0.03 | 0.03 | 0.03 |
| Total Metals | Aluminum (Al) (%) | 1.11 | 1.14 | 1.19 | 1.27 | 1.38 |
| | Antimony (Sb) (ppm) | <0.05 | 0.05 | 0.52 | <0.05 | 0.72 |
| | Arsenic (As) (ppm) | 1.2 | 4.9 | 6.8 | 0.8 | 8.1 |
| | Barium (Ba) (ppm) | 250 | 190 | 280 | 230 | 320 |
| | Beryllium (Be) (ppm) | 0.35 | 0.23 | 0.45 | 0.30 | 0.52 |
| | Bismuth (Bi) (ppm) | 0.04 | 0.25 | 0.10 | 0.04 | 0.13 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.05 | 0.66 | 0.28 | 0.07 | 0.30 |
| | Calcium (Ca) (%) | 1.22 | 1.45 | 1.34 | 1.26 | 1.19 |
| | Cerium (Ce) (ppm) | 23.3 | 23.7 | 30.2 | 30.7 | 32.1 |
| | Cesium (Cs) (ppm) | 0.32 | 0.72 | 0.78 | 0.44 | 1.12 |
| | Chromium (Cr) (ppm) | 5 | 5 | 28 | 5 | 33 |
| | Cobalt (Co) (ppm) | 5.5 | 5.7 | 9.7 | 7.5 | 11.5 |
| | Copper (Cu) (ppm) | 214 | 5320 | 206 | 535 | 95.1 |
| | Gallium (Ga) (ppm) | 6.17 | 6.70 | 4.42 | 6.85 | 5.06 |
| | Germanium (Ge) (ppm) | 0.09 | 0.10 | 0.08 | 0.07 | 0.06 |
| | Gold (Au) (ppm) | <0.02 | 0.13 | <0.02 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.04 | 0.04 | 0.26 | 0.05 | 0.29 |
| | Indium (In) (ppm) | 0.019 | 0.156 | 0.025 | 0.028 | 0.027 |
| | Iron (Fe) (%) | 2.30 | 3.29 | 2.47 | 2.61 | 2.81 |
| | Lanthanum (La) (ppm) | 12.5 | 12.4 | 15.6 | 16.5 | 16.0 |
| | Lead (Pb) (ppm) | 3.2 | 4.0 | 6.7 | 2.6 | 7.4 |
| | Lithium (Li) (ppm) | 7.2 | 4.9 | 8.7 | 6.8 | 9.5 |
| | Magnesium (Mg) (%) | 0.60 | 0.61 | 0.60 | 0.74 | 0.72 |
| | Manganese (Mn) (ppm) | 515 | 535 | 604 | 618 | 603 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1932915-6 Waste 04-MAY-17 135373 | L1932915-7 Waste 05-MAY-17 135374 | L1932915-8 Waste 05-MAY-17 135375 | L1932915-9 Waste 06-MAY-17 140903 | L1932915-10 Waste 05-MAY-17 140901 |
|---|--|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.8 | 8.3 | 8.2 | 8.7 | 8.7 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.26 | 0.21 | <0.05 | 0.23 | 0.25 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 1 | 1 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 1.3 | 0.6 | 0.3 | 0.6 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 30 | 23 | 6 | 27 | 31 |
| | NNP (tCaCO3/1Kt) | 29 | 22 | 6 | 26 | 31 |
| | Ratio (NP/MPA) (Unity) | 24.00 | 36.80 | 19.20 | 43.20 | 99.20 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | 0.02 | 0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | 0.03 | <0.01 | 0.01 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.04 | <0.01 | <0.01 | 0.01 | 0.01 |
| | Total Sulfur (combustion) (%) | 0.04 | 0.02 | 0.01 | 0.02 | 0.01 |
| Total Metals | Aluminum (Al) (%) | 1.22 | 0.84 | 0.79 | 1.12 | 0.57 |
| | Antimony (Sb) (ppm) | <0.05 | 0.28 | 0.09 | <0.05 | 0.05 |
| | Arsenic (As) (ppm) | 1.0 | 4.2 | 5.6 | 1.5 | 10.6 |
| | Barium (Ba) (ppm) | 200 | 230 | 160 | 180 | 230 |
| | Beryllium (Be) (ppm) | 0.34 | 0.30 | 0.36 | 0.31 | 0.40 |
| | Bismuth (Bi) (ppm) | 0.11 | 0.30 | 0.24 | 0.10 | 0.04 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | 10 |
| | Cadmium (Cd) (ppm) | 0.09 | 0.18 | 0.37 | 0.05 | 0.27 |
| | Calcium (Ca) (%) | 1.29 | 0.87 | 0.27 | 1.20 | 1.26 |
| | Cerium (Ce) (ppm) | 21.4 | 20.1 | 23.6 | 23.0 | 25.1 |
| | Cesium (Cs) (ppm) | 0.36 | 0.54 | 0.58 | 0.41 | 0.47 |
| | Chromium (Cr) (ppm) | 5 | 14 | 8 | 5 | 6 |
| | Cobalt (Co) (ppm) | 6.8 | 6.4 | 6.9 | 7.6 | 6.3 |
| | Copper (Cu) (ppm) | 668 | 2600 | 3260 | 699 | 495 |
| | Gallium (Ga) (ppm) | 6.40 | 3.88 | 4.71 | 5.96 | 4.56 |
| | Germanium (Ge) (ppm) | 0.07 | 0.06 | 0.06 | 0.07 | 0.07 |
| | Gold (Au) (ppm) | <0.02 | 0.10 | 0.10 | 0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.06 | 0.15 | 0.09 | 0.06 | 0.05 |
| | Indium (In) (ppm) | 0.029 | 0.080 | 0.048 | 0.020 | 0.057 |
| | Iron (Fe) (%) | 2.50 | 2.39 | 2.59 | 2.28 | 2.47 |
| | Lanthanum (La) (ppm) | 11.4 | 10.6 | 11.1 | 12.5 | 12.6 |
| | Lead (Pb) (ppm) | 2.4 | 3.6 | 3.3 | 2.5 | 3.5 |
| | Lithium (Li) (ppm) | 6.3 | 4.5 | 3.6 | 6.2 | 2.5 |
| | Magnesium (Mg) (%) | 0.75 | 0.39 | 0.23 | 0.67 | 0.14 |
| | Manganese (Mn) (ppm) | 637 | 423 | 494 | 556 | 732 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1932915-11 Waste 08-MAY-17 140904 | L1932915-12 Waste 08-MAY-17 140905 | L1932915-13 Waste 26-MAY-17 135360 | L1932915-14 Waste 12-MAY-17 140909 | L1932915-15 Waste 14-MAY-17 140913 |
|---|---|---|---|---|---|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.3 | 8.5 | 8.1 | 8.8 | 8.8 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.27 | 0.08 | 0.19 | 0.14 | 0.35 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 1 | 1 | 1 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 0.9 | 0.3 | 0.9 | 6.6 | 4.4 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 28 | 11 | 21 | 22 | 33 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 27 | 11 | 20 | 15 | 29 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 29.87 | 35.20 | 22.40 | 3.35 | 7.54 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | 0.01 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | 0.01 | 0.02 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | 0.03 | 0.01 | 0.03 | 0.20 | 0.13 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.03 | 0.01 | 0.03 | 0.21 | 0.14 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 0.85 | 0.64 | 0.95 | 1.26 | 1.15 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.45 | 0.14 | 0.50 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 4.8 | 4.6 | 5.8 | 0.4 | 0.7 |
| | Barium (Ba) (ppm) | | | | |
| | 280 | 230 | 300 | 330 | 250 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.34 | 0.39 | 0.38 | 0.21 | 0.25 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.21 | 0.96 | 0.23 | 0.20 | 0.07 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.18 | 0.18 | 0.21 | 0.26 | 0.21 |
| | Calcium (Ca) (%) | | | | |
| | 1.19 | 0.39 | 0.92 | 0.74 | 1.29 |
| | Cerium (Ce) (ppm) | | | | |
| | 21.2 | 15.15 | 22.3 | 24.1 | 24.8 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.62 | 0.61 | 0.72 | 0.36 | 0.48 |
| | Chromium (Cr) (ppm) | | | | |
| | 21 | 8 | 20 | 6 | 5 |
| | Cobalt (Co) (ppm) | | | | |
| | 7.4 | 5.8 | 7.9 | 6.9 | 6.7 |
| | Copper (Cu) (ppm) | | | | |
| | 694 | 4370 | 367 | 3050 | 1455 |
| | Gallium (Ga) (ppm) | | | | |
| | 3.44 | 4.91 | 4.21 | 6.35 | 6.43 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.05 | 0.06 | 0.05 | 0.06 | 0.07 |
| | Gold (Au) (ppm) | | | | |
| | 0.05 | 0.18 | 0.02 | 0.06 | 0.03 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.20 | 0.06 | 0.18 | 0.06 | 0.05 |
| | Indium (In) (ppm) | | | | |
| | 0.037 | 0.067 | 0.034 | 0.060 | 0.053 |
| | Iron (Fe) (%) | | | | |
| | 2.07 | 2.88 | 2.36 | 2.54 | 2.79 |
| | Lanthanum (La) (ppm) | | | | |
| | 10.7 | 7.7 | 11.3 | 12.7 | 12.7 |
| | Lead (Pb) (ppm) | | | | |
| | 4.3 | 3.3 | 4.7 | 2.0 | 2.3 |
| | Lithium (Li) (ppm) | | | | |
| | 5.5 | 3.4 | 6.2 | 6.1 | 5.2 |
| | Magnesium (Mg) (%) | | | | |
| | 0.43 | 0.18 | 0.43 | 0.74 | 0.68 |
| | Manganese (Mn) (ppm) | | | | |
| | 410 | 473 | 478 | 543 | 605 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1932915-16 Waste 09-MAY-17 140906 | L1932915-17 Waste 02-MAY-17 135371 | L1932915-18 Waste 10-MAY-17 140907 | L1932915-19 Waste 11-MAY-17 140908 | L1932915-20 Waste 12-MAY-17 140910 |
|-----------------------------------|---|---|---|---|---|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.5 | 8.7 | 8.6 | 8.4 | 8.7 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.07 | 0.50 | 0.27 | 0.16 | 0.36 |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | 2 | 2 | 1 | 2 |
| | MPA (tCaCO3/1Kt) | 0.3 | 0.3 | 0.6 | 0.9 | 3.1 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 14 | 44 | 27 | 22 | 36 |
| | NNP (tCaCO3/1Kt) | 14 | 44 | 26 | 21 | 33 |
| | Ratio (NP/MPA) (Unity) | 44.80 | 140.80 | 43.20 | 23.47 | 11.52 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.02 | 0.01 | <0.01 | 0.01 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.01 | 0.01 | 0.02 | 0.03 | 0.10 |
| | Total Sulfur (combustion) (%) | 0.01 | 0.01 | 0.02 | 0.03 | 0.10 |
| Total Metals | Aluminum (Al) (%) | 0.90 | 0.48 | 0.51 | 0.95 | 0.98 |
| | Antimony (Sb) (ppm) | 0.05 | 0.06 | 0.17 | 0.07 | <0.05 |
| | Arsenic (As) (ppm) | 1.4 | 11.2 | 5.8 | 1.8 | 0.9 |
| | Barium (Ba) (ppm) | 210 | 240 | 460 | 170 | 190 |
| | Beryllium (Be) (ppm) | 0.33 | 0.40 | 0.43 | 0.30 | 0.30 |
| | Bismuth (Bi) (ppm) | 0.05 | 0.02 | 0.05 | 0.10 | 0.28 |
| | Boron (B) (ppm) | <10 | 10 | 10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.10 | 0.09 | 0.13 | 0.18 | 0.09 |
| | Calcium (Ca) (%) | 0.59 | 1.83 | 1.15 | 0.92 | 1.33 |
| | Cerium (Ce) (ppm) | 22.5 | 24.2 | 18.15 | 26.3 | 34.4 |
| | Cesium (Cs) (ppm) | 0.46 | 0.42 | 0.33 | 0.44 | 0.46 |
| | Chromium (Cr) (ppm) | 5 | 4 | 6 | 7 | 6 |
| | Cobalt (Co) (ppm) | 5.5 | 4.5 | 5.5 | 5.6 | 7.4 |
| | Copper (Cu) (ppm) | 1105 | 191.0 | 573 | 916 | 2710 |
| | Gallium (Ga) (ppm) | 5.07 | 4.02 | 3.50 | 5.07 | 5.82 |
| | Germanium (Ge) (ppm) | 0.06 | 0.05 | <0.05 | 0.06 | 0.08 |
| | Gold (Au) (ppm) | <0.02 | <0.02 | 0.03 | 0.03 | 0.06 |
| | Hafnium (Hf) (ppm) | 0.06 | 0.04 | 0.07 | 0.07 | 0.06 |
| | Indium (In) (ppm) | 0.033 | 0.039 | 0.066 | 0.038 | 0.048 |
| | Iron (Fe) (%) | 2.19 | 2.02 | 1.99 | 2.34 | 2.87 |
| | Lanthanum (La) (ppm) | 11.1 | 12.5 | 9.6 | 14.1 | 18.6 |
| | Lead (Pb) (ppm) | 2.9 | 3.6 | 9.1 | 4.5 | 3.1 |
| | Lithium (Li) (ppm) | 4.8 | 2.1 | 1.6 | 4.4 | 4.7 |
| | Magnesium (Mg) (%) | 0.40 | 0.11 | 0.07 | 0.43 | 0.58 |
| | Manganese (Mn) (ppm) | 559 | 486 | 412 | 642 | 625 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1932915-21 | L1932915-22 | L1932915-23 |
|-----------------------------------|--|--------------|-------------|-------------|-------------|
| | | Description | Waste | Waste | Waste |
| | | Sampled Date | 18-MAY-17 | 15-MAY-17 | 16-MAY-17 |
| | | Sampled Time | | | |
| | | Client ID | 140918 | 140914 | 140916 |
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | 8.5 | 8.3 | 8.7 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | 0.26 | 0.05 | 0.31 |
| Acid Base Accounting | FIZZ RATING (Unity) | | 2 | 1 | 2 |
| | MPA (tCaCO3/1Kt) | | 0.6 | 0.6 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | 25 | 10 | 32 |
| | NNP (tCaCO3/1Kt) | | 24 | 9 | 31 |
| | Ratio (NP/MPA) (Unity) | | 40.00 | 16.00 | 51.20 |
| | Sulfate Sulfur (carbonate leach) (%) | | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | <0.01 | <0.01 | 0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | 0.02 | 0.02 | 0.02 |
| | Total Sulfur (combustion) (%) | | 0.02 | 0.02 | 0.02 |
| Total Metals | Aluminum (Al) (%) | | 0.50 | 0.91 | 0.70 |
| | Antimony (Sb) (ppm) | | 0.11 | 0.07 | 0.06 |
| | Arsenic (As) (ppm) | | 6.3 | 2.1 | 6.1 |
| | Barium (Ba) (ppm) | | 280 | 170 | 190 |
| | Beryllium (Be) (ppm) | | 0.44 | 0.28 | 0.35 |
| | Bismuth (Bi) (ppm) | | 0.21 | 0.42 | 0.05 |
| | Boron (B) (ppm) | | 10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | 0.16 | 0.29 | 0.05 |
| | Calcium (Ca) (%) | | 0.98 | 0.27 | 1.29 |
| | Cerium (Ce) (ppm) | | 18.85 | 20.5 | 27.5 |
| | Cesium (Cs) (ppm) | | 0.45 | 0.51 | 0.59 |
| | Chromium (Cr) (ppm) | | 5 | 5 | 4 |
| | Cobalt (Co) (ppm) | | 5.7 | 8.1 | 5.5 |
| | Copper (Cu) (ppm) | | 2770 | 7840 | 879 |
| | Gallium (Ga) (ppm) | | 4.10 | 5.30 | 4.52 |
| | Germanium (Ge) (ppm) | | 0.05 | 0.08 | 0.06 |
| | Gold (Au) (ppm) | | 0.07 | 0.22 | <0.02 |
| | Hafnium (Hf) (ppm) | | 0.05 | 0.10 | 0.03 |
| | Indium (In) (ppm) | | 0.080 | 0.203 | 0.035 |
| | Iron (Fe) (%) | | 2.41 | 3.80 | 2.14 |
| | Lanthanum (La) (ppm) | | 9.5 | 10.3 | 13.9 |
| | Lead (Pb) (ppm) | | 4.1 | 6.1 | 2.8 |
| | Lithium (Li) (ppm) | | 2.2 | 3.8 | 3.6 |
| | Magnesium (Mg) (%) | | 0.10 | 0.34 | 0.29 |
| | Manganese (Mn) (ppm) | | 653 | 419 | 476 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1932915-1 | L1932915-2 | L1932915-3 | L1932915-4 | L1932915-5 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | Waste | Waste | Waste | Waste | Waste |
| | | Sampled Date | 24-APR-17 | 24-APR-17 | 02-MAY-17 | 02-MAY-17 | 03-MAY-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 135357 | 135358 | 135369 | 135370 | 135372 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | 0.02 | 0.05 | <0.01 | 0.05 | |
| | Molybdenum (Mo) (ppm) | 0.81 | 1.13 | 1.08 | 0.95 | 1.16 | |
| | Nickel (Ni) (ppm) | 2.7 | 2.3 | 23.9 | 3.2 | 28.9 | |
| | Niobium (Nb) (ppm) | 0.06 | 0.33 | 0.87 | 0.10 | 0.91 | |
| | Phosphorus (P) (ppm) | 590 | 650 | 880 | 810 | 900 | |
| | Potassium (K) (%) | 0.35 | 0.72 | 0.18 | 0.43 | 0.20 | |
| | Rhenium (Re) (ppm) | 0.002 | 0.005 | 0.003 | 0.001 | 0.001 | |
| | Rubidium (Rb) (ppm) | 16.5 | 39.4 | 11.7 | 19.5 | 13.2 | |
| | Scandium (Sc) (ppm) | 3.4 | 5.6 | 5.4 | 4.8 | 6.1 | |
| | Selenium (Se) (ppm) | 0.4 | 4.7 | 0.8 | 0.6 | 1.0 | |
| | Silver (Ag) (ppm) | 0.08 | 0.93 | 0.10 | 0.12 | 0.12 | |
| | Sodium (Na) (%) | 0.06 | 0.06 | 0.05 | 0.06 | 0.04 | |
| | Strontium (Sr) (ppm) | 62.1 | 56.7 | 61.9 | 84.5 | 66.5 | |
| | Sulfur (S) (%) | 0.01 | 0.95 | 0.02 | 0.03 | 0.03 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.01 | 0.15 | 0.01 | 0.02 | 0.03 | |
| | Thallium (Tl) (ppm) | 0.10 | 0.35 | 0.12 | 0.11 | 0.13 | |
| | Thorium (Th) (ppm) | 2.2 | 4.1 | 3.9 | 3.6 | 4.7 | |
| | Tin (Sn) (ppm) | 0.5 | 1.5 | 0.5 | 0.6 | 0.5 | |
| | Titanium (Ti) (%) | 0.053 | 0.121 | 0.074 | 0.065 | 0.079 | |
| | Tungsten (W) (ppm) | 0.25 | 1.53 | 0.28 | 0.78 | 0.34 | |
| | Uranium (U) (ppm) | 0.21 | 0.33 | 0.73 | 0.24 | 0.87 | |
| | Vanadium (V) (ppm) | 44 | 61 | 52 | 51 | 59 | |
| | Yttrium (Y) (ppm) | 5.76 | 8.34 | 10.25 | 7.36 | 10.70 | |
| | Zinc (Zn) (ppm) | 62 | 69 | 61 | 74 | 73 | |
| | Zirconium (Zr) (ppm) | 0.8 | 0.9 | 7.6 | 1.3 | 10.6 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.0 | 1.5 | 1.0 | 1.1 | 0.9 | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1932915-6 Waste 04-MAY-17 135373 | L1932915-7 Waste 05-MAY-17 135374 | L1932915-8 Waste 05-MAY-17 135375 | L1932915-9 Waste 06-MAY-17 140903 | L1932915-10 Waste 05-MAY-17 140901 |
|------------------------|--------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | 0.03 | 0.02 | <0.01 | 0.01 | |
| | Molybdenum (Mo) (ppm) | 0.80 | 1.22 | 1.35 | 0.58 | 1.19 | |
| | Nickel (Ni) (ppm) | 2.6 | 11.4 | 8.3 | 2.5 | 2.6 | |
| | Niobium (Nb) (ppm) | 0.14 | 0.83 | 0.38 | 0.18 | 0.08 | |
| | Phosphorus (P) (ppm) | 720 | 750 | 710 | 720 | 620 | |
| | Potassium (K) (%) | 0.38 | 0.25 | 0.32 | 0.35 | 0.25 | |
| | Rhenium (Re) (ppm) | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | |
| | Rubidium (Rb) (ppm) | 16.2 | 14.8 | 18.6 | 15.6 | 13.3 | |
| | Scandium (Sc) (ppm) | 3.8 | 4.3 | 5.6 | 4.1 | 9.4 | |
| | Selenium (Se) (ppm) | 1.0 | 1.8 | 1.2 | 0.8 | 0.5 | |
| | Silver (Ag) (ppm) | 0.24 | 0.70 | 0.47 | 0.19 | 0.10 | |
| | Sodium (Na) (%) | 0.08 | 0.04 | 0.05 | 0.08 | 0.06 | |
| | Strontium (Sr) (ppm) | 70.2 | 46.4 | 30.3 | 78.6 | 57.9 | |
| | Sulfur (S) (%) | 0.05 | 0.02 | 0.01 | 0.02 | 0.01 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.03 | 0.16 | 0.11 | 0.04 | 0.01 | |
| | Thallium (Tl) (ppm) | 0.08 | 0.13 | 0.12 | 0.09 | 0.07 | |
| | Thorium (Th) (ppm) | 2.1 | 3.2 | 3.8 | 2.7 | 2.6 | |
| | Tin (Sn) (ppm) | 0.4 | 0.6 | 0.6 | 0.4 | 0.8 | |
| | Titanium (Ti) (%) | 0.078 | 0.070 | 0.046 | 0.078 | 0.030 | |
| | Tungsten (W) (ppm) | 0.82 | 1.05 | 0.46 | 3.79 | 0.46 | |
| | Uranium (U) (ppm) | 0.34 | 0.45 | 0.27 | 0.23 | 0.19 | |
| | Vanadium (V) (ppm) | 51 | 49 | 55 | 50 | 54 | |
| | Yttrium (Y) (ppm) | 6.91 | 7.50 | 7.27 | 7.74 | 9.12 | |
| | Zinc (Zn) (ppm) | 69 | 57 | 73 | 60 | 80 | |
| | Zirconium (Zr) (ppm) | 1.2 | 5.2 | 2.6 | 1.1 | 1.0 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.9 | 0.8 | 0.2 | 0.8 | 0.9 | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1932915-11 Waste 08-MAY-17 140904 | L1932915-12 Waste 08-MAY-17 140905 | L1932915-13 Waste 26-MAY-17 135360 | L1932915-14 Waste 12-MAY-17 140909 | L1932915-15 Waste 14-MAY-17 140913 |
|------------------------|--------------------------|---|---|---|---|---|---|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.03 | 0.03 | 0.04 | 0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | | 1.12 | 1.30 | 1.30 | 12.75 | 2.96 |
| | Nickel (Ni) (ppm) | | 17.8 | 5.6 | 18.0 | 2.8 | 2.4 |
| | Niobium (Nb) (ppm) | | 0.58 | 0.20 | 0.86 | 0.13 | 0.21 |
| | Phosphorus (P) (ppm) | | 680 | 530 | 710 | 740 | 720 |
| | Potassium (K) (%) | | 0.17 | 0.30 | 0.21 | 0.58 | 0.53 |
| | Rhenium (Re) (ppm) | | 0.001 | <0.001 | 0.001 | 0.034 | 0.011 |
| | Rubidium (Rb) (ppm) | | 9.6 | 15.9 | 12.4 | 25.6 | 24.3 |
| | Scandium (Sc) (ppm) | | 4.3 | 4.3 | 4.7 | 3.7 | 4.8 |
| | Selenium (Se) (ppm) | | 1.0 | 1.5 | 0.8 | 2.3 | 1.5 |
| | Silver (Ag) (ppm) | | 0.29 | 1.26 | 0.18 | 1.02 | 0.31 |
| | Sodium (Na) (%) | | 0.04 | 0.05 | 0.04 | 0.08 | 0.06 |
| | Strontium (Sr) (ppm) | | 58.3 | 33.7 | 52.4 | 44.9 | 71.5 |
| | Sulfur (S) (%) | | 0.02 | 0.01 | 0.03 | 0.18 | 0.16 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.07 | 0.29 | 0.06 | 0.13 | 0.06 |
| | Thallium (Tl) (ppm) | | 0.09 | 0.10 | 0.10 | 0.15 | 0.14 |
| | Thorium (Th) (ppm) | | 2.8 | 1.7 | 3.0 | 3.1 | 2.9 |
| | Tin (Sn) (ppm) | | 0.4 | 0.6 | 0.5 | 0.6 | 0.7 |
| | Titanium (Ti) (%) | | 0.062 | 0.036 | 0.065 | 0.096 | 0.086 |
| | Tungsten (W) (ppm) | | 0.62 | 0.57 | 0.78 | 0.59 | 0.46 |
| | Uranium (U) (ppm) | | 0.53 | 0.27 | 0.52 | 0.21 | 0.37 |
| | Vanadium (V) (ppm) | | 44 | 49 | 49 | 54 | 56 |
| | Yttrium (Y) (ppm) | | 7.55 | 6.84 | 8.38 | 6.38 | 8.47 |
| | Zinc (Zn) (ppm) | | 48 | 71 | 56 | 84 | 71 |
| | Zirconium (Zr) (ppm) | | 7.2 | 2.1 | 6.4 | 1.9 | 0.9 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 1.0 | 0.3 | 0.7 | 0.5 | 1.3 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1932915-16 Waste 09-MAY-17 140906 | L1932915-17 Waste 02-MAY-17 135371 | L1932915-18 Waste 10-MAY-17 140907 | L1932915-19 Waste 11-MAY-17 140908 | L1932915-20 Waste 12-MAY-17 140910 |
|------------------------|--------------------------|---|---|---|---|---|---|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | | 1.39 | 0.67 | 1.31 | 4.21 | 5.46 |
| | Nickel (Ni) (ppm) | | 3.2 | 3.6 | 6.5 | 4.6 | 2.6 |
| | Niobium (Nb) (ppm) | | 0.15 | 0.05 | <0.05 | 0.23 | 0.15 |
| | Phosphorus (P) (ppm) | | 700 | 580 | 640 | 700 | 830 |
| | Potassium (K) (%) | | 0.28 | 0.20 | 0.18 | 0.40 | 0.45 |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | 0.001 | 0.001 | 0.010 |
| | Rubidium (Rb) (ppm) | | 12.8 | 8.5 | 7.1 | 20.6 | 21.7 |
| | Scandium (Sc) (ppm) | | 4.6 | 7.4 | 5.6 | 5.0 | 7.0 |
| | Selenium (Se) (ppm) | | 0.6 | 0.4 | 0.4 | 0.9 | 2.1 |
| | Silver (Ag) (ppm) | | 0.06 | 0.06 | 0.24 | 0.17 | 0.45 |
| | Sodium (Na) (%) | | 0.06 | 0.05 | 0.04 | 0.06 | 0.06 |
| | Strontium (Sr) (ppm) | | 40.8 | 53.6 | 55.8 | 41.5 | 80.9 |
| | Sulfur (S) (%) | | 0.01 | 0.01 | 0.02 | 0.03 | 0.12 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.02 | <0.01 | 0.04 | 0.03 | 0.10 |
| | Thallium (Tl) (ppm) | | 0.07 | 0.04 | 0.04 | 0.14 | 0.12 |
| | Thorium (Th) (ppm) | | 2.6 | 2.6 | 2.9 | 4.5 | 4.1 |
| | Tin (Sn) (ppm) | | 0.5 | 0.6 | 1.1 | 0.6 | 0.7 |
| | Titanium (Ti) (%) | | 0.039 | 0.014 | 0.011 | 0.067 | 0.068 |
| | Tungsten (W) (ppm) | | 0.46 | 0.79 | 0.25 | 0.47 | 0.84 |
| | Uranium (U) (ppm) | | 0.21 | 0.18 | 0.17 | 0.30 | 0.22 |
| | Vanadium (V) (ppm) | | 45 | 44 | 50 | 48 | 64 |
| | Yttrium (Y) (ppm) | | 10.20 | 7.30 | 8.39 | 8.89 | 10.45 |
| | Zinc (Zn) (ppm) | | 63 | 57 | 55 | 86 | 73 |
| | Zirconium (Zr) (ppm) | | 1.3 | 1.2 | 2.3 | 2.0 | 1.5 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.3 | 1.8 | 1.0 | 0.6 | 1.3 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1932915-21 Waste 18-MAY-17 140918 | L1932915-22 Waste 15-MAY-17 140914 | L1932915-23 Waste 16-MAY-17 140916 |
|------------------------|--------------------------|---|---|---|---|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | 0.02 | 0.01 | |
| | Molybdenum (Mo) (ppm) | 1.25 | 11.35 | 0.67 | |
| | Nickel (Ni) (ppm) | 3.5 | 4.2 | 2.0 | |
| | Niobium (Nb) (ppm) | 0.06 | 0.63 | 0.13 | |
| | Phosphorus (P) (ppm) | 590 | 760 | 720 | |
| | Potassium (K) (%) | 0.20 | 0.47 | 0.25 | |
| | Rhenium (Re) (ppm) | <0.001 | 0.002 | <0.001 | |
| | Rubidium (Rb) (ppm) | 10.0 | 26.2 | 13.0 | |
| | Scandium (Sc) (ppm) | 5.3 | 6.1 | 5.0 | |
| | Selenium (Se) (ppm) | 0.8 | 3.8 | 0.6 | |
| | Silver (Ag) (ppm) | 0.40 | 1.74 | 0.23 | |
| | Sodium (Na) (%) | 0.04 | 0.04 | 0.05 | |
| | Strontium (Sr) (ppm) | 41.7 | 22.2 | 57.9 | |
| | Sulfur (S) (%) | 0.02 | 0.02 | 0.02 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.09 | 0.50 | 0.02 | |
| | Thallium (Tl) (ppm) | 0.05 | 0.24 | 0.06 | |
| | Thorium (Th) (ppm) | 2.4 | 5.3 | 2.8 | |
| | Tin (Sn) (ppm) | 0.7 | 1.1 | 0.7 | |
| | Titanium (Ti) (%) | 0.018 | 0.085 | 0.033 | |
| | Tungsten (W) (ppm) | 0.19 | 0.42 | 0.33 | |
| | Uranium (U) (ppm) | 0.25 | 0.56 | 0.21 | |
| | Vanadium (V) (ppm) | 50 | 69 | 46 | |
| | Yttrium (Y) (ppm) | 7.20 | 8.61 | 8.31 | |
| | Zinc (Zn) (ppm) | 72 | 126 | 61 | |
| | Zirconium (Zr) (ppm) | 1.5 | 3.5 | 0.9 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.9 | 0.2 | 1.1 | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06-AX | Soil | Sulfide Sulfur Calc from Carbonate Leach | ALS Minerals S-CAL06 |
| Sulfide Sulfur (as S) is calculated by subtracting the Carbonate Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-18

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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 Account: APN

CERTIFICATE VA17109714

Project: L1932915
 P.O. No.: ALSM-CW16-102-APN
 This report is for 23 Other samples submitted to our lab in Vancouver, BC, Canada on 31-MAY-2017.
 The following have access to data associated with this certificate:

| | | |
|--------------------------|----------------------------|-------------|
| ELSE VANCOUVER WEBTRIEVE | SOFTWARE DEVELOPMENT GROUP | SHANE STACK |
|--------------------------|----------------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | WEI-21 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | OA-VOL08m | S-IR08 | S-GRA06 | S-GRA06a | S-CAL06 | C-GAS05 | C-GAS05 | ME-MS41 | ME-MS41 |
|--------------------|--------------------------|--------------|----------------|----------------|----------------|---------------|----------|-----------------|--------|---------|----------|---------|---------|---------|---------|---------|
| | | Recvd Wt. kg | MPA tCaCO3/1Kt | FIZZ RAT Unity | NNP tCaCO3/1Kt | NP tCaCO3/1Kt | pH Unity | Ratio (N) Unity | S % | S % | S % | S % | C % | CO2 % | Ag ppm | Al % |
| L1932915-1 135357 | | 0.88 | 0.6 | 2 | 27 | 28 | 8.7 | 44.80 | 0.02 | <0.01 | 0.01 | 0.02 | 0.27 | 1.0 | 0.08 | 1.11 |
| L1932915-2 135358 | | 0.90 | 27.2 | 2 | 10 | 37 | 8.5 | 1.36 | 0.87 | 0.01 | 0.02 | 0.86 | 0.41 | 1.5 | 0.93 | 1.14 |
| L1932915-3 135369 | | 1.12 | 0.9 | 2 | 27 | 28 | 7.9 | 29.87 | 0.03 | <0.01 | 0.01 | 0.03 | 0.27 | 1.0 | 0.10 | 1.19 |
| L1932915-4 135370 | | 1.12 | 0.9 | 2 | 31 | 32 | 8.6 | 34.13 | 0.03 | <0.01 | 0.02 | 0.03 | 0.30 | 1.1 | 0.12 | 1.27 |
| L1932915-5 135372 | | 1.08 | 0.9 | 2 | 25 | 26 | 8.0 | 27.73 | 0.03 | <0.01 | 0.03 | 0.03 | 0.23 | 0.9 | 0.12 | 1.38 |
| L1932915-6 135373 | | 1.16 | 1.3 | 2 | 29 | 30 | 8.8 | 24.00 | 0.04 | <0.01 | 0.01 | 0.04 | 0.26 | 0.9 | 0.24 | 1.22 |
| L1932915-7 135374 | | 0.90 | 0.6 | 1 | 22 | 23 | 8.3 | 36.80 | 0.02 | 0.02 | 0.03 | <0.01 | 0.21 | 0.8 | 0.70 | 0.84 |
| L1932915-8 135375 | | 0.94 | 0.3 | 1 | 6 | 6 | 8.2 | 19.20 | 0.01 | 0.01 | <0.01 | <0.01 | <0.05 | 0.2 | 0.47 | 0.79 |
| L1932915-9 140903 | | 1.14 | 0.6 | 2 | 26 | 27 | 8.7 | 43.20 | 0.02 | 0.01 | 0.01 | 0.01 | 0.23 | 0.8 | 0.19 | 1.12 |
| L1932915-10 140901 | | 1.14 | 0.3 | 2 | 31 | 31 | 8.7 | 99.20 | 0.01 | <0.01 | <0.01 | 0.01 | 0.25 | 0.9 | 0.10 | 0.57 |
| L1932915-11 140904 | | 1.10 | 0.9 | 2 | 27 | 28 | 8.3 | 29.87 | 0.03 | <0.01 | <0.01 | 0.03 | 0.27 | 1.0 | 0.29 | 0.85 |
| L1932915-12 140905 | | 0.90 | 0.3 | 1 | 11 | 11 | 8.5 | 35.20 | 0.01 | <0.01 | <0.01 | 0.01 | 0.08 | 0.3 | 1.26 | 0.64 |
| L1932915-13 135360 | | 1.14 | 0.9 | 1 | 20 | 21 | 8.1 | 22.40 | 0.03 | <0.01 | <0.01 | 0.03 | 0.19 | 0.7 | 0.18 | 0.95 |
| L1932915-14 140909 | | 1.14 | 6.6 | 1 | 15 | 22 | 8.8 | 3.35 | 0.21 | 0.01 | 0.01 | 0.20 | 0.14 | 0.5 | 1.02 | 1.26 |
| L1932915-15 140913 | | 1.12 | 4.4 | 2 | 29 | 33 | 8.8 | 7.54 | 0.14 | 0.01 | 0.02 | 0.13 | 0.35 | 1.3 | 0.31 | 1.15 |
| L1932915-16 140906 | | 1.16 | 0.3 | 1 | 14 | 14 | 8.5 | 44.80 | 0.01 | <0.01 | 0.02 | 0.01 | 0.07 | 0.3 | 0.06 | 0.90 |
| L1932915-17 135371 | | 1.06 | 0.3 | 2 | 44 | 44 | 8.7 | 140.80 | 0.01 | <0.01 | 0.01 | 0.01 | 0.50 | 1.8 | 0.06 | 0.48 |
| L1932915-18 140907 | | 1.18 | 0.6 | 2 | 26 | 27 | 8.6 | 43.20 | 0.02 | <0.01 | <0.01 | 0.02 | 0.27 | 1.0 | 0.24 | 0.51 |
| L1932915-19 140908 | | 1.38 | 0.9 | 1 | 21 | 22 | 8.4 | 23.47 | 0.03 | <0.01 | 0.01 | 0.03 | 0.16 | 0.6 | 0.17 | 0.95 |
| L1932915-20 140910 | | 1.16 | 3.1 | 2 | 33 | 36 | 8.7 | 11.52 | 0.10 | <0.01 | <0.01 | 0.10 | 0.36 | 1.3 | 0.45 | 0.98 |
| L1932915-21 140918 | | 1.16 | 0.6 | 2 | 24 | 25 | 8.5 | 40.00 | 0.02 | <0.01 | <0.01 | 0.02 | 0.26 | 0.9 | 0.40 | 0.50 |
| L1932915-22 140914 | | 1.16 | 0.6 | 1 | 9 | 10 | 8.3 | 16.00 | 0.02 | <0.01 | <0.01 | 0.02 | 0.05 | 0.2 | 1.74 | 0.91 |
| L1932915-23 140916 | | 1.14 | 0.6 | 2 | 31 | 32 | 8.7 | 51.20 | 0.02 | <0.01 | 0.01 | 0.02 | 0.31 | 1.1 | 0.23 | 0.70 |



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CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga |
| | | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| | | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 |
| L1932915-1 135357 | | 1.2 | <0.02 | <10 | 250 | 0.35 | 0.04 | 1.22 | 0.05 | 23.3 | 5.5 | 5 | 0.32 | 214 | 2.30 | 6.17 |
| L1932915-2 135358 | | 4.9 | 0.13 | <10 | 190 | 0.23 | 0.25 | 1.45 | 0.66 | 23.7 | 5.7 | 5 | 0.72 | 5320 | 3.29 | 6.70 |
| L1932915-3 135369 | | 6.8 | <0.02 | <10 | 280 | 0.45 | 0.10 | 1.34 | 0.28 | 30.2 | 9.7 | 28 | 0.78 | 206 | 2.47 | 4.42 |
| L1932915-4 135370 | | 0.8 | <0.02 | <10 | 230 | 0.30 | 0.04 | 1.26 | 0.07 | 30.7 | 7.5 | 5 | 0.44 | 535 | 2.61 | 6.85 |
| L1932915-5 135372 | | 8.1 | <0.02 | <10 | 320 | 0.52 | 0.13 | 1.19 | 0.30 | 32.1 | 11.5 | 33 | 1.12 | 95.1 | 2.81 | 5.06 |
| L1932915-6 135373 | | 1.0 | <0.02 | <10 | 200 | 0.34 | 0.11 | 1.29 | 0.09 | 21.4 | 6.8 | 5 | 0.36 | 668 | 2.50 | 6.40 |
| L1932915-7 135374 | | 4.2 | 0.10 | <10 | 230 | 0.30 | 0.30 | 0.87 | 0.18 | 20.1 | 6.4 | 14 | 0.54 | 2600 | 2.39 | 3.88 |
| L1932915-8 135375 | | 5.6 | 0.10 | <10 | 160 | 0.36 | 0.24 | 0.27 | 0.37 | 23.6 | 6.9 | 8 | 0.58 | 3260 | 2.59 | 4.71 |
| L1932915-9 140903 | | 1.5 | 0.02 | <10 | 180 | 0.31 | 0.10 | 1.20 | 0.05 | 23.0 | 7.6 | 5 | 0.41 | 699 | 2.28 | 5.96 |
| L1932915-10 140901 | | 10.6 | <0.02 | 10 | 230 | 0.40 | 0.04 | 1.26 | 0.27 | 25.1 | 6.3 | 6 | 0.47 | 495 | 2.47 | 4.56 |
| L1932915-11 140904 | | 4.8 | 0.05 | <10 | 280 | 0.34 | 0.21 | 1.19 | 0.18 | 21.2 | 7.4 | 21 | 0.62 | 694 | 2.07 | 3.44 |
| L1932915-12 140905 | | 4.6 | 0.18 | <10 | 230 | 0.39 | 0.96 | 0.39 | 0.18 | 15.15 | 5.8 | 8 | 0.61 | 4370 | 2.88 | 4.91 |
| L1932915-13 135360 | | 5.8 | 0.02 | <10 | 300 | 0.38 | 0.23 | 0.92 | 0.21 | 22.3 | 7.9 | 20 | 0.72 | 367 | 2.36 | 4.21 |
| L1932915-14 140909 | | 0.4 | 0.06 | <10 | 330 | 0.21 | 0.20 | 0.74 | 0.26 | 24.1 | 6.9 | 6 | 0.36 | 3050 | 2.54 | 6.35 |
| L1932915-15 140913 | | 0.7 | 0.03 | <10 | 250 | 0.25 | 0.07 | 1.29 | 0.21 | 24.8 | 6.7 | 5 | 0.48 | 1455 | 2.79 | 6.43 |
| L1932915-16 140906 | | 1.4 | <0.02 | <10 | 210 | 0.33 | 0.05 | 0.59 | 0.10 | 22.5 | 5.5 | 5 | 0.46 | 1105 | 2.19 | 5.07 |
| L1932915-17 135371 | | 11.2 | <0.02 | 10 | 240 | 0.40 | 0.02 | 1.83 | 0.09 | 24.2 | 4.5 | 4 | 0.42 | 191.0 | 2.02 | 4.02 |
| L1932915-18 140907 | | 5.8 | 0.03 | 10 | 460 | 0.43 | 0.05 | 1.15 | 0.13 | 18.15 | 5.5 | 6 | 0.33 | 573 | 1.99 | 3.50 |
| L1932915-19 140908 | | 1.8 | 0.03 | <10 | 170 | 0.30 | 0.10 | 0.92 | 0.18 | 26.3 | 5.6 | 7 | 0.44 | 916 | 2.34 | 5.07 |
| L1932915-20 140910 | | 0.9 | 0.06 | <10 | 190 | 0.30 | 0.28 | 1.33 | 0.09 | 34.4 | 7.4 | 6 | 0.46 | 2710 | 2.87 | 5.82 |
| L1932915-21 140918 | | 6.3 | 0.07 | 10 | 280 | 0.44 | 0.21 | 0.98 | 0.16 | 18.85 | 5.7 | 5 | 0.45 | 2770 | 2.41 | 4.10 |
| L1932915-22 140914 | | 2.1 | 0.22 | <10 | 170 | 0.28 | 0.42 | 0.27 | 0.29 | 20.5 | 8.1 | 5 | 0.51 | 7840 | 3.80 | 5.30 |
| L1932915-23 140916 | | 6.1 | <0.02 | <10 | 190 | 0.35 | 0.05 | 1.29 | 0.05 | 27.5 | 5.5 | 4 | 0.59 | 879 | 2.14 | 4.52 |



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CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P | |
| | Units | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm | |
| | LOR | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | |
| L1932915-1 135357 | | 0.09 | 0.04 | <0.01 | 0.019 | 0.35 | 12.5 | 7.2 | 0.60 | 515 | 0.81 | 0.06 | 0.06 | 2.7 | 590 | 3.2 |
| L1932915-2 135358 | | 0.10 | 0.04 | 0.02 | 0.156 | 0.72 | 12.4 | 4.9 | 0.61 | 535 | 1.13 | 0.06 | 0.33 | 2.3 | 650 | 4.0 |
| L1932915-3 135369 | | 0.08 | 0.26 | 0.05 | 0.025 | 0.18 | 15.6 | 8.7 | 0.60 | 604 | 1.08 | 0.05 | 0.87 | 23.9 | 880 | 6.7 |
| L1932915-4 135370 | | 0.07 | 0.05 | <0.01 | 0.028 | 0.43 | 16.5 | 6.8 | 0.74 | 618 | 0.95 | 0.06 | 0.10 | 3.2 | 810 | 2.6 |
| L1932915-5 135372 | | 0.06 | 0.29 | 0.05 | 0.027 | 0.20 | 16.0 | 9.5 | 0.72 | 603 | 1.16 | 0.04 | 0.91 | 28.9 | 900 | 7.4 |
| L1932915-6 135373 | | 0.07 | 0.06 | <0.01 | 0.029 | 0.38 | 11.4 | 6.3 | 0.75 | 637 | 0.80 | 0.08 | 0.14 | 2.6 | 720 | 2.4 |
| L1932915-7 135374 | | 0.06 | 0.15 | 0.03 | 0.080 | 0.25 | 10.6 | 4.5 | 0.39 | 423 | 1.22 | 0.04 | 0.83 | 11.4 | 750 | 3.6 |
| L1932915-8 135375 | | 0.06 | 0.09 | 0.02 | 0.048 | 0.32 | 11.1 | 3.6 | 0.23 | 494 | 1.35 | 0.05 | 0.38 | 8.3 | 710 | 3.3 |
| L1932915-9 140903 | | 0.07 | 0.06 | <0.01 | 0.020 | 0.35 | 12.5 | 6.2 | 0.67 | 556 | 0.58 | 0.08 | 0.18 | 2.5 | 720 | 2.5 |
| L1932915-10 140901 | | 0.07 | 0.05 | 0.01 | 0.057 | 0.25 | 12.6 | 2.5 | 0.14 | 732 | 1.19 | 0.06 | 0.08 | 2.6 | 620 | 3.5 |
| L1932915-11 140904 | | 0.05 | 0.20 | 0.03 | 0.037 | 0.17 | 10.7 | 5.5 | 0.43 | 410 | 1.12 | 0.04 | 0.58 | 17.8 | 680 | 4.3 |
| L1932915-12 140905 | | 0.06 | 0.06 | 0.03 | 0.067 | 0.30 | 7.7 | 3.4 | 0.18 | 473 | 1.30 | 0.05 | 0.20 | 5.6 | 530 | 3.3 |
| L1932915-13 135360 | | 0.05 | 0.18 | 0.04 | 0.034 | 0.21 | 11.3 | 6.2 | 0.43 | 478 | 1.30 | 0.04 | 0.86 | 18.0 | 710 | 4.7 |
| L1932915-14 140909 | | 0.06 | 0.06 | 0.01 | 0.060 | 0.58 | 12.7 | 6.1 | 0.74 | 543 | 12.75 | 0.08 | 0.13 | 2.8 | 740 | 2.0 |
| L1932915-15 140913 | | 0.07 | 0.05 | 0.01 | 0.053 | 0.53 | 12.7 | 5.2 | 0.68 | 605 | 2.96 | 0.06 | 0.21 | 2.4 | 720 | 2.3 |
| L1932915-16 140906 | | 0.06 | 0.06 | 0.01 | 0.033 | 0.28 | 11.1 | 4.8 | 0.40 | 559 | 1.39 | 0.06 | 0.15 | 3.2 | 700 | 2.9 |
| L1932915-17 135371 | | 0.05 | 0.04 | 0.01 | 0.039 | 0.20 | 12.5 | 2.1 | 0.11 | 486 | 0.67 | 0.05 | 0.05 | 3.6 | 580 | 3.6 |
| L1932915-18 140907 | | <0.05 | 0.07 | 0.01 | 0.066 | 0.18 | 9.6 | 1.6 | 0.07 | 412 | 1.31 | 0.04 | <0.05 | 6.5 | 640 | 9.1 |
| L1932915-19 140908 | | 0.06 | 0.07 | 0.01 | 0.038 | 0.40 | 14.1 | 4.4 | 0.43 | 642 | 4.21 | 0.06 | 0.23 | 4.6 | 700 | 4.5 |
| L1932915-20 140910 | | 0.08 | 0.06 | 0.01 | 0.048 | 0.45 | 18.6 | 4.7 | 0.58 | 625 | 5.46 | 0.06 | 0.15 | 2.6 | 830 | 3.1 |
| L1932915-21 140918 | | 0.05 | 0.05 | 0.01 | 0.080 | 0.20 | 9.5 | 2.2 | 0.10 | 653 | 1.25 | 0.04 | 0.06 | 3.5 | 590 | 4.1 |
| L1932915-22 140914 | | 0.08 | 0.10 | 0.02 | 0.203 | 0.47 | 10.3 | 3.8 | 0.34 | 419 | 11.35 | 0.04 | 0.63 | 4.2 | 760 | 6.1 |
| L1932915-23 140916 | | 0.06 | 0.03 | 0.01 | 0.035 | 0.25 | 13.9 | 3.6 | 0.29 | 476 | 0.67 | 0.05 | 0.13 | 2.0 | 720 | 2.8 |



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CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U | V |
| | Units | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm |
| | LOR | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 |
| L1932915-1 135357 | | 16.5 | 0.002 | 0.01 | <0.05 | 3.4 | 0.4 | 0.5 | 62.1 | <0.01 | 0.01 | 2.2 | 0.053 | 0.10 | 0.21 | 44 |
| L1932915-2 135358 | | 39.4 | 0.005 | 0.95 | 0.05 | 5.6 | 4.7 | 1.5 | 56.7 | <0.01 | 0.15 | 4.1 | 0.121 | 0.35 | 0.33 | 61 |
| L1932915-3 135369 | | 11.7 | 0.003 | 0.02 | 0.52 | 5.4 | 0.8 | 0.5 | 61.9 | <0.01 | 0.01 | 3.9 | 0.074 | 0.12 | 0.73 | 52 |
| L1932915-4 135370 | | 19.5 | 0.001 | 0.03 | <0.05 | 4.8 | 0.6 | 0.6 | 84.5 | <0.01 | 0.02 | 3.6 | 0.065 | 0.11 | 0.24 | 51 |
| L1932915-5 135372 | | 13.2 | 0.001 | 0.03 | 0.72 | 6.1 | 1.0 | 0.5 | 66.5 | <0.01 | 0.03 | 4.7 | 0.079 | 0.13 | 0.87 | 59 |
| L1932915-6 135373 | | 16.2 | <0.001 | 0.05 | <0.05 | 3.8 | 1.0 | 0.4 | 70.2 | <0.01 | 0.03 | 2.1 | 0.078 | 0.08 | 0.34 | 51 |
| L1932915-7 135374 | | 14.8 | <0.001 | 0.02 | 0.28 | 4.3 | 1.8 | 0.6 | 46.4 | <0.01 | 0.16 | 3.2 | 0.070 | 0.13 | 0.45 | 49 |
| L1932915-8 135375 | | 18.6 | <0.001 | 0.01 | 0.09 | 5.6 | 1.2 | 0.6 | 30.3 | <0.01 | 0.11 | 3.8 | 0.046 | 0.12 | 0.27 | 55 |
| L1932915-9 140903 | | 15.6 | 0.001 | 0.02 | <0.05 | 4.1 | 0.8 | 0.4 | 78.6 | <0.01 | 0.04 | 2.7 | 0.078 | 0.09 | 0.23 | 50 |
| L1932915-10 140901 | | 13.3 | <0.001 | 0.01 | 0.05 | 9.4 | 0.5 | 0.8 | 57.9 | <0.01 | 0.01 | 2.6 | 0.030 | 0.07 | 0.19 | 54 |
| L1932915-11 140904 | | 9.6 | 0.001 | 0.02 | 0.45 | 4.3 | 1.0 | 0.4 | 58.3 | <0.01 | 0.07 | 2.8 | 0.062 | 0.09 | 0.53 | 44 |
| L1932915-12 140905 | | 15.9 | <0.001 | 0.01 | 0.14 | 4.3 | 1.5 | 0.6 | 33.7 | <0.01 | 0.29 | 1.7 | 0.036 | 0.10 | 0.27 | 49 |
| L1932915-13 135360 | | 12.4 | 0.001 | 0.03 | 0.50 | 4.7 | 0.8 | 0.5 | 52.4 | <0.01 | 0.06 | 3.0 | 0.065 | 0.10 | 0.52 | 49 |
| L1932915-14 140909 | | 25.6 | 0.034 | 0.18 | <0.05 | 3.7 | 2.3 | 0.6 | 44.9 | <0.01 | 0.13 | 3.1 | 0.096 | 0.15 | 0.21 | 54 |
| L1932915-15 140913 | | 24.3 | 0.011 | 0.16 | <0.05 | 4.8 | 1.5 | 0.7 | 71.5 | <0.01 | 0.06 | 2.9 | 0.086 | 0.14 | 0.37 | 56 |
| L1932915-16 140906 | | 12.8 | <0.001 | 0.01 | 0.05 | 4.6 | 0.6 | 0.5 | 40.8 | <0.01 | 0.02 | 2.6 | 0.039 | 0.07 | 0.21 | 45 |
| L1932915-17 135371 | | 8.5 | <0.001 | 0.01 | 0.06 | 7.4 | 0.4 | 0.6 | 53.6 | <0.01 | <0.01 | 2.6 | 0.014 | 0.04 | 0.18 | 44 |
| L1932915-18 140907 | | 7.1 | 0.001 | 0.02 | 0.17 | 5.6 | 0.4 | 1.1 | 55.8 | <0.01 | 0.04 | 2.9 | 0.011 | 0.04 | 0.17 | 50 |
| L1932915-19 140908 | | 20.6 | 0.001 | 0.03 | 0.07 | 5.0 | 0.9 | 0.6 | 41.5 | <0.01 | 0.03 | 4.5 | 0.067 | 0.14 | 0.30 | 48 |
| L1932915-20 140910 | | 21.7 | 0.010 | 0.12 | <0.05 | 7.0 | 2.1 | 0.7 | 80.9 | <0.01 | 0.10 | 4.1 | 0.068 | 0.12 | 0.22 | 64 |
| L1932915-21 140918 | | 10.0 | <0.001 | 0.02 | 0.11 | 5.3 | 0.8 | 0.7 | 41.7 | <0.01 | 0.09 | 2.4 | 0.018 | 0.05 | 0.25 | 50 |
| L1932915-22 140914 | | 26.2 | 0.002 | 0.02 | 0.07 | 6.1 | 3.8 | 1.1 | 22.2 | <0.01 | 0.50 | 5.3 | 0.085 | 0.24 | 0.56 | 69 |
| L1932915-23 140916 | | 13.0 | <0.001 | 0.02 | 0.06 | 5.0 | 0.6 | 0.7 | 57.9 | <0.01 | 0.02 | 2.8 | 0.033 | 0.06 | 0.21 | 46 |



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CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------|--------------------------|---------|---------|---------|---------|
| | | W ppm | Y ppm | Zn ppm | Zr ppm |
| | | 0.05 | 0.05 | 2 | 0.5 |
| L1932915-1 135357 | | 0.25 | 5.76 | 62 | 0.8 |
| L1932915-2 135358 | | 1.53 | 8.34 | 69 | 0.9 |
| L1932915-3 135369 | | 0.28 | 10.25 | 61 | 7.6 |
| L1932915-4 135370 | | 0.78 | 7.36 | 74 | 1.3 |
| L1932915-5 135372 | | 0.34 | 10.70 | 73 | 10.6 |
| L1932915-6 135373 | | 0.82 | 6.91 | 69 | 1.2 |
| L1932915-7 135374 | | 1.05 | 7.50 | 57 | 5.2 |
| L1932915-8 135375 | | 0.46 | 7.27 | 73 | 2.6 |
| L1932915-9 140903 | | 3.79 | 7.74 | 60 | 1.1 |
| L1932915-10 140901 | | 0.46 | 9.12 | 80 | 1.0 |
| L1932915-11 140904 | | 0.62 | 7.55 | 48 | 7.2 |
| L1932915-12 140905 | | 0.57 | 6.84 | 71 | 2.1 |
| L1932915-13 135360 | | 0.78 | 8.38 | 56 | 6.4 |
| L1932915-14 140909 | | 0.59 | 6.38 | 84 | 1.9 |
| L1932915-15 140913 | | 0.46 | 8.47 | 71 | 0.9 |
| L1932915-16 140906 | | 0.46 | 10.20 | 63 | 1.3 |
| L1932915-17 135371 | | 0.79 | 7.30 | 57 | 1.2 |
| L1932915-18 140907 | | 0.25 | 8.39 | 55 | 2.3 |
| L1932915-19 140908 | | 0.47 | 8.89 | 86 | 2.0 |
| L1932915-20 140910 | | 0.84 | 10.45 | 73 | 1.5 |
| L1932915-21 140918 | | 0.19 | 7.20 | 72 | 1.5 |
| L1932915-22 140914 | | 0.42 | 8.61 | 126 | 3.5 |
| L1932915-23 140916 | | 0.33 | 8.31 | 61 | 0.9 |



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CERTIFICATE OF ANALYSIS VA17109714

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
 ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|-----------|----------|---------|----------|
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



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QC CERTIFICATE VA17109714

Project: L1932915
 P.O. No.: ALSM-CW16-102-APN
 This report is for 23 Other samples submitted to our lab in Vancouver, BC, Canada on 31-MAY-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: ALS ENVIRONMENTAL
 ATTN: SHANE STACK
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17109714

| Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | S-CAL06 S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|----------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|-------------------------|---------------------------------|------------------|-------------------|--------------------|-------------------|-------------------|---------------------|----------------------|--------------------|----------------------|
| Sample Description | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | 6.0 | | | | | | | | | | |
| Buffer pH6 | | | | | 6.0 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.3 | | | | | | | | | | |
| Upper Bound | | | | | 6.7 | | | | | | | | | | |
| GS310-10 | | | | | | | 0.26 | | | | | | | | |
| GS310-10 | | | | | | | 0.27 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 0.25 | | | | | | | | |
| Upper Bound | | | | | | | 0.29 | | | | | | | | |
| KZK-1 | 25.0 | 2 | 32 | 57 | | 2.28 | | | | | | | | | |
| KZK-1 | 25.0 | 2 | 31 | 56 | | 2.24 | | | | | | | | | |
| Target Range - Lower Bound | 22.9 | <1 | 30 | 54 | | 2.18 | | | | | | | | | |
| Upper Bound | 27.1 | >4 | 38 | 64 | | 2.53 | | | | | | | | | |
| MA-1b | | | | | | | 1.18 | | | | | | | | |
| MA-1b | | | | | | | 1.16 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 1.12 | | | | | | | | |
| Upper Bound | | | | | | | 1.22 | | | | | | | | |
| MA-3a | | | | | | | | | | 2.36 | 8.6 | | | | |
| Target Range - Lower Bound | | | | | | | | | | 2.31 | 8.4 | | | | |
| Upper Bound | | | | | | | | | | 2.77 | 10.2 | | | | |
| MRGeo08 | | | | | | | | | | | | | 4.32 | 2.60 | 31.7 |
| Target Range - Lower Bound | | | | | | | | | | | | | 4.00 | 2.44 | 29.6 |
| Upper Bound | | | | | | | | | | | | | 4.92 | 3.00 | 36.4 |
| OGGeo08 | | | | | | | | | | | | | 18.80 | 2.09 | 113.5 |
| Target Range - Lower Bound | | | | | | | | | | | | | 18.15 | 2.05 | 107.0 |
| Upper Bound | | | | | | | | | | | | | 22.2 | 2.53 | 131.0 |
| OREAS 905 | | | | | | | | | | | | | 0.55 | 0.76 | 32.0 |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.45 | 0.73 | 28.4 |
| Upper Bound | | | | | | | | | | | | | 0.58 | 0.91 | 35.0 |
| OREAS 920 | | | | | | | | | | | | | 0.13 | 2.30 | 4.7 |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.07 | 2.18 | 3.8 |
| Upper Bound | | | | | | | | | | | | | 0.12 | 2.68 | 4.9 |
| SY-4 | | | | | | | | | | 0.89 | 3.3 | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.84 | 3.0 | | | | |
| Upper Bound | | | | | | | | | | 1.08 | 4.0 | | | | |



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QC CERTIFICATE OF ANALYSIS VA17109714

| Method Analyte Units LOR | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm |
|----------------------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | <0.02 | <10 | 440 | 0.78 | 0.62 | 1.08 | 2.25 | 75.3 | 18.3 | 90 | 10.90 | 600 | 3.53 | 9.61 | 0.18 |
| Target Range - Lower Bound | <0.02 | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 | 3.22 | 8.73 | 0.07 |
| Upper Bound | 0.04 | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 | 3.96 | 10.80 | 0.29 |
| OGGeo08 | 0.07 | <10 | 120 | 0.73 | 10.35 | 0.85 | 18.15 | 60.0 | 92.1 | 78 | 8.98 | 8030 | 4.87 | 8.37 | 0.16 |
| Target Range - Lower Bound | 0.03 | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | 4.51 | 8.05 | 0.21 |
| Upper Bound | 0.11 | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | 5.53 | 9.95 | 0.45 |
| OREAS 905 | 0.42 | <10 | 240 | 0.94 | 5.33 | 0.34 | 0.34 | 79.3 | 13.9 | 17 | 1.11 | 1550 | 3.37 | 6.16 | 0.12 |
| Target Range - Lower Bound | 0.33 | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 | 3.14 | 5.74 | <0.05 |
| Upper Bound | 0.45 | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 | 3.86 | 7.12 | 0.22 |
| OREAS 920 | <0.02 | <10 | 80 | 0.61 | 0.62 | 0.31 | 0.05 | 73.7 | 14.2 | 40 | 2.01 | 109.5 | 3.47 | 6.97 | 0.10 |
| Target Range - Lower Bound | <0.02 | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | 3.26 | 6.12 | <0.05 |
| Upper Bound | 0.04 | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | 4.00 | 7.60 | 0.22 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | |
| | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 0.76 | 0.06 | 0.152 | 1.26 | 37.3 | 33.7 | 1.14 | 404 | 14.00 | 0.33 | 0.96 | 691 | 1020 | 1050 | 144.5 | |
| Target Range - Lower Bound | 0.64 | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 | 900 | 959 | 132.0 | |
| Upper Bound | 0.83 | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 | 1130 | 1175 | 162.0 | |
| OGGeo08 | 0.75 | 0.47 | 1.420 | 1.03 | 29.1 | 31.6 | 0.92 | 374 | 852 | 0.28 | 1.23 | 8470 | 770 | 6890 | 113.0 | |
| Target Range - Lower Bound | 0.72 | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 | 700 | 6520 | 109.5 | |
| Upper Bound | 0.92 | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 | 880 | 7970 | 134.5 | |
| OREAS 905 | 1.17 | 0.01 | 0.592 | 0.30 | 39.6 | 4.4 | 0.15 | 346 | 3.00 | 0.09 | 0.21 | 8.6 | 240 | 16.0 | 18.3 | |
| Target Range - Lower Bound | 1.08 | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 | | 15.2 | 17.3 | |
| Upper Bound | 1.36 | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 | | 19.0 | 21.3 | |
| OREAS 920 | 0.56 | 0.01 | 0.031 | 0.41 | 36.7 | 19.0 | 1.04 | 489 | 0.34 | 0.02 | 0.36 | 38.1 | 680 | 20.1 | 23.7 | |
| Target Range - Lower Bound | 0.53 | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 | | 19.2 | 22.2 | |
| Upper Bound | 0.69 | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 | | 23.9 | 27.4 | |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Tl % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|----------------------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|
| Sample Description | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 0.007 | 0.30 | 2.87 | 7.0 | 1.6 | 3.1 | 79.3 | 0.01 | 0.02 | 21.0 | 0.391 | 0.77 | 5.20 | 100 | 2.51 |
| Target Range - Lower Bound | 0.006 | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 | 4.93 | 90 | 2.44 |
| Upper Bound | 0.010 | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 | 6.13 | 112 | 3.42 |
| OGGeo08 | 1.365 | 2.67 | 21.5 | 6.3 | 10.9 | 12.6 | 62.0 | 0.01 | 0.15 | 16.2 | 0.302 | 1.28 | 4.87 | 77 | 3.23 |
| Target Range - Lower Bound | 1.295 | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | 4.45 | 70 | 2.58 |
| Upper Bound | 1.585 | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | 5.55 | 88 | 3.60 |
| OREAS 905 | 0.001 | 0.06 | 0.95 | 1.8 | 2.8 | 1.2 | 12.4 | <0.01 | 0.07 | 7.8 | 0.020 | 0.10 | 2.06 | 6 | 0.46 |
| Target Range - Lower Bound | <0.001 | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 | 2.08 | 4 | 0.44 |
| Upper Bound | 0.002 | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 | 2.66 | 8 | 0.76 |
| OREAS 920 | <0.001 | 0.04 | 0.65 | 2.9 | 0.9 | 1.1 | 17.7 | 0.01 | 0.02 | 14.9 | 0.121 | 0.14 | 1.93 | 24 | 0.49 |
| Target Range - Lower Bound | <0.001 | <0.01 | 0.45 | 2.5 | 0.4 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | 1.89 | 23 | 0.31 |
| Upper Bound | 0.002 | 0.05 | 0.77 | 3.3 | 1.3 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | 2.42 | 30 | 0.61 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|--------------------------|--------------------|------------------|--------------------|
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS310-10 | | | | |
| GS310-10 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-1b | | | | |
| MA-1b | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-3a | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MGeo08 | | 18.80 | 746 | 21.8 |
| Target Range - Lower Bound | | 17.50 | 708 | 18.1 |
| Upper Bound | | 21.5 | 870 | 25.7 |
| OGGeo08 | | 15.45 | 6830 | 22.3 |
| Target Range - Lower Bound | | 15.35 | 6500 | 19.5 |
| Upper Bound | | 18.85 | 7950 | 27.5 |
| OREAS 905 | | 7.00 | 63 | 42.7 |
| Target Range - Lower Bound | | 6.32 | 58 | 39.9 |
| Upper Bound | | 7.84 | 76 | 55.1 |
| OREAS 920 | | 17.20 | 100 | 22.3 |
| Target Range - Lower Bound | | 16.85 | 93 | 17.6 |
| Upper Bound | | 20.7 | 119 | 25.0 |
| SY-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Method Analyte Units LOR | OA-VOL08m MPA | OA-VOL08m FIZZ RAT | OA-VOL08m NNP | OA-VOL08m NP | OA-ELE07 pH | OA-VOL08m Ratio (N) | S-IR08 S | S-GRA06 S | S-GRA06a S | S-CAL06 S | C-GAS05 C | C-GAS05 CO2 | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As |
|----------------------------|---------------|--------------------|---------------|--------------|-------------|---------------------|----------|-----------|------------|-----------|-----------|-------------|------------|------------|------------|
| Sample Description | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | % | ppm | % | ppm |
| | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 |
| STANDARDS | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | 0.89 | | | | | | | |
| UTS-1 | | | | | | | | 0.86 | | | | | | | |
| UTS-1 | | | | | | | | 0.85 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.83 | | | | | | | |
| Upper Bound | | | | | | | | 0.93 | | | | | | | |
| UTS-1 | | | | | | | | | 0.88 | | | | | | |
| UTS-1 | | | | | | | | | 0.84 | | | | | | |
| UTS-1 | | | | | | | | | 0.93 | | | | | | |
| UTS-1 | | | | | | | | | 0.91 | | | | | | |
| UTS-1 | | | | | | | | | 0.90 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.81 | | | | | | |
| Upper Bound | | | | | | | | | 0.95 | | | | | | |
| UTS-4 | | | | | | | | 1.66 | | | | | | | |
| UTS-4 | | | | | | | | 1.75 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.64 | | | | | | | |
| Upper Bound | | | | | | | | 1.84 | | | | | | | |
| UTS-4 | | | | | | | | | 1.78 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 1.61 | | | | | | |
| Upper Bound | | | | | | | | | 1.87 | | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | <0.05 | <0.2 | | | |
| Target Range - Lower Bound | | | | | | | | | | | <0.05 | <0.2 | | | |
| Upper Bound | | | | | | | | | | | 0.10 | 0.4 | | | |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | 0.1 |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 |
| Upper Bound | | | | | | | | | | | | | 0.02 | 0.02 | 0.2 |
| BLANK | | | | | 6.0 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.5 | | | | | | | | | | |
| Upper Bound | | | | | 6.9 | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | ME-MS41 Au ppm 0.02 | ME-MS41 B ppm 10 | ME-MS41 Ba ppm 10 | ME-MS41 Be ppm 0.05 | ME-MS41 Bi ppm 0.01 | ME-MS41 Ca % 0.01 | ME-MS41 Cd ppm 0.01 | ME-MS41 Ce ppm 0.02 | ME-MS41 Co ppm 0.1 | ME-MS41 Cr ppm 1 | ME-MS41 Cs ppm 0.05 | ME-MS41 Cu ppm 0.2 | ME-MS41 Fe % 0.01 | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 |
|----------------------------|-----------------------------------|------------------------------|---------------------------|----------------------------|------------------------------|------------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|---------------------------|------------------------------|-----------------------------|----------------------------|------------------------------|------------------------------|
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 |
| BLANK | | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 |
| Target Range - Lower Bound | | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 |
| Upper Bound | | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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Project: L1932915

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| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | |
| | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | |
| BLANK | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | |
| Target Range - Lower Bound | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | |
| Upper Bound | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | | |
|----------------------------|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|-------|-----|-------|
| | | | | | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U | V | W |
| | | | | | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm |
| | | | | | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| BLANK | | | | | 0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| BLANK | | | | | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Target Range - Lower Bound | | | | | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Upper Bound | | | | | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 |
| BLANK | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|--------------------------|-----------------------------|---------------------------|-----------------------------|
| STANDARDS | | | | |
| UTS-1 | | | | |
| UTS-1 | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| UTS-1 | | | | |
| UTS-1 | | | | |
| UTS-1 | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANKS | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | <0.05 | <2 | <0.5 |
| BLANK | | <0.05 | <2 | <0.5 |
| Target Range - Lower Bound | | <0.05 | <2 | <0.5 |
| Upper Bound | | 0.10 | 4 | 1.0 |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Method Analyte Units LOR | OA-VOL08m MPA | OA-VOL08m FIZZ RAT | OA-VOL08m NNP | OA-VOL08m NP | OA-ELE07 pH | OA-VOL08m Ratio (N) | S-IR08 S | S-GRA06 S | S-GRA06a S | S-CAL06 S | C-GAS05 C | C-GAS05 CO2 | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As |
|----------------------------|------------------|-----------------------|------------------|-----------------|----------------|------------------------|-------------|--------------|---------------|--------------|--------------|----------------|---------------|---------------|---------------|
| Sample Description | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | % | ppm | % | ppm |
| | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | <0.01 | | | | | | | |
| BLANK | | | | | | | | <0.01 | | | | | | | |
| BLANK | | | | | | | | <0.01 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.01 | | | | | | | |
| Upper Bound | | | | | | | | 0.02 | | | | | | | |
| BLANK | | | | | | | | | <0.01 | | | | | | |
| BLANK | | | | | | | | | <0.01 | | | | | | |
| BLANK | | | | | | | | | <0.01 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | <0.01 | | | | | | |
| Upper Bound | | | | | | | | | 0.02 | | | | | | |
| BLANK | | | | | | | <0.01 | | | | | | | | |
| BLANK | | | | | | | <0.01 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | <0.01 | | | | | | | | |
| Upper Bound | | | | | | | 0.02 | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | 0.02 | 0.40 | 1.4 |
| DUP | | | | | | | | | | | | | 0.02 | 0.41 | 1.3 |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | 0.37 | 1.2 |
| Upper Bound | | | | | | | | | | | | | 0.03 | 0.44 | 1.5 |
| L1932915-2 135358 | | | | | | | | 0.01 | 0.02 | | | | | | |
| DUP | | | | | | | | <0.01 | 0.01 | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.01 | <0.01 | | | | | | |
| Upper Bound | | | | | | | | 0.02 | 0.02 | | | | | | |
| L1932915-4 135370 | | | | | 8.6 | | | | | | | | | | |
| DUP | | | | | 8.6 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 8.1 | | | | | | | | | | |
| Upper Bound | | | | | 9.1 | | | | | | | | | | |
| L1932915-7 135374 | | | | | | | | | 0.03 | | | | | | |
| DUP | | | | | | | | | 0.04 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.02 | | | | | | |
| Upper Bound | | | | | | | | | 0.04 | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm |
|----------------------------|--------------------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|
| | | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| BLANKS | | | | | | | | | | | | | | | | |
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| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | <0.02 | <10 | 60 | 0.29 | 0.04 | 0.19 | 0.02 | 10.80 | 2.0 | 4 | 2.11 | 4.4 | 0.36 | 1.24 | 0.08 |
| DUP | | <0.02 | <10 | 60 | 0.29 | 0.04 | 0.19 | 0.02 | 11.10 | 2.1 | 4 | 2.12 | 4.8 | 0.37 | 1.28 | 0.08 |
| Target Range - Lower Bound | | <0.02 | <10 | 50 | 0.23 | 0.03 | 0.17 | <0.01 | 10.40 | 1.8 | 3 | 1.96 | 4.2 | 0.34 | 1.15 | <0.05 |
| Upper Bound | | 0.04 | 20 | 70 | 0.35 | 0.05 | 0.21 | 0.03 | 11.50 | 2.3 | 5 | 2.27 | 5.0 | 0.39 | 1.37 | 0.10 |
| L1932915-2 135358 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1932915-4 135370 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1932915-7 135374 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Method Analyte Units LOR | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm |
|----------------------------|----------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|
| Sample Description | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 |
| BLANKS | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | 0.15 | 0.05 | 0.008 | 0.15 | 5.1 | 1.9 | 0.08 | 59 | 0.24 | 0.13 | 0.05 | 1.8 | 90 | 3.6 | 7.5 |
| DUP | 0.16 | 0.05 | 0.008 | 0.15 | 5.1 | 1.9 | 0.08 | 62 | 0.24 | 0.14 | 0.05 | 1.8 | 80 | 3.7 | 7.8 |
| Target Range - Lower Bound | 0.13 | 0.04 | <0.005 | 0.13 | 4.6 | 1.7 | 0.07 | 52 | 0.18 | 0.12 | <0.05 | 1.5 | 70 | 3.3 | 7.2 |
| Upper Bound | 0.18 | 0.06 | 0.010 | 0.17 | 5.6 | 2.1 | 0.09 | 69 | 0.30 | 0.15 | 0.10 | 2.1 | 100 | 4.0 | 8.1 |
| L1932915-2 135358 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L1932915-4 135370 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L1932915-7 135374 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|----------------------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|
| Sample Description | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| BLANKS | | | | | | | | | | | | | | | |
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| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| BLANK | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | 0.001 | <0.01 | 0.37 | 0.9 | 0.2 | 0.2 | 21.5 | <0.01 | <0.01 | 1.8 | 0.014 | 0.06 | 0.98 | 17 | 0.09 |
| DUP | 0.001 | <0.01 | 0.37 | 0.9 | <0.2 | 0.2 | 22.1 | <0.01 | <0.01 | 2.0 | 0.014 | 0.06 | 1.02 | 17 | 0.09 |
| Target Range - Lower Bound | <0.001 | <0.01 | 0.29 | 0.8 | <0.2 | <0.2 | 20.5 | <0.01 | <0.01 | 1.6 | 0.008 | 0.04 | 0.90 | 15 | <0.05 |
| Upper Bound | 0.002 | 0.02 | 0.45 | 1.0 | 0.4 | 0.4 | 23.1 | 0.02 | 0.02 | 2.2 | 0.020 | 0.08 | 1.10 | 19 | 0.10 |
| L1932915-2 135358 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L1932915-4 135370 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L1932915-7 135374 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|--------------------------|--------------------|------------------|--------------------|
| BLANKS | | | | |
| BLANK | | | | |
| BLANK | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
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| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DUPLICATES | | | | |
| ORIGINAL | | 2.50 | 13 | 4.3 |
| DUP | | 2.52 | 14 | 4.2 |
| Target Range - Lower Bound | | 2.33 | 11 | 3.4 |
| Upper Bound | | 2.69 | 16 | 5.1 |
| L1932915-2 135358 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L1932915-4 135370 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L1932915-7 135374 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

***** See Appendix Page for comments regarding this certificate *****



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
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Project: L1932915

QC CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | S-CAL06 S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|-------------|---------------|----------------|--------------|----------------|
| | | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L1932915-10 140901 | | 0.3 | 2 | 31 | 31 | | 99.20 | 0.01 | <0.01 | | 0.01 | | | | | |
| DUP | | 0.3 | 2 | 31 | 31 | | 99.20 | 0.01 | <0.01 | | 0.01 | | | | | |
| Target Range - Lower Bound | | <0.3 | <1 | 28 | 28 | | 94.23 | <0.01 | <0.01 | | <0.01 | | | | | |
| Upper Bound | | 0.6 | 3 | 34 | 34 | | 104.17 | 0.02 | 0.02 | | 0.02 | | | | | |
| L1932915-13 135360 | | | | | | | | | | | | | | 0.18 | 0.95 | 5.8 |
| DUP | | | | | | | | | | | | | | 0.18 | 0.93 | 5.8 |
| Target Range - Lower Bound | | | | | | | | | | | | | | 0.16 | 0.88 | 5.4 |
| Upper Bound | | | | | | | | | | | | | | 0.20 | 1.00 | 6.2 |
| ORIGINAL | | | | | | | | | 0.64 | | | | | | | |
| DUP | | | | | | | | | 0.64 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.61 | | | | | | | |
| Upper Bound | | | | | | | | | 0.67 | | | | | | | |
| ORIGINAL | | | | | | | | | | | | 1.39 | 5.1 | | | |
| DUP | | | | | | | | | | | | 1.43 | 5.2 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | 1.29 | 4.7 | | | |
| Upper Bound | | | | | | | | | | | | 1.53 | 5.6 | | | |
| ORIGINAL | | | | | | | | 0.24 | | | | | | | | |
| DUP | | | | | | | | 0.25 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.23 | | | | | | | | |
| Upper Bound | | | | | | | | 0.26 | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Method Analyte Units LOR | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm |
|--|-------------------------------|-------------------------|--------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------------------|----------------------|------------------------------|--------------------------|------------------------------|------------------------------|-------------------------------|
| Sample Description | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| L1932915-10 140901 DUP Target Range - Lower Bound Upper Bound | DUPLICATES | | | | | | | | | | | | | | |
| L1932915-13 135360 DUP Target Range - Lower Bound Upper Bound | 0.02 0.03 <0.02 0.04 | <10 <10 <10 20 | 300 300 270 330 | 0.38 0.40 0.32 0.46 | 0.23 0.23 0.21 0.25 | 0.92 0.90 0.85 0.97 | 0.21 0.21 0.19 0.23 | 22.3 22.8 21.4 23.7 | 7.9 7.8 7.4 8.3 | 20 20 18 22 | 0.72 0.72 0.63 0.81 | 367 400 370 397 | 2.36 2.32 2.21 2.47 | 4.21 4.25 3.97 4.49 | 0.05 0.05 <0.05 0.10 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | ME-MS41 Hf ppm 0.02 | ME-MS41 Hg ppm 0.01 | ME-MS41 In ppm 0.005 | ME-MS41 K % 0.01 | ME-MS41 La ppm 0.2 | ME-MS41 Li ppm 0.1 | ME-MS41 Mg % 0.01 | ME-MS41 Mn ppm 5 | ME-MS41 Mo ppm 0.05 | ME-MS41 Na % 0.01 | ME-MS41 Nb ppm 0.05 | ME-MS41 Ni ppm 0.2 | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 | ME-MS41 Rb ppm 0.1 |
|--|-----------------------------------|------------------------------|------------------------------|----------------------------------|------------------------------|------------------------------|-----------------------------|------------------------------|---------------------------|------------------------------|------------------------------|------------------------------|------------------------------|---------------------------|-----------------------------|------------------------------|
| DUPLICATES | | | | | | | | | | | | | | | | |
| L1932915-10 140901 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1932915-13 135360 DUP Target Range - Lower Bound Upper Bound | | 0.18 0.19 0.16 0.21 | 0.04 0.03 0.02 0.05 | 0.034 0.034 0.027 0.041 | 0.21 0.20 0.18 0.23 | 11.3 11.5 10.6 12.2 | 6.2 7.0 6.2 7.0 | 0.43 0.42 0.39 0.46 | 478 467 444 501 | 1.30 1.28 1.18 1.40 | 0.04 0.04 0.03 0.05 | 0.86 0.85 0.76 0.95 | 18.0 17.9 16.9 19.0 | 710 700 660 750 | 4.7 4.7 4.3 5.1 | 12.4 12.1 11.5 13.0 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|--|--------------------------|-----------------------------------|------------------------------|------------------------------|--------------------------|--------------------------|--------------------------|------------------------------|---------------------------------|------------------------------|--------------------------|----------------------------------|------------------------------|------------------------------|----------------------|------------------------------|
| | | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L1932915-10 140901 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1932915-13 135360 DUP Target Range - Lower Bound Upper Bound | | 0.001 0.001 <0.001 0.002 | 0.03 0.03 0.02 0.04 | 0.50 0.50 0.41 0.59 | 4.7 4.7 4.4 5.0 | 0.8 0.6 0.5 0.9 | 0.5 0.5 0.3 0.7 | 52.4 50.7 48.8 54.3 | <0.01 <0.01 <0.01 0.02 | 0.06 0.06 0.05 0.07 | 3.0 3.1 2.7 3.4 | 0.065 0.064 0.056 0.073 | 0.10 0.10 0.07 0.13 | 0.52 0.58 0.47 0.63 | 49 47 45 51 | 0.78 0.93 0.74 0.97 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17109714

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|--|--------------------------|------------------------------|----------------------|--------------------------|
| DUPLICATES | | | | |
| L1932915-10 140901 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1932915-13 135360 DUP Target Range - Lower Bound Upper Bound | | 8.38 8.20 7.83 8.75 | 56 55 51 60 | 6.4 6.3 5.4 7.3 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | |
| | | | | |



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QC CERTIFICATE OF ANALYSIS VA17109714

| CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | | |
|-----------------------------|---|---------|----------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|--|--|
| Applies to Method: | <p style="text-align: center;">ANALYTICAL COMMENTS</p> <p>Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41</p> | | | | | | | | | | | | | | | | |
| Applies to Method: | <p style="text-align: center;">LABORATORY ADDRESSES</p> <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> <td style="width: 33%;">OA-ELE07</td> </tr> <tr> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> <td>S-CAL06</td> </tr> <tr> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> <td>SPL-21</td> </tr> <tr> <td>WEI-21</td> <td></td> <td></td> <td></td> </tr> </table> | C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | | |
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | | | | | | | | | | | | | | |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | | | | | | | | | | | | | | |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | | | | | | | | | | | | | | |
| WEI-21 | | | | | | | | | | | | | | | | | |



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L1932915-COFC

COC Number: **17-18**

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| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | <small>E&P TATs with your AM - surcharges will apply</small> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|--------------|---|---|-----------------------------|---|------------------|-----------------------|-----------------------------|---|---------------------------|-----------------------|-----------------------------|--|---------------------------|----------------------|---|--------|-----------|--|--------|---|---|---|---|---|---|--|---|--------|-----------|--|--|---|---|---|---|---|---|--|---|--------|----------|--|--|---|---|---|---|---|---|--|---|--------|----------|--|--|---|---|---|---|---|---|--|---|--------|----------|--|--|---|---|---|---|---|---|--|---|--------|----------|--|--|---|---|---|---|---|---|--|---|--------|----------|--|--|---|---|---|---|---|---|--|---|--------|----------|--|--|---|---|---|---|---|---|--|---|--------|----------|--|--|---|---|---|---|---|---|--|----|--------|----------|--|--|---|---|---|---|---|---|--|----|--------|----------|--|--|---|---|---|---|---|---|--|----|--------|----------|--|------|---|---|---|---|---|---|--|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | PROPERTY (Business Days) 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day; Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| City/Province: Vancouver, British Columbia | | Email 2 | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>ALS Sample # (lab use only)</th> <th>Sample Identification and/or Coordinates (This description will appear on the report)</th> <th>Date (dd-mmm-yy)</th> <th>Time (hh:mm)</th> <th>Sample Type</th> <th>Total Metals - Aqua regia digestion (ICP)</th> <th>Acid pH</th> <th>% Inorganic Carbonate</th> <th>Total Carbon/Sulphur (Leco)</th> <th>AP - determination by % sulphide sulphur</th> <th>Modified NP - (MEND 1991)</th> <th>Number of Containers</th> </tr> </thead> <tbody> <tr><td>1</td><td>135357</td><td>24-APR-17</td><td></td><td>VS0975</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> <tr><td>2</td><td>135358</td><td>24-APR-17</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> <tr><td>3</td><td>135369</td><td>2-MAY-17</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> <tr><td>4</td><td>135370</td><td>2-MAY-17</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> <tr><td>5</td><td>135372</td><td>3-MAY-17</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> <tr><td>6</td><td>135373</td><td>4-MAY-17</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> <tr><td>7</td><td>135374</td><td>5-MAY-17</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> <tr><td>8</td><td>135375</td><td>5-MAY-17</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> <tr><td>9</td><td>140903</td><td>6-MAY-17</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> <tr><td>10</td><td>140901</td><td>5-MAY-17</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> <tr><td>11</td><td>140904</td><td>8-MAY-17</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> <tr><td>12</td><td>140905</td><td>8-MAY-17</td><td></td><td>VS10</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr> </tbody> </table> | | ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals - Aqua regia digestion (ICP) | Acid pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | 1 | 135357 | 24-APR-17 | | VS0975 | X | X | X | X | X | X | | 2 | 135358 | 24-APR-17 | | | X | X | X | X | X | X | | 3 | 135369 | 2-MAY-17 | | | X | X | X | X | X | X | | 4 | 135370 | 2-MAY-17 | | | X | X | X | X | X | X | | 5 | 135372 | 3-MAY-17 | | | X | X | X | X | X | X | | 6 | 135373 | 4-MAY-17 | | | X | X | X | X | X | X | | 7 | 135374 | 5-MAY-17 | | | X | X | X | X | X | X | | 8 | 135375 | 5-MAY-17 | | | X | X | X | X | X | X | | 9 | 140903 | 6-MAY-17 | | | X | X | X | X | X | X | | 10 | 140901 | 5-MAY-17 | | | X | X | X | X | X | X | | 11 | 140904 | 8-MAY-17 | | | X | X | X | X | X | X | | 12 | 140905 | 8-MAY-17 | | VS10 | X | X | X | X | X | X | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | | | Sample Type | Total Metals - Aqua regia digestion (ICP) | Acid pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 135357 | 24-APR-17 | | | | VS0975 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 135358 | 24-APR-17 | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 135369 | 2-MAY-17 | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 135370 | 2-MAY-17 | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 135372 | 3-MAY-17 | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 135373 | 4-MAY-17 | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | 135374 | 5-MAY-17 | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | 135375 | 5-MAY-17 | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | 140903 | 6-MAY-17 | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | 140901 | 5-MAY-17 | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | 140904 | 8-MAY-17 | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | 140905 | 8-MAY-17 | | VS10 | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center | | PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Mirror Code | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: TBD | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFUSE TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy
 1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

COC Number: **17-18**
Page of



L1932915-COFC

www.alsglobal.com

| | | | | | |
|--|---|---|---|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format | | *all E&P TATs with your AM - surcharges will apply | |
| Company: | Minto Explorations Ltd. | Select Report Format: | <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input type="checkbox"/> E&P (DIGITAL) | Standard TAT if received by 3 pm - business days - no surcharges apply | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | PRIORITY (Business days) | EMERGENCY |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | 4 day [P4] <input type="checkbox"/> | 1 Business day [E1] <input type="checkbox"/> |
| Company address below will appear on the final report | | Select Distribution: | <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | 3 day [P3] <input type="checkbox"/> | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax | minto_environment@mintomine.com | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | |
| City/Province: | Vancouver, British Columbia | Email 2 | | For tests that can not be performed according to the service level selected, you will be contacted. | |
| Postal Code: | V6B 0M3 | Email 3 | | Analysis Request | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: | <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax | ap@mintomine.com | | |
| Contact: | Ruth Cayetano | Email 2 | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | |
| ALS Account # / Quote # | | AFE/Cost Center: | | PO# | |
| Job #: | | Major/Minor Code | | Routing Code: | |
| PO / AFE: | TBD | Requisitioner: | | | |
| LSD: | | Location: | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Number of Containers |
| | | | | Composite | |
| 13 | 135360 | 26-APR-17 | | WASTE | |
| 14 | 140909 | 12-may-17 | | | |
| 15 | 140913 | 14-may-17 | | | |
| 16 | 140906 | 9-may-17 | | | |
| 17 | 135371 | 02-may-17 | | | |
| 18 | 140907 | 10-may-17 | | | |
| 19 | 140908 | 11-may-17 | | | |
| 20 | 140910 | 12-may-17 | | | |
| 21 | 140918 | 12-may-17 | | | |
| 22 | 140914 | 15-may-17 | | | |
| 23 | 140916 | 16-may-17 | | WASTE | |
| Drinking Water (DW) Samples (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | |
| | | | | Cooling Initiated <input type="checkbox"/> | |
| | | | | INITIAL COOLER TEMPERATURES °C | |
| | | | | FINAL COOLER TEMPERATURES °C | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | FINAL SHIPMENT RECEPTION (lab use only) | |
| Released by: | Date: | Time: | Received by: | Date: | Time: |
| | | | | | |

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form, the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

1: if any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 21-JUN-17
Report Date: 20-JUL-17 14:00 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1946295
Project P.O. #: TRD
Job Reference:
C of C Numbers: 17-19
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1946295-1 WASTE 13-MAY-17 140911 | L1946295-2 WASTE 14-MAY-17 140912 | L1946295-3 WASTE 15-MAY-17 140915 | L1946295-4 WASTE 17-MAY-17 140917 | L1946295-5 WASTE 21-MAY-17 140919 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.0 | 8.4 | 8.3 | 8.4 | 8.2 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.10 | 0.52 | 0.27 | 0.30 | 0.22 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 1 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 0.3 | 15.9 | 0.6 | 1.6 | 0.9 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 8 | 41 | 27 | 30 | 22 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 8 | 25 | 26 | 28 | 21 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 25.60 | 2.57 | 43.20 | 19.20 | 23.47 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | 0.01 | 0.02 | 0.02 | 0.03 | 0.02 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | 0.01 | 0.51 | 0.02 | 0.05 | 0.03 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.01 | 0.51 | 0.02 | 0.05 | 0.03 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.01 | 0.96 | 0.65 | 0.89 | 0.89 |
| | Antimony (Sb) (ppm) | | | | |
| | <0.05 | <0.05 | 0.07 | <0.05 | 0.41 |
| | Arsenic (As) (ppm) | | | | |
| | 2.7 | 0.8 | 5.1 | 0.7 | 5.9 |
| | Barium (Ba) (ppm) | | | | |
| | 150 | 510 | 190 | 130 | 260 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.32 | 0.24 | 0.40 | 0.33 | 0.45 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.31 | 0.32 | 0.21 | 0.07 | 0.26 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | 10 | <10 | 10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.12 | 0.32 | 0.38 | 0.17 | 0.21 |
| | Calcium (Ca) (%) | | | | |
| | 0.26 | 1.50 | 1.12 | 1.24 | 0.96 |
| | Cerium (Ce) (ppm) | | | | |
| | 26.3 | 20.2 | 26.8 | 24.2 | 22.9 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.67 | 0.59 | 0.63 | 0.44 | 0.77 |
| | Chromium (Cr) (ppm) | | | | |
| | 4 | 4 | 4 | 4 | 18 |
| | Cobalt (Co) (ppm) | | | | |
| | 6.0 | 7.6 | 6.6 | 5.6 | 8.2 |
| | Copper (Cu) (ppm) | | | | |
| | 8790 | 7190 | 4540 | 1125 | 1655 |
| | Gallium (Ga) (ppm) | | | | |
| | 5.49 | 5.62 | 4.16 | 5.06 | 4.23 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.14 | 0.13 | 0.12 | 0.11 | 0.11 |
| | Gold (Au) (ppm) | | | | |
| | 0.18 | 0.18 | 0.05 | 0.04 | 0.04 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.13 | 0.03 | 0.05 | 0.05 | 0.17 |
| | Indium (In) (ppm) | | | | |
| | 0.086 | 0.166 | 0.053 | 0.036 | 0.044 |
| | Iron (Fe) (%) | | | | |
| | 2.56 | 3.41 | 2.49 | 2.41 | 2.61 |
| | Lanthanum (La) (ppm) | | | | |
| | 14.5 | 10.6 | 13.9 | 13.2 | 11.8 |
| | Lead (Pb) (ppm) | | | | |
| | 2.9 | 2.8 | 3.1 | 12.4 | 4.7 |
| | Lithium (Li) (ppm) | | | | |
| | 4.8 | 4.2 | 3.5 | 4.9 | 6.2 |
| | Magnesium (Mg) (%) | | | | |
| | 0.45 | 0.68 | 0.25 | 0.50 | 0.42 |
| | Manganese (Mn) (ppm) | | | | |
| | 329 | 602 | 610 | 629 | 472 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1946295-6 WASTE 22-MAY-17 140920 | L1946295-7 WASTE 05-APR-17 APR TAL COMP. 2017 | L1946295-8 WASTE 10-APR-17 APR TAL U/F 2017 | L1946295-9 WASTE 08-MAY-17 MAY TAL U/F 2017 | L1946295-10 WASTE 29-MAY-17 MAY TAL U/F 2017 | |
|---|--|---|--|--|---|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.9 | 8.0 | 8.0 | 8.0 | 7.9 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.11 | 0.23 | 0.19 | 0.18 | 0.21 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.6 | 1.9 | 2.8 | 2.8 | 5.0 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 19 | 25 | 23 | 19 | 19 |
| | NNP (tCaCO3/1Kt) | 18 | 23 | 20 | 16 | 14 |
| | Ratio (NP/MPA) (Unity) | 30.40 | 13.33 | 8.18 | 6.76 | 3.80 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | 0.03 |
| | Sulfate Sulfur (HCl leach) (%) | 0.02 | 0.03 | 0.02 | 0.03 | 0.07 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.02 | 0.06 | 0.09 | 0.09 | 0.13 |
| | Total Sulfur (combustion) (%) | 0.02 | 0.06 | 0.09 | 0.09 | 0.16 |
| Total Metals | Aluminum (Al) (%) | 1.10 | 1.44 | 1.18 | 1.11 | 1.06 |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 0.6 | 1.4 | 1.1 | 1.1 | 1.1 |
| | Barium (Ba) (ppm) | 280 | 240 | 200 | 210 | 220 |
| | Beryllium (Be) (ppm) | 0.24 | 0.33 | 0.26 | 0.23 | 0.23 |
| | Bismuth (Bi) (ppm) | 0.05 | 0.54 | 0.22 | 0.59 | 0.29 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.04 | 0.22 | 0.23 | 0.28 | 0.38 |
| | Calcium (Ca) (%) | 0.83 | 1.23 | 1.04 | 0.84 | 0.90 |
| | Cerium (Ce) (ppm) | 19.70 | 23.0 | 19.95 | 17.30 | 19.75 |
| | Cesium (Cs) (ppm) | 0.43 | 0.50 | 0.45 | 0.44 | 0.46 |
| | Chromium (Cr) (ppm) | 4 | 6 | 5 | 6 | 5 |
| | Cobalt (Co) (ppm) | 6.1 | 7.4 | 7.7 | 7.9 | 8.2 |
| | Copper (Cu) (ppm) | 401 | 2080 | 1830 | 2850 | 2910 |
| | Gallium (Ga) (ppm) | 5.22 | 8.20 | 7.55 | 8.02 | 7.08 |
| | Germanium (Ge) (ppm) | 0.13 | 0.14 | 0.13 | 0.13 | 0.14 |
| | Gold (Au) (ppm) | <0.02 | 0.20 | 0.11 | 0.18 | 0.15 |
| | Hafnium (Hf) (ppm) | 0.06 | 0.05 | 0.04 | 0.04 | 0.04 |
| | Indium (In) (ppm) | 0.022 | 0.111 | 0.080 | 0.095 | 0.080 |
| | Iron (Fe) (%) | 2.34 | 3.37 | 4.00 | 4.26 | 3.97 |
| | Lanthanum (La) (ppm) | 10.4 | 11.8 | 10.4 | 9.1 | 10.5 |
| | Lead (Pb) (ppm) | 1.5 | 2.4 | 2.2 | 2.7 | 2.4 |
| | Lithium (Li) (ppm) | 5.3 | 7.4 | 5.7 | 5.4 | 5.1 |
| | Magnesium (Mg) (%) | 0.67 | 0.75 | 0.66 | 0.61 | 0.59 |
| | Manganese (Mn) (ppm) | 616 | 566 | 590 | 617 | 602 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1946295-11 WASTE 18-MAY-17 140921 | L1946295-12 WASTE 24-MAY-17 140924 | L1946295-13 WASTE 24-MAY-17 140923 | L1946295-14 WASTE 24-MAY-17 140922 | L1946295-15 WASTE 25-MAY-17 140925 |
|---|---|---|---|---|---|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.5 | 8.8 | 8.6 | 8.6 | 8.3 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.29 | 0.34 | 0.38 | 0.39 | 0.31 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 0.6 | 1.3 | 13.8 | 4.4 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 27 | 32 | 34 | 32 | 31 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 26 | 31 | 20 | 28 | 30 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 43.20 | 25.60 | 2.47 | 7.31 | 49.60 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | <0.01 | 0.02 | 0.02 | 0.01 | 0.02 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | 0.01 | 0.04 | 0.44 | 0.14 | 0.02 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.02 | 0.04 | 0.44 | 0.14 | 0.02 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 0.77 | 1.15 | 1.37 | 1.05 | 0.97 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.39 | <0.05 | <0.05 | <0.05 | 0.43 |
| | Arsenic (As) (ppm) | | | | |
| | 5.6 | 0.5 | 0.4 | 0.7 | 5.3 |
| | Barium (Ba) (ppm) | | | | |
| | 240 | 250 | 310 | 240 | 260 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.33 | 0.32 | 0.25 | 0.29 | 0.38 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.08 | 0.03 | 0.11 | 0.04 | 0.12 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.15 | 0.05 | 0.19 | 0.09 | 0.18 |
| | Calcium (Ca) (%) | | | | |
| | 1.30 | 1.35 | 1.36 | 1.33 | 1.44 |
| | Cerium (Ce) (ppm) | | | | |
| | 20.1 | 22.0 | 25.3 | 25.5 | 24.1 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.57 | 0.36 | 0.61 | 0.39 | 0.70 |
| | Chromium (Cr) (ppm) | | | | |
| | 19 | 6 | 6 | 7 | 23 |
| | Cobalt (Co) (ppm) | | | | |
| | 6.9 | 6.7 | 7.1 | 6.8 | 8.1 |
| | Copper (Cu) (ppm) | | | | |
| | 361 | 283 | 4100 | 1170 | 604 |
| | Gallium (Ga) (ppm) | | | | |
| | 3.01 | 6.00 | 6.88 | 5.35 | 3.79 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.10 | 0.12 | 0.14 | 0.11 | 0.11 |
| | Gold (Au) (ppm) | | | | |
| | <0.02 | <0.02 | 0.05 | 0.02 | 0.02 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.22 | 0.04 | 0.04 | 0.05 | 0.25 |
| | Indium (In) (ppm) | | | | |
| | 0.023 | 0.024 | 0.136 | 0.062 | 0.025 |
| | Iron (Fe) (%) | | | | |
| | 1.93 | 2.50 | 2.99 | 2.58 | 2.23 |
| | Lanthanum (La) (ppm) | | | | |
| | 10.4 | 11.8 | 13.1 | 13.5 | 12.4 |
| | Lead (Pb) (ppm) | | | | |
| | 3.7 | 2.6 | 2.7 | 2.4 | 4.3 |
| | Lithium (Li) (ppm) | | | | |
| | 5.3 | 6.6 | 5.7 | 5.0 | 6.8 |
| | Magnesium (Mg) (%) | | | | |
| | 0.39 | 0.69 | 0.80 | 0.67 | 0.51 |
| | Manganese (Mn) (ppm) | | | | |
| | 336 | 561 | 561 | 571 | 412 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1946295-16 WASTE 25-MAY-17 142501 | | | | |
|---|---|-------|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | 8.1 | | | |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.06 | | | |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | | | |
| | MPA (tCaCO3/1Kt) | 0.3 | | | |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 8 | | | |
| | NNP (tCaCO3/1Kt) | 8 | | | |
| | Ratio (NP/MPA) (Unity) | 25.60 | | | |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | | | |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | | | |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.01 | | | |
| | Total Sulfur (combustion) (%) | 0.01 | | | |
| Total Metals | Aluminum (Al) (%) | 1.03 | | | |
| | Antimony (Sb) (ppm) | 0.06 | | | |
| | Arsenic (As) (ppm) | 3.6 | | | |
| | Barium (Ba) (ppm) | 190 | | | |
| | Beryllium (Be) (ppm) | 0.32 | | | |
| | Bismuth (Bi) (ppm) | 0.32 | | | |
| | Boron (B) (ppm) | <10 | | | |
| | Cadmium (Cd) (ppm) | 0.11 | | | |
| | Calcium (Ca) (%) | 0.29 | | | |
| | Cerium (Ce) (ppm) | 27.4 | | | |
| | Cesium (Cs) (ppm) | 0.63 | | | |
| | Chromium (Cr) (ppm) | 8 | | | |
| | Cobalt (Co) (ppm) | 6.5 | | | |
| | Copper (Cu) (ppm) | 7350 | | | |
| | Gallium (Ga) (ppm) | 5.29 | | | |
| | Germanium (Ge) (ppm) | 0.14 | | | |
| | Gold (Au) (ppm) | 0.10 | | | |
| | Hafnium (Hf) (ppm) | 0.10 | | | |
| | Indium (In) (ppm) | 0.086 | | | |
| | Iron (Fe) (%) | 2.65 | | | |
| | Lanthanum (La) (ppm) | 13.3 | | | |
| | Lead (Pb) (ppm) | 3.5 | | | |
| | Lithium (Li) (ppm) | 5.0 | | | |
| | Magnesium (Mg) (%) | 0.47 | | | |
| | Manganese (Mn) (ppm) | 426 | | | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1946295-1 | L1946295-2 | L1946295-3 | L1946295-4 | L1946295-5 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 13-MAY-17 | 14-MAY-17 | 15-MAY-17 | 17-MAY-17 | 21-MAY-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 140911 | 140912 | 140915 | 140917 | 140919 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.02 | 0.01 | 0.02 | 0.01 | 0.04 |
| | Molybdenum (Mo) (ppm) | | 1.37 | 2.65 | 0.99 | 2.57 | 1.76 |
| | Nickel (Ni) (ppm) | | 2.5 | 2.0 | 2.4 | 2.0 | 15.4 |
| | Niobium (Nb) (ppm) | | 1.16 | 0.26 | 0.13 | 0.15 | 0.42 |
| | Phosphorus (P) (ppm) | | 790 | 800 | 660 | 700 | 720 |
| | Potassium (K) (%) | | 0.60 | 0.55 | 0.28 | 0.30 | 0.25 |
| | Rhenium (Re) (ppm) | | <0.001 | 0.010 | <0.001 | 0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | | 38.5 | 29.3 | 18.3 | 16.6 | 16.2 |
| | Scandium (Sc) (ppm) | | 6.7 | 4.4 | 6.2 | 4.7 | 5.6 |
| | Selenium (Se) (ppm) | | 1.5 | 5.5 | 1.3 | 0.8 | 0.9 |
| | Silver (Ag) (ppm) | | 0.72 | 1.59 | 0.49 | 0.29 | 0.38 |
| | Sodium (Na) (%) | | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 |
| | Strontium (Sr) (ppm) | | 16.0 | 75.7 | 39.2 | 55.0 | 48.6 |
| | Sulfur (S) (%) | | 0.01 | 0.55 | 0.02 | 0.04 | 0.03 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.18 | 0.23 | 0.12 | 0.04 | 0.09 |
| | Thallium (Tl) (ppm) | | 0.24 | 0.16 | 0.08 | 0.10 | 0.10 |
| | Thorium (Th) (ppm) | | 6.3 | 2.3 | 2.8 | 4.6 | 2.8 |
| | Tin (Sn) (ppm) | | 0.7 | 1.0 | 0.6 | 0.6 | 0.5 |
| | Titanium (Ti) (%) | | 0.114 | 0.094 | 0.040 | 0.043 | 0.054 |
| | Tungsten (W) (ppm) | | 0.50 | 0.41 | 0.32 | 0.34 | 0.58 |
| | Uranium (U) (ppm) | | 0.31 | 0.27 | 0.23 | 0.28 | 0.48 |
| | Vanadium (V) (ppm) | | 57 | 63 | 50 | 46 | 50 |
| | Yttrium (Y) (ppm) | | 10.90 | 7.32 | 8.93 | 8.42 | 9.69 |
| | Zinc (Zn) (ppm) | | 69 | 86 | 81 | 106 | 69 |
| | Zirconium (Zr) (ppm) | | 3.5 | 0.9 | 1.1 | 1.1 | 5.2 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.4 | 1.9 | 1.0 | 1.1 | 0.8 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1946295-6 WASTE 22-MAY-17 140920 | L1946295-7 WASTE 05-APR-17 APR TAL COMP. 2017 | L1946295-8 WASTE 10-APR-17 APR TAL U/F 2017 | L1946295-9 WASTE 08-MAY-17 MAY TAL U/F 2017 | L1946295-10 WASTE 29-MAY-17 MAY TAL U/F 2017 |
|---|--------------------------|--|---|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 |
| | Molybdenum (Mo) (ppm) | 0.51 | 1.02 | 2.07 | 1.83 | 3.00 |
| | Nickel (Ni) (ppm) | 2.0 | 2.7 | 2.2 | 2.4 | 2.2 |
| | Niobium (Nb) (ppm) | 0.18 | 0.29 | 0.25 | 0.28 | 0.27 |
| | Phosphorus (P) (ppm) | 650 | 1000 | 840 | 740 | 740 |
| | Potassium (K) (%) | 0.69 | 0.62 | 0.57 | 0.55 | 0.57 |
| | Rhenium (Re) (ppm) | <0.001 | 0.001 | 0.003 | 0.002 | 0.003 |
| | Rubidium (Rb) (ppm) | 32.3 | 36.8 | 30.9 | 30.6 | 30.9 |
| | Scandium (Sc) (ppm) | 3.7 | 4.8 | 3.9 | 3.8 | 3.8 |
| | Selenium (Se) (ppm) | 0.5 | 1.6 | 1.4 | 2.3 | 2.1 |
| | Silver (Ag) (ppm) | 0.12 | 0.94 | 0.60 | 1.09 | 0.89 |
| | Sodium (Na) (%) | 0.08 | 0.06 | 0.04 | 0.05 | 0.05 |
| | Strontium (Sr) (ppm) | 46.7 | 111.0 | 81.4 | 83.2 | 72.7 |
| | Sulfur (S) (%) | 0.01 | 0.07 | 0.09 | 0.11 | 0.17 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.02 | 0.36 | 0.21 | 0.34 | 0.27 |
| | Thallium (Tl) (ppm) | 0.16 | 0.19 | 0.17 | 0.18 | 0.16 |
| | Thorium (Th) (ppm) | 2.1 | 5.2 | 3.8 | 3.8 | 2.9 |
| | Tin (Sn) (ppm) | 0.5 | 0.9 | 0.8 | 0.8 | 0.8 |
| | Titanium (Ti) (%) | 0.128 | 0.111 | 0.105 | 0.102 | 0.108 |
| | Tungsten (W) (ppm) | 0.60 | 0.06 | 0.06 | 0.07 | 0.08 |
| | Uranium (U) (ppm) | 0.27 | 0.40 | 0.32 | 0.33 | 0.35 |
| | Vanadium (V) (ppm) | 51 | 67 | 68 | 69 | 71 |
| | Yttrium (Y) (ppm) | 8.49 | 8.77 | 6.95 | 6.26 | 7.00 |
| | Zinc (Zn) (ppm) | 67 | 101 | 94 | 98 | 102 |
| | Zirconium (Zr) (ppm) | 0.8 | 1.1 | 0.9 | 1.0 | 0.9 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.4 | 0.9 | 0.7 | 0.7 | 0.8 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1946295-11 WASTE 18-MAY-17 140921 | L1946295-12 WASTE 24-MAY-17 140924 | L1946295-13 WASTE 24-MAY-17 140923 | L1946295-14 WASTE 24-MAY-17 140922 | L1946295-15 WASTE 25-MAY-17 140925 |
|------------------------|--------------------------|---|---|---|---|---|---|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.03 | 0.01 | 0.01 | <0.01 | 0.05 | |
| | Molybdenum (Mo) (ppm) | 0.88 | 0.53 | 3.15 | 1.91 | 0.86 | |
| | Nickel (Ni) (ppm) | 14.1 | 2.6 | 2.4 | 3.0 | 16.3 | |
| | Niobium (Nb) (ppm) | 0.50 | 0.17 | 0.36 | 0.15 | 0.69 | |
| | Phosphorus (P) (ppm) | 660 | 630 | 1120 | 750 | 780 | |
| | Potassium (K) (%) | 0.14 | 0.49 | 0.87 | 0.48 | 0.20 | |
| | Rhenium (Re) (ppm) | 0.001 | 0.001 | 0.012 | 0.007 | 0.001 | |
| | Rubidium (Rb) (ppm) | 9.3 | 24.2 | 44.3 | 22.8 | 13.5 | |
| | Scandium (Sc) (ppm) | 4.3 | 3.4 | 6.2 | 7.8 | 5.3 | |
| | Selenium (Se) (ppm) | 0.7 | 0.5 | 3.6 | 1.1 | 0.5 | |
| | Silver (Ag) (ppm) | 0.16 | 0.10 | 0.83 | 0.24 | 0.20 | |
| | Sodium (Na) (%) | 0.05 | 0.06 | 0.06 | 0.06 | 0.05 | |
| | Strontium (Sr) (ppm) | 60.9 | 69.2 | 47.8 | 69.1 | 66.5 | |
| | Sulfur (S) (%) | 0.02 | 0.04 | 0.49 | 0.17 | 0.02 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.03 | 0.02 | 0.15 | 0.04 | 0.04 | |
| | Thallium (Tl) (ppm) | 0.08 | 0.11 | 0.24 | 0.12 | 0.10 | |
| | Thorium (Th) (ppm) | 2.5 | 2.0 | 2.0 | 2.7 | 2.9 | |
| | Tin (Sn) (ppm) | 0.4 | 0.5 | 1.3 | 0.7 | 0.4 | |
| | Titanium (Ti) (%) | 0.063 | 0.086 | 0.150 | 0.073 | 0.078 | |
| | Tungsten (W) (ppm) | 0.68 | 0.63 | 0.51 | 0.76 | 0.31 | |
| | Uranium (U) (ppm) | 0.45 | 0.40 | 0.34 | 0.31 | 0.51 | |
| | Vanadium (V) (ppm) | 41 | 50 | 72 | 55 | 48 | |
| | Yttrium (Y) (ppm) | 8.17 | 6.72 | 9.15 | 8.89 | 9.30 | |
| | Zinc (Zn) (ppm) | 40 | 67 | 85 | 66 | 52 | |
| | Zirconium (Zr) (ppm) | 7.3 | 0.7 | 0.9 | 0.8 | 8.5 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.1 | 1.3 | 1.4 | 1.4 | 1.2 | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | Sample ID Description Sampled Date Sampled Time Client ID | L1946295-16 WASTE 25-MAY-17 142501 | | | | |
|------------------------|--------------------------|---|---|--|--|--|--|
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.01 | | | | |
| | Molybdenum (Mo) (ppm) | | 1.78 | | | | |
| | Nickel (Ni) (ppm) | | 3.6 | | | | |
| | Niobium (Nb) (ppm) | | 1.01 | | | | |
| | Phosphorus (P) (ppm) | | 840 | | | | |
| | Potassium (K) (%) | | 0.55 | | | | |
| | Rhenium (Re) (ppm) | | <0.001 | | | | |
| | Rubidium (Rb) (ppm) | | 36.8 | | | | |
| | Scandium (Sc) (ppm) | | 6.6 | | | | |
| | Selenium (Se) (ppm) | | 1.4 | | | | |
| | Silver (Ag) (ppm) | | 0.56 | | | | |
| | Sodium (Na) (%) | | 0.04 | | | | |
| | Strontium (Sr) (ppm) | | 20.5 | | | | |
| | Sulfur (S) (%) | | 0.01 | | | | |
| | Tantalum (Ta) (ppm) | | <0.01 | | | | |
| | Tellurium (Te) (ppm) | | 0.15 | | | | |
| | Thallium (Tl) (ppm) | | 0.25 | | | | |
| | Thorium (Th) (ppm) | | 5.6 | | | | |
| | Tin (Sn) (ppm) | | 0.7 | | | | |
| | Titanium (Ti) (%) | | 0.108 | | | | |
| | Tungsten (W) (ppm) | | 0.54 | | | | |
| | Uranium (U) (ppm) | | 0.32 | | | | |
| | Vanadium (V) (ppm) | | 61 | | | | |
| | Yttrium (Y) (ppm) | | 10.70 | | | | |
| | Zinc (Zn) (ppm) | | 73 | | | | |
| | Zirconium (Zr) (ppm) | | 3.0 | | | | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.2 | | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|-----------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| <p>A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.</p> | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06-AX | Soil | Sulfide Sulfur Calc from Carbonate Leach | ALS Minerals S-CAL06 |
| <p>Sulfide Sulfur (as S) is calculated by subtracting the Carbonate Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.</p> | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| <p>A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| <p>A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| <p>The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-19

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



L1946295-COFC

DC Number: 17-19

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Canada Toll Free: 1 800 668 9878

www.alsglobal.com

| | | | | | | | | | | | | |
|---|--|--|--|-------|--|------------------|-----------|------------------------------|--|-------------|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all EAP TATs with your AM - surcharges will apply | | | | | | | |
| Company: Minto Explorations Ltd | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular (R) <input checked="" type="checkbox"/> Standard TAT received by 3 pm business days - no surcharges apply | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | Priority (Business Days) | | EMERGENCY | | 1 Business day (E1) <input type="checkbox"/> | | | |
| Phone: 1-804-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | 4 day (P4) <input type="checkbox"/> | | | | 3 day (P3) <input type="checkbox"/> | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | 3 day (P2) <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday (E0) <input type="checkbox"/> | | | |
| Street: 2100-510 West Georgia St | | Email 1 or Fax: minto_environment@mintomine.com | | | Date and Time Required for all EAP TATs: dd-mmm-yy hh mm | | | | | | | |
| City/Province: Vancouver British Columbia | | Email 2: | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3: | | | Analysis Request | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | Indicate Filtered (F) Preserved (P) or Filtered and Preserved (FP) below | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | |
| Company: Minto Explorations Ltd | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2: | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | |
| ALS Account # / Quote # | | AFF Cost Center | | | | | | | | | | |
| Job # | | Major Asset Code | | | | | | | | | | |
| PO A/E: TRD | | Requestioner | | | | | | | | | | |
| LSD | | Location | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | | | | | | | | | |
| | | Sampler: | | | | | | | | | | |
| ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date | | Time | | Sample Type | | | |
| | | | | | | | | | | | | |
| 140911 | | | | | 13-MAY-17 | | | | Composite | | | |
| 140912 | | | | | 14-MAY-17 | | | | WASTE | | | |
| 140915 | | | | | 15-MAY-17 | | | | WASTE | | | |
| 140917 | | | | | 17-MAY-17 | | | | WASTE | | | |
| 140919 | | | | | 21-MAY-17 | | | | WASTE | | | |
| 140920 | | | | | 22-MAY-17 | | | | WASTE | | | |
| APR TAL COMP. 2017 | | | | | 05-APR-17 | | | | TAILS | | | |
| APR TAL U/F. 2017 | | | | | 10-APR-17 | | | | TAILS | | | |
| MAY TAL U/F. 2017 | | | | | 08-MAY-17 | | | | TAILS | | | |
| MAY TAL U/F. 2017 | | | | | 29-MAY-17 | | | | TAILS | | | |
| MAY 140921 | | | | | 18-MAY-17 | | | | WASTE | | | |
| Drinking Water (DW) Samples (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | |
| | | | | | Cooling Initiator <input type="checkbox"/> | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | FINAL COOLER TEMPERATURES °C | | | | |
| | | | | | 18.0 | | | 20 | | | | |
| SHIPPING RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | |
| Released by: KALA JDE | | Date: JUN 17 2017 | | Time: | | Received by: EHF | | Date: 20 JUN 2017 | | Time: 16:29 | | |
| | | | | | | | | JC | | 6/21/17 2pm | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION. WHITE - LABORATORY COPY YELLOW - CLIENT COPY. If any water samples are taken from a regulated Drinking Water (DW) System, please submit using an authorized DW SDC form.



Chain of Custody (COC) / Analytical Request Form



L1946295-COFC

XC Number: 17-19

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| Report To Contact and company name below will appear on the final report Company Minto Explorations Ltd Contact Minto Environment - Coordinator Phone 1-604-759-4658 Company address below will appear on the final report Street 2100-510 West Georgia St City/Province Vancouver British Columbia Postal Code V6B 0M3 | | Report Format / Distribution Select Report Format <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report (provide details below if box checked) Select Distribution <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax minto_environment@mintomine.com Email 2 Email 3 | | Select Service Level Below (Please confirm all ESP TATs with your AEM - surcharges will apply) Regular (R) <input checked="" type="checkbox"/> Standard TAT received by 3 pm business days - no surcharges apply Emergency 4 day (P4) <input type="checkbox"/> 3 day (P3) <input type="checkbox"/> 2 day (P2) <input type="checkbox"/> 1 Business day (E1) <input type="checkbox"/> Same Day, Weekend or Statutory holiday (E0) <input type="checkbox"/> Date and Time Required for all ESP TATs: dd-mmm-yy hh:mm For tests that can not be performed according to the service level selected, you will be contacted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|---|----------------------------|--|-------------------------|------------------------------------|--|----------------------|--|--|--|--|--|----------------------|--------------|-----------------------|----------------------------|--|-------------------------|--|--|------------|---|---|---|---|---|---|---|--|-------|---|---|---|---|---|---|---|--|-------|---|---|---|---|---|---|---|--|-------|---|---|---|---|---|---|---|--|-------|---|---|---|---|---|---|---|--|-------|---|---|---|---|---|---|---|--|
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Company Minto Explorations Ltd Contact Ruth Cayetano | | Invoice Distribution Select Invoice Distribution <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax ap@mintomine.com Email 2 | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F+P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information ALS Account # / Quote # Job # PO / AFE TBD LSD | | Oil and Gas Required Fields (client use) AFE Cost Center PO# Requisitioner Location ALS Contact: Sampler: | | <table border="1"> <thead> <tr> <th rowspan="2">Total Metals (As per request) (CP)</th> <th colspan="7">Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F+P) below</th> <th rowspan="2">Number of Containers</th> </tr> <tr> <th>Aspirate Dil</th> <th>% Inorganic Carbonate</th> <th>Total Carbon/Sulphur (LCO)</th> <th>AP determination by % sulphate sulphur</th> <th>Modified NP (MEND 1991)</th> <th></th> <th></th> </tr> </thead> <tbody> <tr> <td>Composites</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> </tbody> </table> | | Total Metals (As per request) (CP) | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F+P) below | | | | | | | Number of Containers | Aspirate Dil | % Inorganic Carbonate | Total Carbon/Sulphur (LCO) | AP determination by % sulphate sulphur | Modified NP (MEND 1991) | | | Composites | R | R | R | R | R | R | R | | WASTE | X | X | X | X | X | X | X | | WASTE | X | X | X | X | X | X | X | | WASTE | X | X | X | X | X | X | X | | WASTE | X | X | X | X | X | X | X | | WASTE | X | X | X | X | X | X | X | |
| Total Metals (As per request) (CP) | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F+P) below | | | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Aspirate Dil | % Inorganic Carbonate | Total Carbon/Sulphur (LCO) | AP determination by % sulphate sulphur | Modified NP (MEND 1991) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Composites | R | R | R | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WASTE | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WASTE | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WASTE | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WASTE | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WASTE | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on the report) Date Time Sample Type 24-MAY-17 WASTE 24-MAY-17 WASTE 24-MAY-17 WASTE 25-MAY-17 WASTE 25-MAY-17 WASTE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples (client use) Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) Frozer <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input type="checkbox"/> INITIAL COOLER TEMPERATURES °C: 18.0 FINAL COOLER TEMPERATURES °C: 20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) Released by: _____ Date: _____ Time: _____ | | INITIAL SHIPMENT RECEPTION (lab use only) Received by: EHF Date: 20/20/2017 Time: 12:20 | | FINAL SHIPMENT RECEPTION (lab use only) Received by: JC Date: 6/21/17 Time: 2pm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 White - LABORATORY COPY Yellow - CLIENT COPY
 Please note that completion of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as set out on the back page of the white report copy.
 Only water samples are taken from a Regulated Drinking Water (DW) System, please submit using an authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 21-JUN-17
Report Date: 04-AUG-17 17:10 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1946299
Project P.O. #: PO#226298
Job Reference:
C of C Numbers: 17-20
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1946299-1 WASTE 26-MAY-17 142503 | L1946299-2 WASTE 27-MAY-17 142502 | L1946299-3 WASTE 29-MAY-17 142505 | L1946299-4 WASTE 29-MAY-17 142507 | L1946299-5 WASTE 29-MAY-17 142504 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.6 | 8.4 | 8.4 | 8.5 | 8.2 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.24 | 0.38 | 0.21 | 0.65 | <0.05 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 2 | 2 | 2 | 1 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 1.6 | <0.3 | 0.6 | 4.7 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 28 | 36 | 24 | 48 | 8 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 26 | 36 | 23 | 43 | 8 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 17.92 | 230.40 | 38.40 | 10.24 | 25.60 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | <0.01 | 0.01 | <0.01 | <0.01 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | <0.01 | 0.01 | 0.02 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | 0.05 | <0.01 | 0.02 | 0.15 | <0.01 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.05 | <0.01 | 0.02 | 0.15 | 0.01 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.15 | 0.76 | 0.92 | 1.30 | 0.96 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.05 | 0.05 | 0.34 | <0.05 | 0.10 |
| | Arsenic (As) (ppm) | | | | |
| | 0.7 | 7.4 | 5.3 | 0.2 | 4.7 |
| | Barium (Ba) (ppm) | | | | |
| | 210 | 150 | 250 | 280 | 280 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.32 | 0.42 | 0.38 | 0.34 | 0.36 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.23 | 0.11 | 0.08 | 0.08 | 0.11 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | 10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.14 | 0.19 | 0.21 | 0.14 | 0.36 |
| | Calcium (Ca) (%) | | | | |
| | 1.07 | 1.39 | 1.04 | 1.79 | 0.40 |
| | Cerium (Ce) (ppm) | | | | |
| | 20.6 | 26.4 | 26.4 | 21.7 | 23.8 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.37 | 0.56 | 0.58 | 0.42 | 0.52 |
| | Chromium (Cr) (ppm) | | | | |
| | 6 | 5 | 17 | 6 | 8 |
| | Cobalt (Co) (ppm) | | | | |
| | 6.4 | 6.0 | 6.9 | 7.9 | 6.8 |
| | Copper (Cu) (ppm) | | | | |
| | 1470 | 482 | 392 | 1210 | 1240 |
| | Gallium (Ga) (ppm) | | | | |
| | 6.40 | 4.87 | 4.09 | 8.25 | 5.56 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.08 | 0.06 | 0.06 | 0.07 | 0.07 |
| | Gold (Au) (ppm) | | | | |
| | <0.02 | <0.02 | <0.02 | 0.02 | 0.02 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.05 | 0.05 | 0.18 | 0.04 | 0.09 |
| | Indium (In) (ppm) | | | | |
| | 0.036 | 0.035 | 0.024 | 0.067 | 0.035 |
| | Iron (Fe) (%) | | | | |
| | 2.38 | 2.18 | 2.01 | 3.91 | 2.47 |
| | Lanthanum (La) (ppm) | | | | |
| | 11.1 | 14.0 | 13.9 | 11.0 | 14.8 |
| | Lead (Pb) (ppm) | | | | |
| | 4.7 | 4.1 | 4.1 | 3.0 | 3.6 |
| | Lithium (Li) (ppm) | | | | |
| | 7.2 | 5.1 | 6.8 | 7.3 | 5.1 |
| | Magnesium (Mg) (%) | | | | |
| | 0.62 | 0.31 | 0.41 | 0.72 | 0.30 |
| | Manganese (Mn) (ppm) | | | | |
| | 607 | 573 | 413 | 678 | 541 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1946299-6 WASTE 29-MAY-17 142508 | L1946299-7 WASTE 31-MAY-17 142509 | L1946299-8 WASTE 29-MAY-17 142506 | L1946299-9 WASTE 30-MAY-17 142510 | L1946299-10 WASTE 02-JUN-17 142513 |
|-------------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.5 | 8.8 | 8.7 | 8.5 | 8.6 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.36 | 0.24 | 0.42 | 0.21 | 0.47 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.9 | 0.6 | 2.2 | 0.3 | 2.5 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 36 | 29 | 35 | 24 | 40 |
| | NNP (tCaCO3/1Kt) | 35 | 28 | 33 | 24 | 38 |
| | Ratio (NP/MPA) (Unity) | 38.40 | 46.40 | 16.00 | 76.80 | 16.00 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | 0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.02 | <0.01 | 0.06 | <0.01 | 0.07 |
| | Total Sulfur (combustion) (%) | 0.03 | 0.02 | 0.07 | 0.01 | 0.08 |
| Total Metals | Aluminum (Al) (%) | 0.78 | 1.25 | 1.13 | 0.74 | 1.18 |
| | Antimony (Sb) (ppm) | 0.09 | <0.05 | <0.05 | 0.08 | <0.05 |
| | Arsenic (As) (ppm) | 3.8 | 0.8 | 0.5 | 6.4 | 0.6 |
| | Barium (Ba) (ppm) | 230 | 210 | 250 | 310 | 120 |
| | Beryllium (Be) (ppm) | 0.47 | 0.38 | 0.29 | 0.51 | 0.37 |
| | Bismuth (Bi) (ppm) | 0.12 | 0.03 | 0.08 | 0.04 | 0.06 |
| | Boron (B) (ppm) | <10 | <10 | <10 | 10 | <10 |
| | Cadmium (Cd) (ppm) | 0.17 | 0.05 | 0.10 | 0.20 | 0.13 |
| | Calcium (Ca) (%) | 1.41 | 1.20 | 1.31 | 0.96 | 1.37 |
| | Cerium (Ce) (ppm) | 29.8 | 28.0 | 27.3 | 31.4 | 23.5 |
| | Cesium (Cs) (ppm) | 0.55 | 0.32 | 0.39 | 0.70 | 0.44 |
| | Chromium (Cr) (ppm) | 4 | 6 | 6 | 5 | 6 |
| | Cobalt (Co) (ppm) | 7.1 | 6.7 | 6.6 | 7.5 | 6.7 |
| | Copper (Cu) (ppm) | 1900 | 199.0 | 956 | 589 | 995 |
| | Gallium (Ga) (ppm) | 4.83 | 6.63 | 5.94 | 4.88 | 6.97 |
| | Germanium (Ge) (ppm) | 0.06 | 0.08 | 0.07 | 0.07 | 0.07 |
| | Gold (Au) (ppm) | 0.05 | <0.02 | <0.02 | <0.02 | 0.02 |
| | Hafnium (Hf) (ppm) | 0.05 | 0.06 | 0.05 | 0.05 | 0.05 |
| | Indium (In) (ppm) | 0.085 | 0.031 | 0.043 | 0.045 | 0.041 |
| | Iron (Fe) (%) | 2.53 | 2.32 | 2.41 | 2.51 | 2.60 |
| | Lanthanum (La) (ppm) | 15.0 | 14.7 | 14.8 | 16.7 | 12.2 |
| | Lead (Pb) (ppm) | 4.2 | 3.1 | 3.3 | 4.7 | 4.4 |
| | Lithium (Li) (ppm) | 3.4 | 7.7 | 5.7 | 3.5 | 7.2 |
| | Magnesium (Mg) (%) | 0.26 | 0.66 | 0.58 | 0.17 | 0.72 |
| | Manganese (Mn) (ppm) | 590 | 561 | 534 | 1010 | 610 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1946299-11 WASTE 02-JUN-17 142511 | L1946299-12 WASTE 02-JUN-17 142512 | L1946299-13 WASTE 04-JUN-17 142514 | L1946299-14 WASTE 06-JUN-17 142517 | L1946299-15 WASTE 06-JUN-17 142516 |
|---|---|---|---|---|---|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.2 | 8.2 | 8.7 | 8.9 | 8.9 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | <0.05 | 0.08 | 0.37 | 0.22 | 0.34 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 1 | 1 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 0.3 | 0.3 | 3.1 | 3.8 | 1.9 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 10 | 7 | 36 | 25 | 30 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 10 | 7 | 33 | 21 | 28 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 32.00 | 22.40 | 11.52 | 6.67 | 16.00 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | 0.01 | 0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | 0.01 | 0.01 | <0.01 | <0.01 | 0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | <0.01 | <0.01 | 0.10 | 0.12 | 0.06 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.01 | 0.01 | 0.10 | 0.12 | 0.06 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.21 | 1.08 | 1.08 | 1.04 | 1.10 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.06 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 2.2 | 2.0 | 0.6 | 0.1 | 0.2 |
| | Barium (Ba) (ppm) | | | | |
| | 330 | 170 | 180 | 160 | 260 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.36 | 0.30 | 0.37 | 0.29 | 0.31 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.08 | 0.71 | 0.21 | 0.48 | 0.21 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.30 | 0.42 | 0.09 | 0.15 | 0.19 |
| | Calcium (Ca) (%) | | | | |
| | 0.41 | 0.23 | 1.36 | 0.97 | 1.07 |
| | Cerium (Ce) (ppm) | | | | |
| | 33.1 | 21.1 | 23.4 | 19.25 | 27.8 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.44 | 0.54 | 0.30 | 0.30 | 0.49 |
| | Chromium (Cr) (ppm) | | | | |
| | 7 | 6 | 5 | 5 | 5 |
| | Cobalt (Co) (ppm) | | | | |
| | 7.7 | 6.1 | 6.1 | 5.1 | 6.3 |
| | Copper (Cu) (ppm) | | | | |
| | 3310 | >10000 | 1060 | 2100 | 979 |
| | Gallium (Ga) (ppm) | | | | |
| | 6.62 | 5.84 | 6.33 | 6.16 | 5.74 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.08 | 0.06 | 0.07 | 0.05 | 0.06 |
| | Gold (Au) (ppm) | | | | |
| | 0.03 | 0.15 | 0.02 | 0.08 | 0.03 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.11 | 0.11 | 0.04 | 0.04 | 0.05 |
| | Indium (In) (ppm) | | | | |
| | 0.070 | 0.175 | 0.041 | 0.043 | 0.033 |
| | Iron (Fe) (%) | | | | |
| | 2.74 | 2.59 | 2.40 | 2.15 | 2.31 |
| | Lanthanum (La) (ppm) | | | | |
| | 18.0 | 10.6 | 12.7 | 10.5 | 15.3 |
| | Lead (Pb) (ppm) | | | | |
| | 3.3 | 4.9 | 3.4 | 4.2 | 2.7 |
| | Lithium (Li) (ppm) | | | | |
| | 6.2 | 4.7 | 6.5 | 6.2 | 5.7 |
| | Magnesium (Mg) (%) | | | | |
| | 0.44 | 0.37 | 0.61 | 0.48 | 0.65 |
| | Manganese (Mn) (ppm) | | | | |
| | 487 | 394 | 502 | 549 | 573 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1946299-16 WASTE 06-JUN-17 142515 | | | | |
|---|---|-------|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | 8.3 | | | |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.14 | | | |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | | | |
| | MPA (tCaCO3/1Kt) | 0.3 | | | |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 18 | | | |
| | NNP (tCaCO3/1Kt) | 18 | | | |
| | Ratio (NP/MPA) (Unity) | 57.60 | | | |
| | Sulfate Sulfur (carbonate leach) (%) | 0.02 | | | |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | | | |
| | Sulfide Sulfur (T minus carbonate leach) (%) | <0.01 | | | |
| | Total Sulfur (combustion) (%) | 0.01 | | | |
| Total Metals | Aluminum (Al) (%) | 1.11 | | | |
| | Antimony (Sb) (ppm) | 0.21 | | | |
| | Arsenic (As) (ppm) | 3.6 | | | |
| | Barium (Ba) (ppm) | 240 | | | |
| | Beryllium (Be) (ppm) | 0.30 | | | |
| | Bismuth (Bi) (ppm) | 0.13 | | | |
| | Boron (B) (ppm) | <10 | | | |
| | Cadmium (Cd) (ppm) | 0.17 | | | |
| | Calcium (Ca) (%) | 0.76 | | | |
| | Cerium (Ce) (ppm) | 36.1 | | | |
| | Cesium (Cs) (ppm) | 0.59 | | | |
| | Chromium (Cr) (ppm) | 12 | | | |
| | Cobalt (Co) (ppm) | 7.0 | | | |
| | Copper (Cu) (ppm) | 2610 | | | |
| | Gallium (Ga) (ppm) | 5.33 | | | |
| | Germanium (Ge) (ppm) | 0.07 | | | |
| | Gold (Au) (ppm) | 0.04 | | | |
| | Hafnium (Hf) (ppm) | 0.15 | | | |
| | Indium (In) (ppm) | 0.084 | | | |
| | Iron (Fe) (%) | 2.25 | | | |
| | Lanthanum (La) (ppm) | 19.6 | | | |
| | Lead (Pb) (ppm) | 4.6 | | | |
| | Lithium (Li) (ppm) | 6.7 | | | |
| | Magnesium (Mg) (%) | 0.46 | | | |
| | Manganese (Mn) (ppm) | 508 | | | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1946299-1 WASTE 26-MAY-17 142503 | L1946299-2 WASTE 27-MAY-17 142502 | L1946299-3 WASTE 29-MAY-17 142505 | L1946299-4 WASTE 29-MAY-17 142507 | L1946299-5 WASTE 29-MAY-17 142504 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | 0.01 | 0.02 | <0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | 1.11 | 0.66 | 1.33 | 1.00 | 1.17 |
| | Nickel (Ni) (ppm) | 4.8 | 4.2 | 13.5 | 2.8 | 5.0 |
| | Niobium (Nb) (ppm) | 0.16 | 0.05 | 0.27 | 0.16 | 0.13 |
| | Phosphorus (P) (ppm) | 620 | 550 | 690 | 800 | 670 |
| | Potassium (K) (%) | 0.42 | 0.20 | 0.21 | 0.53 | 0.36 |
| | Rhenium (Re) (ppm) | 0.002 | <0.001 | 0.001 | 0.003 | <0.001 |
| | Rubidium (Rb) (ppm) | 21.8 | 12.3 | 12.4 | 28.2 | 24.6 |
| | Scandium (Sc) (ppm) | 3.5 | 5.0 | 5.0 | 5.3 | 5.3 |
| | Selenium (Se) (ppm) | 1.4 | 0.5 | 0.6 | 1.2 | 0.8 |
| | Silver (Ag) (ppm) | 0.59 | 0.11 | 0.10 | 0.32 | 0.35 |
| | Sodium (Na) (%) | 0.07 | 0.05 | 0.05 | 0.06 | 0.05 |
| | Strontium (Sr) (ppm) | 53.9 | 56.1 | 51.2 | 75.1 | 35.2 |
| | Sulfur (S) (%) | 0.07 | 0.01 | 0.03 | 0.17 | 0.02 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.10 | 0.05 | 0.02 | 0.05 | 0.05 |
| | Thallium (Tl) (ppm) | 0.11 | 0.06 | 0.08 | 0.15 | 0.11 |
| | Thorium (Th) (ppm) | 2.0 | 2.5 | 3.1 | 1.6 | 2.5 |
| | Tin (Sn) (ppm) | 0.5 | 0.6 | 0.5 | 1.0 | 0.7 |
| | Titanium (Ti) (%) | 0.082 | 0.024 | 0.065 | 0.097 | 0.060 |
| | Tungsten (W) (ppm) | 0.64 | 0.20 | 0.55 | 0.65 | 0.33 |
| | Uranium (U) (ppm) | 0.24 | 0.20 | 0.43 | 0.23 | 0.26 |
| | Vanadium (V) (ppm) | 46 | 41 | 43 | 78 | 54 |
| | Yttrium (Y) (ppm) | 7.42 | 7.73 | 8.29 | 7.97 | 9.63 |
| | Zinc (Zn) (ppm) | 77 | 68 | 53 | 76 | 86 |
| | Zirconium (Zr) (ppm) | 1.0 | 1.0 | 5.5 | 1.1 | 2.3 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.9 | 1.4 | 0.8 | 2.4 | 0.2 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1946299-6 WASTE 29-MAY-17 142508 | L1946299-7 WASTE 31-MAY-17 142509 | L1946299-8 WASTE 29-MAY-17 142506 | L1946299-9 WASTE 30-MAY-17 142510 | L1946299-10 WASTE 02-JUN-17 142513 |
|---|--------------------------|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | <0.01 | 0.01 | 0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | 1.13 | 0.51 | 1.16 | 0.98 | 2.14 |
| | Nickel (Ni) (ppm) | 2.3 | 4.4 | 2.3 | 4.2 | 2.8 |
| | Niobium (Nb) (ppm) | 0.11 | 0.11 | 0.15 | 0.05 | 0.12 |
| | Phosphorus (P) (ppm) | 860 | 690 | 700 | 600 | 680 |
| | Potassium (K) (%) | 0.28 | 0.34 | 0.46 | 0.28 | 0.29 |
| | Rhenium (Re) (ppm) | 0.001 | 0.001 | 0.002 | <0.001 | 0.003 |
| | Rubidium (Rb) (ppm) | 15.9 | 16.3 | 24.5 | 21.9 | 17.8 |
| | Scandium (Sc) (ppm) | 5.4 | 4.6 | 5.1 | 6.9 | 5.0 |
| | Selenium (Se) (ppm) | 1.1 | 0.5 | 0.9 | 0.5 | 0.8 |
| | Silver (Ag) (ppm) | 0.41 | 0.07 | 0.33 | 0.33 | 0.30 |
| | Sodium (Na) (%) | 0.05 | 0.09 | 0.07 | 0.05 | 0.06 |
| | Strontium (Sr) (ppm) | 59.5 | 73.0 | 79.1 | 34.2 | 117.5 |
| | Sulfur (S) (%) | 0.04 | 0.04 | 0.09 | 0.02 | 0.10 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.07 | 0.01 | 0.07 | 0.02 | 0.04 |
| | Thallium (Tl) (ppm) | 0.08 | 0.08 | 0.12 | 0.08 | 0.12 |
| | Thorium (Th) (ppm) | 3.7 | 2.7 | 3.2 | 3.5 | 3.6 |
| | Tin (Sn) (ppm) | 1.1 | 0.6 | 0.8 | 0.7 | 0.8 |
| | Titanium (Ti) (%) | 0.041 | 0.069 | 0.078 | 0.034 | 0.044 |
| | Tungsten (W) (ppm) | 0.18 | 0.98 | 0.28 | 0.15 | 0.38 |
| | Uranium (U) (ppm) | 0.32 | 0.42 | 0.32 | 0.23 | 0.31 |
| | Vanadium (V) (ppm) | 62 | 47 | 51 | 53 | 48 |
| | Yttrium (Y) (ppm) | 12.45 | 7.91 | 7.90 | 7.72 | 8.82 |
| | Zinc (Zn) (ppm) | 70 | 65 | 69 | 81 | 79 |
| | Zirconium (Zr) (ppm) | 1.4 | 1.1 | 1.1 | 1.7 | 1.3 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.3 | 0.9 | 1.6 | 0.8 | 1.7 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1946299-11 | L1946299-12 | L1946299-13 | L1946299-14 | L1946299-15 |
|------------------------|--------------------------|--------------|-------------|-------------|-------------|-------------|-------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 02-JUN-17 | 02-JUN-17 | 04-JUN-17 | 06-JUN-17 | 06-JUN-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 142511 | 142512 | 142514 | 142517 | 142516 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.02 | 0.02 | <0.01 | 0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | | 1.27 | 6.31 | 1.96 | 2.79 | 0.82 |
| | Nickel (Ni) (ppm) | | 5.1 | 2.6 | 2.4 | 1.9 | 2.4 |
| | Niobium (Nb) (ppm) | | 0.21 | 0.69 | 0.09 | 0.13 | 0.16 |
| | Phosphorus (P) (ppm) | | 820 | 660 | 620 | 520 | 630 |
| | Potassium (K) (%) | | 0.49 | 0.51 | 0.27 | 0.37 | 0.54 |
| | Rhenium (Re) (ppm) | | <0.001 | 0.001 | 0.002 | 0.005 | 0.001 |
| | Rubidium (Rb) (ppm) | | 31.4 | 34.9 | 13.7 | 20.3 | 29.1 |
| | Scandium (Sc) (ppm) | | 6.6 | 6.2 | 3.9 | 2.9 | 4.6 |
| | Selenium (Se) (ppm) | | 0.7 | 2.6 | 1.2 | 2.1 | 1.2 |
| | Silver (Ag) (ppm) | | 0.59 | 3.22 | 0.40 | 0.96 | 0.38 |
| | Sodium (Na) (%) | | 0.05 | 0.04 | 0.06 | 0.07 | 0.08 |
| | Strontium (Sr) (ppm) | | 36.1 | 25.9 | 77.8 | 43.8 | 83.0 |
| | Sulfur (S) (%) | | 0.02 | 0.02 | 0.12 | 0.15 | 0.08 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.03 | 0.18 | 0.06 | 0.20 | 0.04 |
| | Thallium (Tl) (ppm) | | 0.15 | 0.27 | 0.06 | 0.10 | 0.15 |
| | Thorium (Th) (ppm) | | 3.5 | 6.7 | 2.5 | 2.2 | 3.1 |
| | Tin (Sn) (ppm) | | 0.9 | 1.1 | 0.6 | 0.5 | 0.7 |
| | Titanium (Ti) (%) | | 0.090 | 0.099 | 0.042 | 0.058 | 0.096 |
| | Tungsten (W) (ppm) | | 0.47 | 0.19 | 0.22 | 0.34 | 0.48 |
| | Uranium (U) (ppm) | | 0.27 | 0.48 | 0.41 | 0.41 | 0.27 |
| | Vanadium (V) (ppm) | | 62 | 58 | 46 | 38 | 48 |
| | Yttrium (Y) (ppm) | | 9.79 | 8.96 | 6.32 | 4.66 | 8.22 |
| | Zinc (Zn) (ppm) | | 89 | 87 | 60 | 56 | 65 |
| | Zirconium (Zr) (ppm) | | 3.0 | 3.7 | 0.9 | 1.0 | 1.1 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.2 | 0.3 | 1.4 | 0.8 | 1.2 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1946299-16 WASTE 06-JUN-17 142515 | | | |
|------------------------|--|---|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | | | |
| | Molybdenum (Mo) (ppm) | 3.01 | | | |
| | Nickel (Ni) (ppm) | 8.5 | | | |
| | Niobium (Nb) (ppm) | 0.57 | | | |
| | Phosphorus (P) (ppm) | 780 | | | |
| | Potassium (K) (%) | 0.34 | | | |
| | Rhenium (Re) (ppm) | 0.004 | | | |
| | Rubidium (Rb) (ppm) | 22.1 | | | |
| | Scandium (Sc) (ppm) | 5.3 | | | |
| | Selenium (Se) (ppm) | 1.2 | | | |
| | Silver (Ag) (ppm) | 0.26 | | | |
| | Sodium (Na) (%) | 0.05 | | | |
| | Strontium (Sr) (ppm) | 43.7 | | | |
| | Sulfur (S) (%) | 0.02 | | | |
| | Tantalum (Ta) (ppm) | <0.01 | | | |
| | Tellurium (Te) (ppm) | 0.05 | | | |
| | Thallium (Tl) (ppm) | 0.14 | | | |
| | Thorium (Th) (ppm) | 3.7 | | | |
| | Tin (Sn) (ppm) | 0.9 | | | |
| | Titanium (Ti) (%) | 0.080 | | | |
| | Tungsten (W) (ppm) | 0.30 | | | |
| | Uranium (U) (ppm) | 0.41 | | | |
| | Vanadium (V) (ppm) | 54 | | | |
| | Yttrium (Y) (ppm) | 10.15 | | | |
| | Zinc (Zn) (ppm) | 59 | | | |
| | Zirconium (Zr) (ppm) | 4.8 | | | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.5 | | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|-----------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| <p>A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.</p> | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06-AX | Soil | Sulfide Sulfur Calc from Carbonate Leach | ALS Minerals S-CAL06 |
| <p>Sulfide Sulfur (as S) is calculated by subtracting the Carbonate Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.</p> | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| <p>A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| <p>A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| <p>The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-20

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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 Account: APN

CERTIFICATE VA17127938

Project: L1946299

This report is for 16 Other samples submitted to our lab in Vancouver, BC, Canada on 22-JUN-2017.

The following have access to data associated with this certificate:

| | | |
|--------------------------|----------------------------|-------------|
| ELSE VANCOUVER WEBTRIEVE | SOFTWARE DEVELOPMENT GROUP | SHANE STACK |
|--------------------------|----------------------------|-------------|

| SAMPLE PREPARATION | |
|---------------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|------------------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| ME-OG46 | Ore Grade Elements - AquaRegia | ICP-AES |
| Cu-OG46 | Ore Grade Cu - Aqua Regia | ICP-AES |
| OA-VOL08m | Modified NP | |
| S-IRO8 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | WEI-21 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | OA-VOL08m | S-IR08 | S-GRA06 | S-GRA06a | S-CAL06 | C-GAS05 | C-GAS05 | ME-MS41 | ME-MS41 |
|--------------------|--------------------------|-----------------|-------------------|-------------------|-------------------|------------------|-------------|--------------------|--------|---------|----------|---------|---------|----------|-----------|---------|
| | | Recvd Wt. kg | MPA tCaCO3/1Kt | FIZZ RAT Unity | NNP tCaCO3/1Kt | NP tCaCO3/1Kt | pH Unity | Ratio (N) Unity | S % | S % | S % | S % | C % | CO2 % | Ag ppm | Al % |
| L1946299-1 142503 | | 0.02 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 |
| L1946299-2 142502 | | 0.92 | 1.6 | 2 | 26 | 28 | 8.6 | 17.92 | 0.05 | <0.01 | <0.01 | 0.05 | 0.24 | 0.9 | 0.59 | 1.15 |
| L1946299-3 142505 | | 1.10 | <0.3 | 2 | 36 | 36 | 8.4 | 230.40 | <0.01 | 0.01 | 0.01 | <0.01 | 0.38 | 1.4 | 0.11 | 0.76 |
| L1946299-4 142507 | | 1.08 | 0.6 | 2 | 23 | 24 | 8.4 | 38.40 | 0.02 | <0.01 | 0.02 | 0.02 | 0.21 | 0.8 | 0.10 | 0.92 |
| L1946299-5 142504 | | 0.92 | 4.7 | 2 | 43 | 48 | 8.5 | 10.24 | 0.15 | <0.01 | <0.01 | 0.15 | 0.65 | 2.4 | 0.32 | 1.30 |
| L1946299-6 142508 | | 1.08 | 0.3 | 1 | 8 | 8 | 8.2 | 25.60 | 0.01 | 0.01 | <0.01 | <0.01 | <0.05 | 0.2 | 0.35 | 0.96 |
| L1946299-7 142509 | | 1.10 | 0.9 | 2 | 35 | 36 | 8.5 | 38.40 | 0.03 | 0.01 | 0.01 | 0.02 | 0.36 | 1.3 | 0.41 | 0.78 |
| L1946299-8 142506 | | 1.08 | 0.6 | 2 | 28 | 29 | 8.8 | 46.40 | 0.02 | 0.02 | 0.01 | <0.01 | 0.24 | 0.9 | 0.07 | 1.25 |
| L1946299-9 142510 | | 1.12 | 2.2 | 2 | 33 | 35 | 8.7 | 16.00 | 0.07 | 0.01 | <0.01 | 0.06 | 0.42 | 1.6 | 0.33 | 1.13 |
| L1946299-10 142513 | | 1.10 | 0.3 | 2 | 24 | 24 | 8.5 | 76.80 | 0.01 | 0.01 | <0.01 | <0.01 | 0.21 | 0.8 | 0.33 | 0.74 |
| L1946299-11 142511 | | 1.06 | 2.5 | 2 | 38 | 40 | 8.6 | 16.00 | 0.08 | 0.01 | <0.01 | 0.07 | 0.47 | 1.7 | 0.30 | 1.18 |
| L1946299-12 142512 | | 1.08 | 0.3 | 1 | 10 | 10 | 8.2 | 32.00 | 0.01 | 0.01 | 0.01 | <0.01 | <0.05 | 0.2 | 0.59 | 1.21 |
| L1946299-13 142514 | | 0.80 | 0.3 | 1 | 7 | 7 | 8.2 | 22.40 | 0.01 | 0.01 | 0.01 | <0.01 | 0.08 | 0.3 | 3.22 | 1.08 |
| L1946299-14 142517 | | 1.06 | 3.1 | 2 | 33 | 36 | 8.7 | 11.52 | 0.10 | <0.01 | <0.01 | 0.10 | 0.37 | 1.4 | 0.40 | 1.08 |
| L1946299-15 142516 | | 1.06 | 3.8 | 2 | 21 | 25 | 8.9 | 6.67 | 0.12 | <0.01 | <0.01 | 0.12 | 0.22 | 0.8 | 0.96 | 1.04 |
| L1946299-16 142515 | | 1.12 | 1.9 | 2 | 28 | 30 | 8.9 | 16.00 | 0.06 | <0.01 | 0.01 | 0.06 | 0.34 | 1.2 | 0.38 | 1.10 |
| L1946299-16 142515 | | 1.06 | 0.3 | 1 | 18 | 18 | 8.3 | 57.60 | 0.01 | 0.02 | <0.01 | <0.01 | 0.14 | 0.5 | 0.26 | 1.11 |

***** See Appendix Page for comments regarding this certificate *****



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CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga |
| | | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| L1946299-1 142503 | | 0.7 | <0.02 | <10 | 210 | 0.32 | 0.23 | 1.07 | 0.14 | 20.6 | 6.4 | 6 | 0.37 | 1470 | 2.38 | 6.40 |
| L1946299-2 142502 | | 7.4 | <0.02 | <10 | 150 | 0.42 | 0.11 | 1.39 | 0.19 | 26.4 | 6.0 | 5 | 0.56 | 482 | 2.18 | 4.87 |
| L1946299-3 142505 | | 5.3 | <0.02 | <10 | 250 | 0.38 | 0.08 | 1.04 | 0.21 | 26.4 | 6.9 | 17 | 0.58 | 392 | 2.01 | 4.09 |
| L1946299-4 142507 | | 0.2 | 0.02 | <10 | 280 | 0.34 | 0.08 | 1.79 | 0.14 | 21.7 | 7.9 | 6 | 0.42 | 1210 | 3.91 | 8.25 |
| L1946299-5 142504 | | 4.7 | 0.02 | 10 | 280 | 0.36 | 0.11 | 0.40 | 0.36 | 23.8 | 6.8 | 8 | 0.52 | 1240 | 2.47 | 5.56 |
| L1946299-6 142508 | | 3.8 | 0.05 | <10 | 230 | 0.47 | 0.12 | 1.41 | 0.17 | 29.8 | 7.1 | 4 | 0.55 | 1900 | 2.53 | 4.83 |
| L1946299-7 142509 | | 0.8 | <0.02 | <10 | 210 | 0.38 | 0.03 | 1.20 | 0.05 | 28.0 | 6.7 | 6 | 0.32 | 199.0 | 2.32 | 6.63 |
| L1946299-8 142506 | | 0.5 | <0.02 | <10 | 250 | 0.29 | 0.08 | 1.31 | 0.10 | 27.3 | 6.6 | 6 | 0.39 | 956 | 2.41 | 5.94 |
| L1946299-9 142510 | | 6.4 | <0.02 | 10 | 310 | 0.51 | 0.04 | 0.96 | 0.20 | 31.4 | 7.5 | 5 | 0.70 | 589 | 2.51 | 4.88 |
| L1946299-10 142513 | | 0.6 | 0.02 | <10 | 120 | 0.37 | 0.06 | 1.37 | 0.13 | 23.5 | 6.7 | 6 | 0.44 | 995 | 2.60 | 6.97 |
| L1946299-11 142511 | | 2.2 | 0.03 | <10 | 330 | 0.36 | 0.08 | 0.41 | 0.30 | 33.1 | 7.7 | 7 | 0.44 | 3310 | 2.74 | 6.62 |
| L1946299-12 142512 | | 2.0 | 0.15 | <10 | 170 | 0.30 | 0.71 | 0.23 | 0.42 | 21.1 | 6.1 | 6 | 0.54 | >10000 | 2.59 | 5.84 |
| L1946299-13 142514 | | 0.6 | 0.02 | <10 | 180 | 0.37 | 0.21 | 1.36 | 0.09 | 23.4 | 6.1 | 5 | 0.30 | 1060 | 2.40 | 6.33 |
| L1946299-14 142517 | | 0.1 | 0.08 | <10 | 160 | 0.29 | 0.48 | 0.97 | 0.15 | 19.25 | 5.1 | 5 | 0.30 | 2100 | 2.15 | 6.16 |
| L1946299-15 142516 | | 0.2 | 0.03 | <10 | 260 | 0.31 | 0.21 | 1.07 | 0.19 | 27.8 | 6.3 | 5 | 0.49 | 979 | 2.31 | 5.74 |
| L1946299-16 142515 | | 3.6 | 0.04 | <10 | 240 | 0.30 | 0.13 | 0.76 | 0.17 | 36.1 | 7.0 | 12 | 0.59 | 2610 | 2.25 | 5.33 |



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CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 | ME-MS41 Hg ppm 0.01 | ME-MS41 In ppm 0.005 | ME-MS41 K % 0.01 | ME-MS41 La ppm 0.2 | ME-MS41 Li ppm 0.1 | ME-MS41 Mg % 0.01 | ME-MS41 Mn ppm 5 | ME-MS41 Mo ppm 0.05 | ME-MS41 Na % 0.01 | ME-MS41 Nb ppm 0.05 | ME-MS41 Ni ppm 0.2 | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 |
|--------------------|-----------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|---------------------------|-----------------------------|-----------------------------|----------------------------|---------------------------|------------------------------|----------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|
| L1946299-1 142503 | | 0.08 | 0.05 | <0.01 | 0.036 | 0.42 | 11.1 | 7.2 | 0.62 | 607 | 1.11 | 0.07 | 0.16 | 4.8 | 620 | 4.7 |
| L1946299-2 142502 | | 0.06 | 0.05 | 0.01 | 0.035 | 0.20 | 14.0 | 5.1 | 0.31 | 573 | 0.66 | 0.05 | 0.05 | 4.2 | 550 | 4.1 |
| L1946299-3 142505 | | 0.06 | 0.18 | 0.02 | 0.024 | 0.21 | 13.9 | 6.8 | 0.41 | 413 | 1.33 | 0.05 | 0.27 | 13.5 | 690 | 4.1 |
| L1946299-4 142507 | | 0.07 | 0.04 | <0.01 | 0.067 | 0.53 | 11.0 | 7.3 | 0.72 | 678 | 1.00 | 0.06 | 0.16 | 2.8 | 800 | 3.0 |
| L1946299-5 142504 | | 0.07 | 0.09 | 0.01 | 0.035 | 0.36 | 14.8 | 5.1 | 0.30 | 541 | 1.17 | 0.05 | 0.13 | 5.0 | 670 | 3.6 |
| L1946299-6 142508 | | 0.06 | 0.05 | 0.01 | 0.085 | 0.28 | 15.0 | 3.4 | 0.26 | 590 | 1.13 | 0.05 | 0.11 | 2.3 | 860 | 4.2 |
| L1946299-7 142509 | | 0.08 | 0.06 | <0.01 | 0.031 | 0.34 | 14.7 | 7.7 | 0.66 | 561 | 0.51 | 0.09 | 0.11 | 4.4 | 690 | 3.1 |
| L1946299-8 142506 | | 0.07 | 0.05 | 0.01 | 0.043 | 0.46 | 14.8 | 5.7 | 0.58 | 534 | 1.16 | 0.07 | 0.15 | 2.3 | 700 | 3.3 |
| L1946299-9 142510 | | 0.07 | 0.05 | 0.01 | 0.045 | 0.28 | 16.7 | 3.5 | 0.17 | 1010 | 0.98 | 0.05 | 0.05 | 4.2 | 600 | 4.7 |
| L1946299-10 142513 | | 0.07 | 0.05 | <0.01 | 0.041 | 0.29 | 12.2 | 7.2 | 0.72 | 610 | 2.14 | 0.06 | 0.12 | 2.8 | 680 | 4.4 |
| L1946299-11 142511 | | 0.08 | 0.11 | 0.02 | 0.070 | 0.49 | 18.0 | 6.2 | 0.44 | 487 | 1.27 | 0.05 | 0.21 | 5.1 | 820 | 3.3 |
| L1946299-12 142512 | | 0.06 | 0.11 | 0.02 | 0.175 | 0.51 | 10.6 | 4.7 | 0.37 | 394 | 6.31 | 0.04 | 0.69 | 2.6 | 660 | 4.9 |
| L1946299-13 142514 | | 0.07 | 0.04 | <0.01 | 0.041 | 0.27 | 12.7 | 6.5 | 0.61 | 502 | 1.96 | 0.06 | 0.09 | 2.4 | 620 | 3.4 |
| L1946299-14 142517 | | 0.05 | 0.04 | 0.01 | 0.043 | 0.37 | 10.5 | 6.2 | 0.48 | 549 | 2.79 | 0.07 | 0.13 | 1.9 | 520 | 4.2 |
| L1946299-15 142516 | | 0.06 | 0.05 | <0.01 | 0.033 | 0.54 | 15.3 | 5.7 | 0.65 | 573 | 0.82 | 0.08 | 0.16 | 2.4 | 630 | 2.7 |
| L1946299-16 142515 | | 0.07 | 0.15 | 0.01 | 0.084 | 0.34 | 19.6 | 6.7 | 0.46 | 508 | 3.01 | 0.05 | 0.57 | 8.5 | 780 | 4.6 |



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| Sample Description | Method Analyte Units LOR | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm |
|--------------------|--------------------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|
| L1946299-1 142503 | | 21.8 | 0.002 | 0.07 | 0.05 | 3.5 | 1.4 | 0.5 | 53.9 | <0.01 | 0.10 | 2.0 | 0.082 | 0.11 | 0.24 | 46 |
| L1946299-2 142502 | | 12.3 | <0.001 | 0.01 | 0.05 | 5.0 | 0.5 | 0.6 | 56.1 | <0.01 | 0.05 | 2.5 | 0.024 | 0.06 | 0.20 | 41 |
| L1946299-3 142505 | | 12.4 | 0.001 | 0.03 | 0.34 | 5.0 | 0.6 | 0.5 | 51.2 | <0.01 | 0.02 | 3.1 | 0.065 | 0.08 | 0.43 | 43 |
| L1946299-4 142507 | | 28.2 | 0.003 | 0.17 | <0.05 | 5.3 | 1.2 | 1.0 | 75.1 | <0.01 | 0.05 | 1.6 | 0.097 | 0.15 | 0.23 | 78 |
| L1946299-5 142504 | | 24.6 | <0.001 | 0.02 | 0.10 | 5.3 | 0.8 | 0.7 | 35.2 | <0.01 | 0.05 | 2.5 | 0.060 | 0.11 | 0.26 | 54 |
| L1946299-6 142508 | | 15.9 | 0.001 | 0.04 | 0.09 | 5.4 | 1.1 | 1.1 | 59.5 | <0.01 | 0.07 | 3.7 | 0.041 | 0.08 | 0.32 | 62 |
| L1946299-7 142509 | | 16.3 | 0.001 | 0.04 | <0.05 | 4.6 | 0.5 | 0.6 | 73.0 | <0.01 | 0.01 | 2.7 | 0.069 | 0.08 | 0.42 | 47 |
| L1946299-8 142506 | | 24.5 | 0.002 | 0.09 | <0.05 | 5.1 | 0.9 | 0.8 | 79.1 | <0.01 | 0.07 | 3.2 | 0.078 | 0.12 | 0.32 | 51 |
| L1946299-9 142510 | | 21.9 | <0.001 | 0.02 | 0.08 | 6.9 | 0.5 | 0.7 | 34.2 | <0.01 | 0.02 | 3.5 | 0.034 | 0.08 | 0.23 | 53 |
| L1946299-10 142513 | | 17.8 | 0.003 | 0.10 | <0.05 | 5.0 | 0.8 | 0.8 | 117.5 | <0.01 | 0.04 | 3.6 | 0.044 | 0.12 | 0.31 | 48 |
| L1946299-11 142511 | | 31.4 | <0.001 | 0.02 | 0.06 | 6.6 | 0.7 | 0.9 | 36.1 | <0.01 | 0.03 | 3.5 | 0.090 | 0.15 | 0.27 | 62 |
| L1946299-12 142512 | | 34.9 | 0.001 | 0.02 | <0.05 | 6.2 | 2.6 | 1.1 | 25.9 | <0.01 | 0.18 | 6.7 | 0.099 | 0.27 | 0.48 | 58 |
| L1946299-13 142514 | | 13.7 | 0.002 | 0.12 | <0.05 | 3.9 | 1.2 | 0.6 | 77.8 | <0.01 | 0.06 | 2.5 | 0.042 | 0.06 | 0.41 | 46 |
| L1946299-14 142517 | | 20.3 | 0.005 | 0.15 | <0.05 | 2.9 | 2.1 | 0.5 | 43.8 | <0.01 | 0.20 | 2.2 | 0.058 | 0.10 | 0.41 | 38 |
| L1946299-15 142516 | | 29.1 | 0.001 | 0.08 | <0.05 | 4.6 | 1.2 | 0.7 | 83.0 | <0.01 | 0.04 | 3.1 | 0.096 | 0.15 | 0.27 | 48 |
| L1946299-16 142515 | | 22.1 | 0.004 | 0.02 | 0.21 | 5.3 | 1.2 | 0.9 | 43.7 | <0.01 | 0.05 | 3.7 | 0.080 | 0.14 | 0.41 | 54 |



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 Plus Appendix Pages
 Finalized Date: 16-JUL-2017
 Account: APN

Project: L1946299

CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | ME-MS41 W ppm | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm | Cu-OG46 Cu % |
|--------------------|--------------------------|---------------|---------------|----------------|----------------|--------------|
| | | 0.05 | 0.05 | 2 | 0.5 | 0.001 |
| L1946299-1 142503 | | 0.64 | 7.42 | 77 | 1.0 | |
| L1946299-2 142502 | | 0.20 | 7.73 | 68 | 1.0 | |
| L1946299-3 142505 | | 0.55 | 8.29 | 53 | 5.5 | |
| L1946299-4 142507 | | 0.65 | 7.97 | 76 | 1.1 | |
| L1946299-5 142504 | | 0.33 | 9.63 | 86 | 2.3 | |
| L1946299-6 142508 | | 0.18 | 12.45 | 70 | 1.4 | |
| L1946299-7 142509 | | 0.98 | 7.91 | 65 | 1.1 | |
| L1946299-8 142506 | | 0.28 | 7.90 | 69 | 1.1 | |
| L1946299-9 142510 | | 0.15 | 7.72 | 81 | 1.7 | |
| L1946299-10 142513 | | 0.38 | 8.82 | 79 | 1.3 | |
| L1946299-11 142511 | | 0.47 | 9.79 | 89 | 3.0 | |
| L1946299-12 142512 | | 0.19 | 8.96 | 87 | 3.7 | 1.260 |
| L1946299-13 142514 | | 0.22 | 6.32 | 60 | 0.9 | |
| L1946299-14 142517 | | 0.34 | 4.66 | 56 | 1.0 | |
| L1946299-15 142516 | | 0.48 | 8.22 | 65 | 1.1 | |
| L1946299-16 142515 | | 0.30 | 10.15 | 59 | 4.8 | |



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CERTIFICATE OF ANALYSIS VA17127938

CERTIFICATE COMMENTS

| | | | | | | | | | | | | | | | | | |
|--------------------|--|-----------|----------|--------|---------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|
| | ANALYTICAL COMMENTS | | | | | | | | | | | | | | | | |
| Applies to Method: | Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41 | | | | | | | | | | | | | | | | |
| | LABORATORY ADDRESSES | | | | | | | | | | | | | | | | |
| Applies to Method: | <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">Cu-OG46</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> </tr> <tr> <td>ME-OG46</td> <td>OA-ELE07</td> <td>OA-VOL08m</td> <td>PUL-31</td> </tr> <tr> <td>PUL-QC</td> <td>S-CAL06</td> <td>S-GRA06</td> <td>S-GRA06a</td> </tr> <tr> <td>S-IR08</td> <td>SPL-21</td> <td>WEI-21</td> <td></td> </tr> </table> | C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | |
| C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | | | | | | | | | | | | | | |
| ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | | | | | | | | | | | | | | |
| PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | | | | | | | | | | | | | | |
| S-IR08 | SPL-21 | WEI-21 | | | | | | | | | | | | | | | |



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QC CERTIFICATE VA17127938

Project: L1946299

This report is for 16 Other samples submitted to our lab in Vancouver, BC, Canada on 22-JUN-2017.

The following have access to data associated with this certificate:

| | | |
|--------------------------|----------------------------|-------------|
| ELSE VANCOUVER WEBTRIEVE | SOFTWARE DEVELOPMENT GROUP | SHANE STACK |
|--------------------------|----------------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| ME-OG46 | Ore Grade Elements - AquaRegia | ICP-AES |
| Cu-OG46 | Ore Grade Cu - Aqua Regia | ICP-AES |
| OA-VOL08m | Modified NP | |
| S-IRO8 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17127938

| Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|---------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | 6.0 | | | | | | | | | | |
| Buffer pH6 | | | | | 6.1 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.3 | | | | | | | | | | |
| Upper Bound | | | | | 6.7 | | | | | | | | | | |
| CCU-1e | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | 0.50 | 1.8 | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.42 | 1.5 | | | | |
| Upper Bound | | | | | | | | | | 0.64 | 2.4 | | | | |
| DS-1 | | | | | | | 2.58 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 2.51 | | | | | | | | |
| Upper Bound | | | | | | | 2.71 | | | | | | | | |
| GBM903-13 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GMO-12 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | 1.20 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 1.19 | | | | | | | | |
| Upper Bound | | | | | | | 1.29 | | | | | | | | |
| KZK-1 | 25.0 | 2 | 32 | 57 | | 2.28 | | | | | | | | | |
| KZK-1 | 25.0 | 2 | 32 | 57 | | 2.28 | | | | | | | | | |
| Target Range - Lower Bound | 22.9 | <1 | 30 | 54 | | 2.18 | | | | | | | | | |
| Upper Bound | 27.1 | >4 | 38 | 64 | | 2.53 | | | | | | | | | |
| MGeo08 | | | | | | | | | | | | 4.57 | 2.51 | 31.0 | <0.02 |
| Target Range - Lower Bound | | | | | | | | | | | | 4.00 | 2.44 | 29.6 | <0.02 |
| Upper Bound | | | | | | | | | | | | 4.92 | 3.00 | 36.4 | 0.04 |
| OREAS 604 | | | | | | | | | | | | | | | |
| OREAS 604 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OREAS 621 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OREAS 905 | | | | | | | | | | | | 0.53 | 0.76 | 30.2 | 0.38 |

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QC CERTIFICATE OF ANALYSIS VA17127938

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % | Ga ppm | Ge ppm | Hf ppm | |
| | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CCU-1e | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GBM903-13 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GMO-12 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | <10 | 430 | 0.80 | 0.66 | 1.01 | 2.32 | 78.3 | 19.3 | 87 | 11.30 | 605 | 3.29 | 10.00 | 0.14 | 0.73 | |
| Target Range - Lower Bound | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 | 3.22 | 8.73 | 0.07 | 0.64 | |
| Upper Bound | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 | 3.96 | 10.80 | 0.29 | 0.83 | |
| OREAS 604 | | | | | | | | | | | | | | | | |
| OREAS 604 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS 621 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS 905 | <10 | 240 | 0.95 | 5.47 | 0.32 | 0.36 | 81.1 | 14.0 | 17 | 1.19 | 1500 | 3.13 | 6.34 | 0.09 | 1.18 | |

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QC CERTIFICATE OF ANALYSIS VA17127938

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | Re ppm | |
| | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CCU-1e | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GBM903-13 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GMO-12 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 0.06 | 0.167 | 1.18 | 39.0 | 31.7 | 1.07 | 395 | 15.40 | 0.31 | 0.81 | 682 | 940 | 989 | 151.0 | 0.008 | |
| Target Range - Lower Bound | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 | 900 | 959 | 132.0 | 0.006 | |
| Upper Bound | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 | 1130 | 1175 | 162.0 | 0.010 | |
| OREAS 604 | | | | | | | | | | | | | | | | |
| OREAS 604 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS 621 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS 905 | 0.01 | 0.622 | 0.29 | 41.3 | 4.8 | 0.14 | 326 | 3.13 | 0.08 | 0.31 | 8.8 | 220 | 15.6 | 18.2 | <0.001 | |

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QC CERTIFICATE OF ANALYSIS VA17127938

| Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|----------------------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|---------------|
| Sample Description | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CCU-1e | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GBM903-13 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GMO-12 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 0.30 | 3.64 | 7.3 | 1.5 | 3.6 | 75.2 | 0.01 | 0.02 | 22.8 | 0.383 | 0.75 | 5.55 | 93 | 3.34 | 20.8 |
| Target Range - Lower Bound | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 | 4.93 | 90 | 2.44 | 17.50 |
| Upper Bound | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 | 6.13 | 112 | 3.42 | 21.5 |
| OREAS 604 | | | | | | | | | | | | | | | |
| OREAS 604 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OREAS 621 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OREAS 905 | 0.07 | 1.13 | 1.7 | 2.2 | 1.3 | 11.2 | <0.01 | 0.07 | 8.2 | 0.020 | 0.10 | 2.18 | 5 | 0.63 | 6.90 |

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| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm | ME-MS41 Zr ppm | Cu-OG46 Cu % |
|----------------------------|--------------------------|----------------|----------------|--------------|
| | | 2 | 0.5 | 0.001 |
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| CCU-1e | | | | 23.0 |
| Target Range - Lower Bound | | | | 22.1 |
| Upper Bound | | | | 23.7 |
| CO-ASSAY | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GBM903-13 | | | | 2.93 |
| Target Range - Lower Bound | | | | 2.79 |
| Upper Bound | | | | 3.00 |
| GMO-12 | | | | 0.017 |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS313-8 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MGeo08 | | 745 | 23.5 | |
| Target Range - Lower Bound | | 708 | 18.1 | |
| Upper Bound | | 870 | 25.7 | |
| OREAS 604 | | | | 2.19 |
| OREAS 604 | | | | 2.16 |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OREAS 621 | | | | 0.358 |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OREAS 905 | | 61 | 49.2 | |

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Project: L1946299

QC CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|---------------|----------------|--------------|----------------|----------------|
| | | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.45 | 0.73 | 28.4 | 0.33 |
| Upper Bound | | | | | | | | | | | | | 0.58 | 0.91 | 35.0 | 0.45 |
| UTS-1 | | | | | | | | 0.89 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.83 | | | | | | | | |
| Upper Bound | | | | | | | | 0.93 | | | | | | | | |
| UTS-1 | | | | | | | | | | 0.92 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.81 | | | | | | |
| Upper Bound | | | | | | | | | | 0.95 | | | | | | |
| UTS-4 | | | | | | | | 1.76 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.64 | | | | | | | | |
| Upper Bound | | | | | | | | 1.84 | | | | | | | | |
| UTS-4 | | | | | | | | | | 1.72 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 1.61 | | | | | | |
| Upper Bound | | | | | | | | | | 1.87 | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | <0.05 | <0.2 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | <0.05 | <0.2 | | | |
| Upper Bound | | | | | | | | | | | | 0.10 | 0.4 | | | |
| BLANK | | | | | | | | | | | | | | <0.01 | <0.01 | 0.3 |
| Target Range - Lower Bound | | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 |
| Upper Bound | | | | | | | | | | | | | | 0.02 | 0.02 | 0.2 |
| BLANK | | | | | | 6.0 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.5 | | | | | | | | | | |
| Upper Bound | | | | | | 6.9 | | | | | | | | | | |
| BLANK | | | | | | | | | | <0.01 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.01 | | | | | | |
| Upper Bound | | | | | | | | | | 0.02 | | | | | | |
| BLANK | | | | | | | | | | | | | | <0.01 | | |
| Target Range - Lower Bound | | | | | | | | | | <0.01 | | | | <0.01 | | |
| Upper Bound | | | | | | | | | | 0.02 | | | | 0.02 | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.01 | | | | | | |
| Upper Bound | | | | | | | | | | <0.01 | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | | |
|----------------------------|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|-------|-------|--|
| | | | | | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga | Ge | Hf | |
| | | | | | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | |
| | | | | | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | |
| STANDARDS | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 | 3.14 | 5.74 | <0.05 | 1.08 | |
| Upper Bound | | | | | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 | 3.86 | 7.12 | 0.22 | 1.36 | |
| UTS-1 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | <10 | 10 | <0.05 | 0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | <0.02 | |
| Upper Bound | | | | | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | <0.02 | |
| BLANK | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 | 0.04 | |
| Upper Bound | | | | | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 | 0.04 | |
| BLANK | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm |
|----------------------------|--------------------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|
| | | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 | | 15.2 | 17.3 | <0.001 |
| Upper Bound | | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 | | 19.0 | 21.3 | 0.002 |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|----------------------------|--------------------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|---------------|
| | | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 | 2.08 | 4 | 0.44 | 6.32 |
| Upper Bound | | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 | 2.66 | 8 | 0.76 | 7.84 |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | 0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Target Range - Lower Bound | | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Upper Bound | | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | 0.10 |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm | ME-MS41 Zr ppm | Cu-OG46 Cu % |
|----------------------------|--------------------------|----------------|----------------|--------------|
| | | 2 | 0.5 | 0.001 |
| STANDARDS | | | | |
| Target Range - Lower Bound | | 58 | 39.9 | |
| Upper Bound | | 76 | 55.1 | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANKS | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | <0.001 |
| Target Range - Lower Bound | | | | <0.001 |
| Upper Bound | | | | 0.002 |
| BLANK | | <2 | <0.5 | |
| Target Range - Lower Bound | | <2 | <0.5 | |
| Upper Bound | | 4 | 1.0 | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

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QC CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | OA-VOL08m MPA | OA-VOL08m FIZZ RAT | OA-VOL08m NNP | OA-VOL08m NP | OA-ELE07 pH | OA-VOL08m Ratio (N) | S-IR08 S | S-GRA06 S | S-GRA06a S | C-GAS05 C | C-GAS05 CO2 | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As | ME-MS41 Au |
|----------------------------|--------------------------|---------------|--------------------|---------------|--------------|-------------|---------------------|----------|-----------|------------|-----------|-------------|------------|------------|------------|------------|
| | | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | ppm | % | ppm | ppm |
| | | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L1946299-8 142506 | | | | | | | | | 0.01 | | | | | | | |
| DUP | | | | | | | | | <0.01 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | <0.01 | | | | | | | |
| Upper Bound | | | | | | | | | 0.02 | | | | | | | |
| L1946299-10 142513 | | 2.5 | 2 | 38 | 40 | 8.6 | 16.00 | | | <0.01 | 0.47 | 1.7 | 0.30 | 1.18 | 0.6 | 0.02 |
| DUP | | 2.5 | 2 | 37 | 39 | 8.6 | 15.60 | | | <0.01 | 0.48 | 1.8 | 0.29 | 1.20 | 0.5 | 0.03 |
| Target Range - Lower Bound | | 2.1 | <1 | 35 | 37 | 8.1 | 15.00 | | | <0.01 | 0.40 | 1.5 | 0.27 | 1.12 | 0.4 | <0.02 |
| Upper Bound | | 2.9 | 3 | 40 | 42 | 9.1 | 16.60 | | | 0.02 | 0.55 | 2.0 | 0.32 | 1.26 | 0.7 | 0.04 |
| ORIGINAL | | | | | | | | | 0.05 | | | | | | | |
| DUP | | | | | | | | | 0.05 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.04 | | | | | | | |
| Upper Bound | | | | | | | | | 0.06 | | | | | | | |

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Project: L1946299

QC CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | ME-MS41 B ppm 10 | ME-MS41 Ba ppm 10 | ME-MS41 Be ppm 0.05 | ME-MS41 Bi ppm 0.01 | ME-MS41 Ca % 0.01 | ME-MS41 Cd ppm 0.01 | ME-MS41 Ce ppm 0.02 | ME-MS41 Co ppm 0.1 | ME-MS41 Cr ppm 1 | ME-MS41 Cs ppm 0.05 | ME-MS41 Cu ppm 0.2 | ME-MS41 Fe % 0.01 | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 |
|--|--------------------------|--------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------------------|--------------------|------------------------------|---------------------------|------------------------------|------------------------------|-------------------------------|------------------------------|---------------------|
| DUPLICATES | | | | | | | | | | | | | | | | |
| L1946299-8 142506 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1946299-10 142513 DUP Target Range - Lower Bound Upper Bound | <10 <10 <10 20 | 120 120 100 140 | 0.37 0.42 0.33 0.46 | 0.06 0.06 0.05 0.07 | 1.37 1.39 1.30 1.46 | 0.13 0.12 0.11 0.14 | 23.5 23.6 22.4 24.7 | 6.7 6.5 6.2 7.0 | 6 5 4 7 | 0.44 0.45 0.37 0.52 | 995 998 961 1030 | 2.60 2.62 2.47 2.75 | 6.97 6.78 6.48 7.27 | 0.07 0.07 <0.05 0.10 | 0.05 0.06 0.03 0.08 | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |

***** See Appendix Page for comments regarding this certificate *****



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 North Vancouver BC V7H 0A7
 Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 4 - C
 Total # Pages: 4 (A - E)
 Plus Appendix Pages
 Finalized Date: 16-JUL-2017
 Account: APN

Project: L1946299

QC CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm |
|--|---------------------------------|----------------------------------|------------------------------|------------------------------|--------------------------|------------------------------|--------------------------|------------------------------|------------------------------|------------------------------|--------------------------|--------------------------|--------------------------|------------------------------|----------------------------------|----------------|
| | | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 |
| L1946299-8 142506 DUP Target Range - Lower Bound Upper Bound | DUPLICATES | | | | | | | | | | | | | | | |
| L1946299-10 142513 DUP Target Range - Lower Bound Upper Bound | <0.01 <0.01 <0.01 0.02 | 0.041 0.037 0.032 0.046 | 0.29 0.29 0.27 0.31 | 12.2 12.3 11.4 13.1 | 7.2 7.0 6.6 7.6 | 0.72 0.72 0.67 0.77 | 610 614 576 648 | 2.14 2.37 2.09 2.42 | 0.06 0.06 0.05 0.07 | 0.12 0.11 0.06 0.17 | 2.8 2.7 2.4 3.1 | 680 690 640 730 | 4.4 4.4 4.0 4.8 | 17.8 18.1 17.0 18.9 | 0.003 0.003 0.002 0.004 | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |

***** See Appendix Page for comments regarding this certificate *****



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 BURNABY BC V5A 1W9

Page: 4 - D
 Total # Pages: 4 (A - E)
 Plus Appendix Pages
 Finalized Date: 16-JUL-2017
 Account: APN

Project: L1946299

QC CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|----------------------------|--------------------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|---------------|
| | | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L1946299-8 142506 DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1946299-10 142513 DUP | | 0.10 | <0.05 | 5.0 | 0.8 | 0.8 | 117.5 | <0.01 | 0.04 | 3.6 | 0.044 | 0.12 | 0.31 | 48 | 0.38 | 8.82 |
| Target Range - Lower Bound | | 0.10 | <0.05 | 4.9 | 0.9 | 0.8 | 118.0 | <0.01 | 0.05 | 3.6 | 0.044 | 0.13 | 0.33 | 49 | 0.40 | 8.80 |
| Upper Bound | | 0.09 | <0.05 | 4.6 | 0.6 | 0.6 | 111.5 | <0.01 | 0.03 | 3.2 | 0.037 | 0.10 | 0.25 | 45 | 0.31 | 8.32 |
| Lower Bound | | 0.12 | 0.10 | 5.3 | 1.1 | 1.0 | 124.0 | 0.02 | 0.06 | 4.0 | 0.051 | 0.15 | 0.39 | 52 | 0.47 | 9.30 |
| ORIGINAL DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

***** See Appendix Page for comments regarding this certificate *****



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 Total # Pages: 4 (A - E)
 Plus Appendix Pages
 Finalized Date: 16-JUL-2017
 Account: APN

Project: L1946299

QC CERTIFICATE OF ANALYSIS VA17127938

| Sample Description | Method Analyte Units | ME-MS41 Zn ppm | ME-MS41 Zr ppm | Cu-OG46 Cu % |
|--|----------------------|----------------------|--------------------------|--------------|
| | LOR | 2 | 0.5 | 0.001 |
| DUPLICATES | | | | |
| L1946299-8 142506 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1946299-10 142513 DUP Target Range - Lower Bound Upper Bound | | 79 79 73 85 | 1.3 1.3 0.7 1.9 | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | |
| | | | | |

***** See Appendix Page for comments regarding this certificate *****



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Page: Appendix 1
 Total # Appendix Pages: 1
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 Account: APN

Project: L1946299

QC CERTIFICATE OF ANALYSIS VA17127938

| | CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | |
|--------------------|---|-----------|----------|--------|---------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|
| Applies to Method: | <p style="text-align: center;">ANALYTICAL COMMENTS</p> <p>Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41</p> | | | | | | | | | | | | | | | | |
| Applies to Method: | <p style="text-align: center;">LABORATORY ADDRESSES</p> <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">Cu-OG46</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> </tr> <tr> <td>ME-OG46</td> <td>OA-ELE07</td> <td>OA-VOL08m</td> <td>PUL-31</td> </tr> <tr> <td>PUL-QC</td> <td>S-CAL06</td> <td>S-GRA06</td> <td>S-GRA06a</td> </tr> <tr> <td>S-IR08</td> <td>SPL-21</td> <td>WEI-21</td> <td></td> </tr> </table> | C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | |
| C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | | | | | | | | | | | | | | |
| ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | | | | | | | | | | | | | | |
| PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | | | | | | | | | | | | | | |
| S-IR08 | SPL-21 | WEI-21 | | | | | | | | | | | | | | | |



Chain of Custody (COC) / Analytical Request Form



L1946299-COFC

COC Number 17 20

Page 2 of

Canada Toll Free: 1 800 668 9878

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| | | | | | |
|---|--|---|--|---|--------------------------|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | Select Service Level Below Please confirm all EAP TATs with your AM. Surcharges will apply. | |
| Company | Minto Explorations Ltd | Select Report Format | <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm business days. no surcharges apply | |
| Contact | Minto Environment - Coordinator | Quality Control (QC) Report with Report | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | 4 day [P4] | <input type="checkbox"/> |
| Phone | 1-804-759-4659 | <input checked="" type="checkbox"/> Compare Results to Order on Report - provide details below if not checked | | 3 day [P3] | <input type="checkbox"/> |
| Company address below will appear on the final report | | Select Distribution | <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | 2 day [P2] | <input type="checkbox"/> |
| Street | 2100-510 West Georgia St | Email 1 or Fax | minto_environment@mintomine.com | EMERGENCY | |
| City/Province | Vancouver British Columbia | Email 2 | | 1 Business day [E1] <input type="checkbox"/> | |
| Postal Code | V6B 0M3 | Email 3 | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | Date and Time Required for all EAP TATs: | |
| Company | Minto Explorations Ltd | Select Invoice Distribution | <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | dd-mmm-yy hh:mm | |
| Contact | Ruth Cayetano | Email 1 or Fax | ap@mintomine.com | For tests that can not be performed according to the service level selected, you will be contacted. | |
| Project Information | | Oil and Gas Required Fields (client use) | | Analysis Request | |
| ALS Account # / Quote # | | APE Cost Center | PO# | Indicate Entries (F) Filtered (P) or Filtered and Preserved (FP) below | |
| Job # | | Major/Minor Code | Routing Code | Total Metals (CP) Trace NH Inorganic Carbonate Total Carbon/Sulphur (1 cool) AP determination by % sulphur sulphur Modified NP (MEND 1831) | Number of Containers |
| PQ: AFE TRD | | Requisitioner | | | |
| LSD | | Location | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Sampler: | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates The description will appear on the report | Date | Time | Sample Type | |
| | 142512 | 2-June-17 | | WASTE | |
| | 142514 | 4-June-17 | | WASTE | |
| | 142517 | 6-June-17 | | WASTE | |
| | 142516 | 6-June-17 | | WASTE | |
| | 142515 | 6-June-17 | | WASTE | |
| Drinking Water (DW) Samples (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input type="checkbox"/> NO | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input type="checkbox"/> NO | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | |
| | | | | Cooling Initiated <input type="checkbox"/> | |
| | | | | INITIAL COOLER TEMPERATURES °C: 18.0 | |
| | | | | FINAL COOLER TEMPERATURES °C: 20 | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | FINAL SHIPMENT RECEPTION (lab use only) | |
| Released by | Date | Time | Received by | Date | Time |
| | | | EHF | 6/21/17 | 2pm |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGITIMATELY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white report copy.
 * If any water samples are taken from a Regulated Drinking Water (DW) System, use same user on Authorized DW COC form.



Chain of Custody (COC) / Analytical-Request Form



COC Number: 17-20

L1946299-COFC

Page 1 of 1

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| Report To | | Report Format / Distribution | | Select Service Level Below | | |
|---|---|---|--------------|--|----------------------|--|
| Contact and company name below will appear on the final report | | Select Report Format <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDO (DIGITAL) | | Please confirm all E&P TATs with your AM - surcharges will apply | | |
| Company | Minto Explorations Ltd | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm business days - no surcharges apply | | |
| Contact | Minto Environment - Coordinator | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | 4 day [P4] <input type="checkbox"/> 1 Business day [E1] <input type="checkbox"/> | | |
| Phone | 1-604-759-4659 | Select Distribution <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | 3 day [P3] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | |
| Company address below will appear on the final report | | Email 1 or Fax minto_environment@mintomine.com | | EMERGENCY | | |
| Street | 2100-510 West Georgia St. | Email 2 | | Date and Time Required for all E&P TATs: dd-mm-yy hh mm | | |
| City/Province | Vancouver, British Columbia | Email 3 | | For tests that can not be performed according to the service level selected, you will be contacted. | | |
| Postal Code | V6B 0M3 | Invoice Distribution | | Analysis Request | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below | | |
| Company | Minto Explorations Ltd | Email 1 or Fax ap@mintomine.com | | Total Metals: Aqua regia digestion (ICP) | | |
| Contact | Ruth Cayetano | Email 2 | | Trace Metals: Aqua regia digestion (ICP) | | |
| Project Information | | Oil and Gas Required Fields (client use) | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below | | |
| ALS Account # / Quote # | | AFE Cost Center | PO# | Trace Metals: Aqua regia digestion (ICP) | | |
| Job # | | Major Miner Code | Routing Code | Trace Metals: Aqua regia digestion (ICP) | | |
| PO AFE | TBD | Requisitioner | | Trace Metals: Aqua regia digestion (ICP) | | |
| LSD | | Location | | Trace Metals: Aqua regia digestion (ICP) | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Sampler: | Trace Metals: Aqua regia digestion (ICP) | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date | Time | Sample Type | Number of Containers | |
| | 142503 | 26-MAY-17 | | WASTE | R | |
| | 142502 | 29-MAY-17 | | WASTE | R | |
| | 142505 | 29-MAY-17 | | WASTE | R | |
| | 142507 | 29-MAY-17 | | WASTE | R | |
| | 142504 | 29-MAY-17 | | WASTE | R | |
| | 142508 | 29-MAY-17 | | WASTE | R | |
| | 142509 | 31-MAY-17 | | WASTE | R | |
| | 142506 | 29-MAY-17 | | WASTE | R | |
| | 142510 | 26-June-17 | | WASTE | R | |
| | 142513 | 27-June-17 | | WASTE | R | |
| | 142511 | 27-June-17 | | WASTE | R | |
| Drinking Water (DW) Samples (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Frozer: <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | |
| | | | | Cooling Initiated <input type="checkbox"/> | | |
| | | | | INITIAL COOLER TEMPERATURES °C: 18.0 | | |
| | | | | FINAL COOLER TEMPERATURES °C: 20 | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | FINAL SHIPMENT RECEPTION (lab use only) | | |
| Released by | Date | Time | Received by | Date | Time | |
| Kara Joe | June 17, 2017 | | EHF | 20 June 2017 | 6:20 | |
| | | | | Received by | Date | |
| | | | | JC | 6/17/2017 | |

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as stated on the back page of the report copy. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 14-JUL-17
Report Date: 08-AUG-17 18:20 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1958661
Project P.O. #: PO#226298
Job Reference:
C of C Numbers: 17 21
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1958661-1 Waste 19-JUN-17 787-49 MM 142654 | L1958661-2 Waste 16-JUN-17 787-52 MM 142652 | L1958661-3 Waste 18-JUN-17 781-44 MM 142653 | L1958661-4 Waste 11-JUN-17 787-48 MM 142521 | L1958661-5 Waste 08-JUN-17 793-32A MM 142519 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.4 | 8.3 | 8.5 | 8.3 | 8.2 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.34 | 0.05 | 0.41 | 0.12 | <0.05 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 1 | 1 | 2 | 2 | 1 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 0.3 | 0.3 | 1.6 | 0.3 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 32 | 9 | 34 | 18 | 7 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 32 | 9 | 32 | 18 | 7 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 102.40 | 28.80 | 21.76 | 57.60 | 22.40 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | 0.01 | <0.01 | <0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | 0.03 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | <0.01 | 0.01 | 0.05 | <0.01 | 0.01 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.01 | 0.01 | 0.05 | 0.01 | 0.01 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 0.72 | 1.07 | 1.22 | 1.10 | 0.86 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.06 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 3.2 | 1.0 | 1.1 | 2.9 | 1.3 |
| | Barium (Ba) (ppm) | | | | |
| | 180 | 280 | 260 | 250 | 180 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.41 | 0.25 | 0.43 | 0.36 | 0.34 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.09 | 0.15 | 0.19 | 0.18 | 0.15 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.12 | 0.31 | 0.08 | 0.38 | 0.27 |
| | Calcium (Ca) (%) | | | | |
| | 1.28 | 0.30 | 1.29 | 0.69 | 0.27 |
| | Cerium (Ce) (ppm) | | | | |
| | 24.7 | 26.8 | 34.7 | 26.6 | 28.0 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.55 | 0.46 | 0.48 | 0.37 | 0.35 |
| | Chromium (Cr) (ppm) | | | | |
| | 4 | 4 | 5 | 8 | 6 |
| | Cobalt (Co) (ppm) | | | | |
| | 5.8 | 6.8 | 6.9 | 7.0 | 5.6 |
| | Copper (Cu) (ppm) | | | | |
| | 705 | 2650 | 751 | 1460 | 2030 |
| | Gallium (Ga) (ppm) | | | | |
| | 4.36 | 5.24 | 6.64 | 5.75 | 4.46 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.10 | 0.11 | 0.13 | 0.12 | 0.11 |
| | Gold (Au) (ppm) | | | | |
| | <0.02 | 0.05 | 0.04 | 0.05 | 0.05 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.04 | 0.06 | 0.05 | 0.09 | 0.05 |
| | Indium (In) (ppm) | | | | |
| | 0.044 | 0.048 | 0.033 | 0.042 | 0.045 |
| | Iron (Fe) (%) | | | | |
| | 2.26 | 2.37 | 2.56 | 2.39 | 2.20 |
| | Lanthanum (La) (ppm) | | | | |
| | 12.6 | 14.5 | 18.3 | 13.7 | 15.6 |
| | Lead (Pb) (ppm) | | | | |
| | 4.7 | 2.8 | 3.2 | 2.9 | 3.5 |
| | Lithium (Li) (ppm) | | | | |
| | 4.6 | 5.9 | 7.5 | 8.9 | 4.5 |
| | Magnesium (Mg) (%) | | | | |
| | 0.27 | 0.48 | 0.74 | 0.61 | 0.32 |
| | Manganese (Mn) (ppm) | | | | |
| | 648 | 570 | 599 | 578 | 493 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1958661-6 Waste 09-JUN-17 793-32B MM 142520 | L1958661-7 Waste 15-JUN-17 787-53 MM 142651 | L1958661-8 Waste 14-JUN-17 787-54 MM 142525 | L1958661-9 Waste 12-JUN-17 787-51 MM 142523 | L1958661-10 Waste 14-JUN-17 787-47 MM 142524 |
|---|--|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.2 | 8.3 | 8.5 | 8.5 | 8.5 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.05 | <0.05 | 0.25 | 0.10 | 0.38 |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | 1 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.3 | 0.9 | 5.9 | <0.3 | 5.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 7 | 8 | 23 | 15 | 33 |
| | NNP (tCaCO3/1Kt) | 7 | 7 | 17 | 15 | 27 |
| | Ratio (NP/MPA) (Unity) | 22.40 | 8.53 | 3.87 | 96.00 | 5.87 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | 0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | <0.01 | 0.02 | 0.19 | <0.01 | 0.18 |
| | Total Sulfur (combustion) (%) | 0.01 | 0.03 | 0.19 | <0.01 | 0.18 |
| Total Metals | Aluminum (Al) (%) | 0.78 | 0.76 | 1.11 | 0.97 | 0.53 |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | <0.05 | <0.05 | 0.07 |
| | Arsenic (As) (ppm) | 1.0 | 1.8 | 0.6 | 0.8 | 3.0 |
| | Barium (Ba) (ppm) | 160 | 120 | 210 | 170 | 90 |
| | Beryllium (Be) (ppm) | 0.32 | 0.25 | 0.27 | 0.38 | 0.34 |
| | Bismuth (Bi) (ppm) | 0.18 | 0.24 | 0.64 | 0.03 | 0.17 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.38 | 0.46 | 0.46 | 0.42 | 0.09 |
| | Calcium (Ca) (%) | 0.30 | 0.27 | 0.73 | 0.61 | 1.22 |
| | Cerium (Ce) (ppm) | 24.7 | 24.8 | 26.9 | 22.5 | 42.3 |
| | Cesium (Cs) (ppm) | 0.35 | 0.41 | 0.58 | 0.32 | 0.28 |
| | Chromium (Cr) (ppm) | 5 | 5 | 6 | 5 | 3 |
| | Cobalt (Co) (ppm) | 5.5 | 5.7 | 7.6 | 5.3 | 7.2 |
| | Copper (Cu) (ppm) | 2170 | 3940 | 7450 | 1195 | 2830 |
| | Gallium (Ga) (ppm) | 4.20 | 4.00 | 5.88 | 5.19 | 3.31 |
| | Germanium (Ge) (ppm) | 0.10 | 0.10 | 0.12 | 0.10 | 0.12 |
| | Gold (Au) (ppm) | 0.05 | 0.08 | 0.16 | <0.02 | 0.04 |
| | Hafnium (Hf) (ppm) | 0.05 | 0.04 | 0.05 | 0.04 | 0.04 |
| | Indium (In) (ppm) | 0.052 | 0.074 | 0.120 | 0.025 | 0.072 |
| | Iron (Fe) (%) | 1.91 | 2.15 | 2.93 | 2.00 | 2.17 |
| | Lanthanum (La) (ppm) | 12.4 | 13.2 | 14.3 | 12.1 | 21.8 |
| | Lead (Pb) (ppm) | 3.1 | 4.8 | 3.6 | 2.9 | 4.9 |
| | Lithium (Li) (ppm) | 4.1 | 3.3 | 5.1 | 6.9 | 2.6 |
| | Magnesium (Mg) (%) | 0.29 | 0.31 | 0.69 | 0.47 | 0.26 |
| | Manganese (Mn) (ppm) | 529 | 625 | 636 | 559 | 498 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1958661-11 Waste 11-JUN-17 787-50 MM 142522 | L1958661-12 Waste 21-JUN-17 781-38 MM 142656 | L1958661-13 Waste 20-JUN-17 781-44 MM 142655 | L1958661-14 Waste 24-JUN-17 781-45 MM 142657 | L1958661-15 Waste 24-JUN-17 781-45 MM 142658 |
|---|---|---|---|---|---|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.2 | 8.5 | 8.5 | 8.7 | 8.6 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | <0.05 | 0.33 | 0.23 | 0.29 | 0.19 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 1 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | <0.3 | 0.9 | 1.3 | 1.3 | 19.1 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 8 | 29 | 25 | 28 | 23 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 8 | 28 | 24 | 27 | 4 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 51.20 | 30.93 | 20.00 | 22.40 | 1.21 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | <0.01 | 0.01 | 0.01 | <0.01 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | <0.01 | 0.02 | 0.03 | 0.04 | 0.60 |
| | Total Sulfur (combustion) (%) | | | | |
| | <0.01 | 0.03 | 0.04 | 0.04 | 0.61 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.06 | 1.11 | 1.11 | 1.21 | 1.43 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.05 | 0.06 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 3.2 | 1.0 | 0.7 | 0.7 | 0.6 |
| | Barium (Ba) (ppm) | | | | |
| | 270 | 190 | 260 | 150 | 170 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.40 | 0.32 | 0.35 | 0.36 | 0.21 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.13 | 0.08 | 0.12 | 0.06 | 2.86 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.24 | 0.10 | 0.10 | 0.04 | 0.17 |
| | Calcium (Ca) (%) | | | | |
| | 0.39 | 1.15 | 1.01 | 1.27 | 0.89 |
| | Cerium (Ce) (ppm) | | | | |
| | 28.6 | 28.5 | 28.1 | 19.95 | 17.75 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.38 | 0.48 | 0.41 | 0.29 | 0.66 |
| | Chromium (Cr) (ppm) | | | | |
| | 5 | 5 | 6 | 5 | 7 |
| | Cobalt (Co) (ppm) | | | | |
| | 6.3 | 6.0 | 7.1 | 5.9 | 6.5 |
| | Copper (Cu) (ppm) | | | | |
| | 1455 | 739 | 836 | 426 | >10000 |
| | Gallium (Ga) (ppm) | | | | |
| | 5.51 | 5.74 | 5.61 | 6.05 | 8.85 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.12 | 0.12 | 0.12 | 0.11 | 0.14 |
| | Gold (Au) (ppm) | | | | |
| | 0.03 | 0.02 | <0.02 | <0.02 | 0.24 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.05 | 0.04 | 0.06 | 0.05 | 0.06 |
| | Indium (In) (ppm) | | | | |
| | 0.044 | 0.035 | 0.036 | 0.026 | 0.136 |
| | Iron (Fe) (%) | | | | |
| | 2.53 | 2.35 | 2.36 | 2.33 | 4.35 |
| | Lanthanum (La) (ppm) | | | | |
| | 14.5 | 14.7 | 14.8 | 10.6 | 9.2 |
| | Lead (Pb) (ppm) | | | | |
| | 3.1 | 3.3 | 2.7 | 3.3 | 4.3 |
| | Lithium (Li) (ppm) | | | | |
| | 8.6 | 7.3 | 6.1 | 7.5 | 7.2 |
| | Magnesium (Mg) (%) | | | | |
| | 0.42 | 0.69 | 0.64 | 0.73 | 0.83 |
| | Manganese (Mn) (ppm) | | | | |
| | 663 | 604 | 607 | 567 | 670 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1958661-16 | L1958661-17 | | |
|-----------------------------------|--|--------------|------------------|------------------|--|--|
| | | Description | Waste | Waste | | |
| | | Sampled Date | 25-JUN-17 | | | |
| | | Sampled Time | | | | |
| | | Client ID | 781-46 MM 142659 | 787-46 MM 142518 | | |
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | | 8.5 | 8.7 | | |
| Organic / Inorganic Carbon | Carbon (C) (%) | | 0.38 | 0.19 | | |
| Acid Base Accounting | FIZZ RATING (Unity) | | 2 | 2 | | |
| | MPA (tCaCO3/1Kt) | | 6.3 | 0.3 | | |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | 32 | 21 | | |
| | NNP (tCaCO3/1Kt) | | 26 | 21 | | |
| | Ratio (NP/MPA) (Unity) | | 5.12 | 67.20 | | |
| | Sulfate Sulfur (carbonate leach) (%) | | 0.01 | <0.01 | | |
| | Sulfate Sulfur (HCl leach) (%) | | <0.01 | <0.01 | | |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | 0.19 | 0.01 | | |
| | Total Sulfur (combustion) (%) | | 0.20 | 0.01 | | |
| Total Metals | Aluminum (Al) (%) | | 1.35 | 1.09 | | |
| | Antimony (Sb) (ppm) | | <0.05 | 0.05 | | |
| | Arsenic (As) (ppm) | | 1.2 | 1.3 | | |
| | Barium (Ba) (ppm) | | 200 | 200 | | |
| | Beryllium (Be) (ppm) | | 0.44 | 0.34 | | |
| | Bismuth (Bi) (ppm) | | 0.66 | 0.02 | | |
| | Boron (B) (ppm) | | <10 | <10 | | |
| | Cadmium (Cd) (ppm) | | 0.69 | 0.07 | | |
| | Calcium (Ca) (%) | | 1.41 | 0.90 | | |
| | Cerium (Ce) (ppm) | | 23.0 | 28.0 | | |
| | Cesium (Cs) (ppm) | | 0.69 | 0.44 | | |
| | Chromium (Cr) (ppm) | | 5 | 5 | | |
| | Cobalt (Co) (ppm) | | 6.6 | 5.7 | | |
| | Copper (Cu) (ppm) | | 2780 | 191.0 | | |
| | Gallium (Ga) (ppm) | | 7.55 | 5.74 | | |
| | Germanium (Ge) (ppm) | | 0.13 | 0.12 | | |
| | Gold (Au) (ppm) | | 0.09 | <0.02 | | |
| | Hafnium (Hf) (ppm) | | 0.05 | 0.04 | | |
| | Indium (In) (ppm) | | 0.060 | 0.026 | | |
| | Iron (Fe) (%) | | 3.18 | 2.10 | | |
| | Lanthanum (La) (ppm) | | 11.3 | 14.2 | | |
| | Lead (Pb) (ppm) | | 4.0 | 2.9 | | |
| | Lithium (Li) (ppm) | | 7.5 | 7.4 | | |
| | Magnesium (Mg) (%) | | 0.76 | 0.63 | | |
| | Manganese (Mn) (ppm) | | 880 | 570 | | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1958661-1 Waste 19-JUN-17 787-49 MM 142654 | L1958661-2 Waste 16-JUN-17 787-52 MM 142652 | L1958661-3 Waste 18-JUN-17 781-44 MM 142653 | L1958661-4 Waste 11-JUN-17 787-48 MM 142521 | L1958661-5 Waste 08-JUN-17 793-32A MM 142519 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | 0.01 | <0.01 | 0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | 1.02 | 3.55 | 0.32 | 0.98 | 1.89 |
| | Nickel (Ni) (ppm) | 2.6 | 2.4 | 2.7 | 11.2 | 2.6 |
| | Niobium (Nb) (ppm) | <0.05 | 0.16 | 0.09 | 0.09 | 0.14 |
| | Phosphorus (P) (ppm) | 600 | 750 | 720 | 740 | 670 |
| | Potassium (K) (%) | 0.20 | 0.55 | 0.37 | 0.39 | 0.28 |
| | Rhenium (Re) (ppm) | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 |
| | Rubidium (Rb) (ppm) | 12.7 | 29.1 | 18.4 | 21.3 | 16.2 |
| | Scandium (Sc) (ppm) | 6.0 | 4.8 | 4.6 | 5.4 | 5.0 |
| | Selenium (Se) (ppm) | 0.8 | 0.9 | 0.9 | 0.8 | 0.7 |
| | Silver (Ag) (ppm) | 0.19 | 0.31 | 0.28 | 0.44 | 0.30 |
| | Sodium (Na) (%) | 0.04 | 0.05 | 0.06 | 0.06 | 0.05 |
| | Strontium (Sr) (ppm) | 51.2 | 25.1 | 93.6 | 45.5 | 22.7 |
| | Sulfur (S) (%) | 0.01 | 0.01 | 0.06 | 0.02 | 0.01 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.02 | 0.11 | 0.06 | 0.05 | 0.09 |
| | Thallium (Tl) (ppm) | 0.06 | 0.18 | 0.10 | 0.11 | 0.10 |
| | Thorium (Th) (ppm) | 2.6 | 3.7 | 3.7 | 2.6 | 4.0 |
| | Tin (Sn) (ppm) | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| | Titanium (Ti) (%) | 0.018 | 0.092 | 0.053 | 0.068 | 0.039 |
| | Tungsten (W) (ppm) | 0.15 | 0.31 | 0.33 | 0.20 | 0.24 |
| | Uranium (U) (ppm) | 0.23 | 0.21 | 0.39 | 0.22 | 0.22 |
| | Vanadium (V) (ppm) | 44 | 54 | 50 | 51 | 43 |
| | Yttrium (Y) (ppm) | 8.86 | 7.84 | 8.54 | 8.86 | 8.52 |
| | Zinc (Zn) (ppm) | 75 | 78 | 74 | 77 | 71 |
| | Zirconium (Zr) (ppm) | 1.0 | 1.5 | 1.0 | 2.3 | 1.4 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.2 | 0.2 | 1.5 | 0.4 | <0.2 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1958661-6 | L1958661-7 | L1958661-8 | L1958661-9 | L1958661-10 |
|------------------------|--------------------------|--------------|----------------------|------------------|------------------|------------------|------------------|
| | | Description | Waste | Waste | Waste | Waste | Waste |
| | | Sampled Date | 09-JUN-17 | 15-JUN-17 | 14-JUN-17 | 12-JUN-17 | 14-JUN-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 793-32B MM 142520 | 787-53 MM 142651 | 787-54 MM 142525 | 787-51 MM 142523 | 787-47 MM 142524 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | | 2.81 | 3.36 | 4.93 | 1.07 | 7.79 |
| | Nickel (Ni) (ppm) | | 2.3 | 2.1 | 2.6 | 2.2 | 2.3 |
| | Niobium (Nb) (ppm) | | 0.07 | 0.17 | 0.17 | 0.06 | 0.07 |
| | Phosphorus (P) (ppm) | | 610 | 760 | 920 | 550 | 870 |
| | Potassium (K) (%) | | 0.21 | 0.39 | 0.70 | 0.21 | 0.15 |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | 0.003 | <0.001 | 0.009 |
| | Rubidium (Rb) (ppm) | | 11.7 | 22.9 | 38.6 | 11.1 | 8.3 |
| | Scandium (Sc) (ppm) | | 5.4 | 4.7 | 5.5 | 4.2 | 4.3 |
| | Selenium (Se) (ppm) | | 1.0 | 2.1 | 4.7 | 0.5 | 2.1 |
| | Silver (Ag) (ppm) | | 0.43 | 0.67 | 1.88 | 0.06 | 0.36 |
| | Sodium (Na) (%) | | 0.05 | 0.05 | 0.04 | 0.06 | 0.04 |
| | Strontium (Sr) (ppm) | | 27.2 | 22.5 | 55.8 | 38.4 | 59.9 |
| | Sulfur (S) (%) | | 0.02 | 0.04 | 0.22 | 0.01 | 0.22 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.09 | 0.14 | 0.27 | 0.02 | 0.05 |
| | Thallium (Tl) (ppm) | | 0.07 | 0.19 | 0.30 | 0.05 | 0.05 |
| | Thorium (Th) (ppm) | | 3.3 | 5.5 | 4.9 | 2.1 | 5.9 |
| | Tin (Sn) (ppm) | | 0.6 | 0.6 | 0.8 | 0.5 | 0.9 |
| | Titanium (Ti) (%) | | 0.023 | 0.054 | 0.111 | 0.027 | 0.012 |
| | Tungsten (W) (ppm) | | 0.19 | 0.38 | 0.55 | 0.30 | 0.32 |
| | Uranium (U) (ppm) | | 0.21 | 0.30 | 0.29 | 0.14 | 0.48 |
| | Vanadium (V) (ppm) | | 36 | 47 | 69 | 36 | 40 |
| | Yttrium (Y) (ppm) | | 8.64 | 8.60 | 9.15 | 7.51 | 12.50 |
| | Zinc (Zn) (ppm) | | 65 | 74 | 103 | 74 | 48 |
| | Zirconium (Zr) (ppm) | | 1.0 | 1.1 | 1.2 | 0.7 | 1.7 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.2 | 0.2 | 0.9 | 0.4 | 1.4 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1958661-11 Waste 11-JUN-17 787-50 MM 142522 | L1958661-12 Waste 21-JUN-17 781-38 MM 142656 | L1958661-13 Waste 20-JUN-17 781-44 MM 142655 | L1958661-14 Waste 24-JUN-17 781-45 MM 142657 | L1958661-15 Waste 24-JUN-17 781-45 MM 142658 |
|---|--------------------------|---|---|---|---|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | 0.90 | 0.60 | 1.31 | 0.80 | 2.16 |
| | Nickel (Ni) (ppm) | 2.9 | 2.8 | 3.4 | 2.3 | 6.2 |
| | Niobium (Nb) (ppm) | 0.07 | 0.16 | 0.17 | 0.14 | 0.32 |
| | Phosphorus (P) (ppm) | 720 | 690 | 690 | 690 | 970 |
| | Potassium (K) (%) | 0.38 | 0.36 | 0.47 | 0.31 | 0.81 |
| | Rhenium (Re) (ppm) | <0.001 | 0.001 | 0.001 | 0.002 | 0.005 |
| | Rubidium (Rb) (ppm) | 19.3 | 17.8 | 22.9 | 14.7 | 40.0 |
| | Scandium (Sc) (ppm) | 6.0 | 5.4 | 4.6 | 3.4 | 4.9 |
| | Selenium (Se) (ppm) | 0.5 | 0.9 | 0.9 | 0.5 | 8.5 |
| | Silver (Ag) (ppm) | 0.21 | 0.19 | 0.28 | 0.15 | 2.71 |
| | Sodium (Na) (%) | 0.06 | 0.07 | 0.07 | 0.08 | 0.05 |
| | Strontium (Sr) (ppm) | 36.4 | 88.4 | 72.8 | 61.7 | 36.6 |
| | Sulfur (S) (%) | 0.01 | 0.05 | 0.06 | 0.06 | 0.67 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.04 | 0.04 | 0.04 | 0.03 | 0.52 |
| | Thallium (Tl) (ppm) | 0.10 | 0.10 | 0.12 | 0.08 | 0.33 |
| | Thorium (Th) (ppm) | 2.8 | 3.2 | 2.9 | 2.0 | 5.0 |
| | Tin (Sn) (ppm) | 0.6 | 0.7 | 0.6 | 0.5 | 0.7 |
| | Titanium (Ti) (%) | 0.051 | 0.059 | 0.085 | 0.074 | 0.144 |
| | Tungsten (W) (ppm) | 0.24 | 0.47 | 0.59 | 0.53 | 4.93 |
| | Uranium (U) (ppm) | 0.21 | 0.26 | 0.33 | 0.38 | 0.25 |
| | Vanadium (V) (ppm) | 50 | 48 | 50 | 48 | 70 |
| | Yttrium (Y) (ppm) | 9.74 | 9.27 | 10.15 | 6.12 | 8.08 |
| | Zinc (Zn) (ppm) | 83 | 68 | 70 | 67 | 72 |
| | Zirconium (Zr) (ppm) | 1.1 | 0.8 | 1.0 | 1.0 | 1.3 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | <0.2 | 1.2 | 0.8 | 1.1 | 0.7 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1958661-16 | L1958661-17 | | |
|------------------------|--------------------------|--------------|------------------|------------------|--|--|
| | | Description | Waste | Waste | | |
| | | Sampled Date | 25-JUN-17 | | | |
| | | Sampled Time | | | | |
| | | Client ID | 781-46 MM 142659 | 787-46 MM 142518 | | |
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | <0.01 | | |
| | Molybdenum (Mo) (ppm) | | 2.23 | 0.63 | | |
| | Nickel (Ni) (ppm) | | 2.4 | 2.8 | | |
| | Niobium (Nb) (ppm) | | 0.31 | 0.18 | | |
| | Phosphorus (P) (ppm) | | 770 | 590 | | |
| | Potassium (K) (%) | | 0.57 | 0.38 | | |
| | Rhenium (Re) (ppm) | | 0.007 | 0.001 | | |
| | Rubidium (Rb) (ppm) | | 29.2 | 18.7 | | |
| | Scandium (Sc) (ppm) | | 4.8 | 4.0 | | |
| | Selenium (Se) (ppm) | | 2.6 | 0.7 | | |
| | Silver (Ag) (ppm) | | 0.96 | 0.05 | | |
| | Sodium (Na) (%) | | 0.07 | 0.09 | | |
| | Strontium (Sr) (ppm) | | 80.3 | 76.9 | | |
| | Sulfur (S) (%) | | 0.23 | 0.01 | | |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | | |
| | Tellurium (Te) (ppm) | | 0.16 | 0.01 | | |
| | Thallium (Tl) (ppm) | | 0.20 | 0.11 | | |
| | Thorium (Th) (ppm) | | 3.2 | 3.0 | | |
| | Tin (Sn) (ppm) | | 0.7 | 0.6 | | |
| | Titanium (Ti) (%) | | 0.103 | 0.069 | | |
| | Tungsten (W) (ppm) | | 0.73 | 0.35 | | |
| | Uranium (U) (ppm) | | 0.56 | 0.26 | | |
| | Vanadium (V) (ppm) | | 57 | 43 | | |
| | Yttrium (Y) (ppm) | | 10.75 | 9.75 | | |
| | Zinc (Zn) (ppm) | | 89 | 61 | | |
| | Zirconium (Zr) (ppm) | | 1.0 | 0.9 | | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 1.4 | 0.7 | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|--------|--|-----------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| <p>A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.</p> | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06-AX | Soil | Sulfide Sulfur Calc from Carbonate Leach | ALS Minerals S-CAL06 |
| <p>Sulfide Sulfur (as S) is calculated by subtracting the Carbonate Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.</p> | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| <p>A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| <p>A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).</p> | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| <p>The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.</p> | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17 21

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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 Plus Appendix Pages
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 Account: APN

CERTIFICATE VA17152306

Project: L1958661
 P.O. No.: ALSM-CW16-102-APN
 This report is for 17 Other samples submitted to our lab in Vancouver, BC, Canada on 18-JUL-2017.
 The following have access to data associated with this certificate:

| | | |
|--------------------------|----------------------------|-------------|
| ELSE VANCOUVER WEBTRIEVE | SOFTWARE DEVELOPMENT GROUP | SHANE STACK |
|--------------------------|----------------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |
| PUL-QC | Pulverizing QC Test |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|------------|
| ALS CODE | DESCRIPTION | INSTRUMENT |
| ME-OG46 | Ore Grade Elements - AquaRegia | ICP-AES |
| Cu-OG46 | Ore Grade Cu - Aqua Regia | ICP-AES |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method | WEI-21 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|------------------------------|---------|-----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | Analyte | Recvd Wt. | Ag | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs |
| | Units | kg | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm |
| | LOR | | | | | | | | | | | | | | | |
| L1958661-1 787-49 MM 142654 | | 1.06 | 0.19 | 0.72 | 3.2 | <0.02 | <10 | 180 | 0.41 | 0.09 | 1.28 | 0.12 | 24.7 | 5.8 | 4 | 0.55 |
| L1958661-2 787-52 MM 142652 | | 1.10 | 0.31 | 1.07 | 1.0 | 0.05 | <10 | 280 | 0.25 | 0.15 | 0.30 | 0.31 | 26.8 | 6.8 | 4 | 0.46 |
| L1958661-3 781-44 MM 142653 | | 1.08 | 0.28 | 1.22 | 1.1 | 0.04 | <10 | 260 | 0.43 | 0.19 | 1.29 | 0.08 | 34.7 | 6.9 | 5 | 0.48 |
| L1958661-4 787-48 MM 142521 | | 1.10 | 0.44 | 1.10 | 2.9 | 0.05 | <10 | 250 | 0.36 | 0.18 | 0.69 | 0.38 | 26.6 | 7.0 | 8 | 0.37 |
| L1958661-5 793-32A MM 142519 | | 1.12 | 0.30 | 0.86 | 1.3 | 0.05 | <10 | 180 | 0.34 | 0.15 | 0.27 | 0.27 | 28.0 | 5.6 | 6 | 0.35 |
| L1958661-6 793-32B MM 142520 | | 1.08 | 0.43 | 0.78 | 1.0 | 0.05 | <10 | 160 | 0.32 | 0.18 | 0.30 | 0.38 | 24.7 | 5.5 | 5 | 0.35 |
| L1958661-7 787-53 MM 142651 | | 1.08 | 0.67 | 0.76 | 1.8 | 0.08 | <10 | 120 | 0.25 | 0.24 | 0.27 | 0.46 | 24.8 | 5.7 | 5 | 0.41 |
| L1958661-8 787-54 MM 142525 | | 1.10 | 1.88 | 1.11 | 0.6 | 0.16 | <10 | 210 | 0.27 | 0.64 | 0.73 | 0.46 | 26.9 | 7.6 | 6 | 0.58 |
| L1958661-9 787-51 MM 142543 | | 1.06 | 0.06 | 0.97 | 0.8 | <0.02 | <10 | 170 | 0.38 | 0.03 | 0.61 | 0.42 | 22.5 | 5.3 | 5 | 0.32 |
| L1958661-10 787-47 MM 142524 | | 1.14 | 0.36 | 0.53 | 3.0 | 0.04 | <10 | 90 | 0.34 | 0.17 | 1.22 | 0.09 | 42.3 | 7.2 | 3 | 0.28 |
| L1958661-11 787-50 MM 142522 | | 1.06 | 0.21 | 1.06 | 3.2 | 0.03 | <10 | 270 | 0.40 | 0.13 | 0.39 | 0.24 | 28.6 | 6.3 | 5 | 0.38 |
| L1958661-12 781-38 MM 142656 | | 1.12 | 0.19 | 1.11 | 1.0 | 0.02 | <10 | 190 | 0.32 | 0.08 | 1.15 | 0.10 | 28.5 | 6.0 | 5 | 0.48 |
| L1958661-13 781-44 MM 142655 | | 1.06 | 0.28 | 1.11 | 0.7 | <0.02 | <10 | 260 | 0.35 | 0.12 | 1.01 | 0.10 | 28.1 | 7.1 | 6 | 0.41 |
| L1958661-14 781-45 MM 142657 | | 1.08 | 0.15 | 1.21 | 0.7 | <0.02 | <10 | 150 | 0.36 | 0.06 | 1.27 | 0.04 | 19.95 | 5.9 | 5 | 0.29 |
| L1958661-15 781-45 MM 142658 | | 1.12 | 2.71 | 1.43 | 0.6 | 0.24 | <10 | 170 | 0.21 | 2.86 | 0.89 | 0.17 | 17.75 | 6.5 | 7 | 0.66 |
| L1958661-16 781-46 MM 142659 | | 1.08 | 0.96 | 1.35 | 1.2 | 0.09 | <10 | 200 | 0.44 | 0.66 | 1.41 | 0.69 | 23.0 | 6.6 | 5 | 0.69 |
| L1958661-17 781-46 MM 142518 | | 1.08 | 0.05 | 1.09 | 1.3 | <0.02 | <10 | 200 | 0.34 | 0.02 | 0.90 | 0.07 | 28.0 | 5.7 | 5 | 0.44 |



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CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|------------------------------|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| | | Cu | Fe | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb |
| | | ppm | % | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm |
| | | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 |
| L1958661-1 787-49 MM 142654 | | 705 | 2.26 | 4.36 | 0.10 | 0.04 | 0.01 | 0.044 | 0.20 | 12.6 | 4.6 | 0.27 | 648 | 1.02 | 0.04 | <0.05 |
| L1958661-2 787-52 MM 142652 | | 2650 | 2.37 | 5.24 | 0.11 | 0.06 | 0.01 | 0.048 | 0.55 | 14.5 | 5.9 | 0.48 | 570 | 3.55 | 0.05 | 0.16 |
| L1958661-3 781-44 MM 142653 | | 751 | 2.56 | 6.64 | 0.13 | 0.05 | <0.01 | 0.033 | 0.37 | 18.3 | 7.5 | 0.74 | 599 | 0.32 | 0.06 | 0.09 |
| L1958661-4 787-48 MM 142521 | | 1460 | 2.39 | 5.75 | 0.12 | 0.09 | 0.01 | 0.042 | 0.39 | 13.7 | 8.9 | 0.61 | 578 | 0.98 | 0.06 | 0.09 |
| L1958661-5 793-32A MM 142519 | | 2030 | 2.20 | 4.46 | 0.11 | 0.05 | 0.01 | 0.045 | 0.28 | 15.6 | 4.5 | 0.32 | 493 | 1.89 | 0.05 | 0.14 |
| L1958661-6 793-32B MM 142520 | | 2170 | 1.91 | 4.20 | 0.10 | 0.05 | 0.01 | 0.052 | 0.21 | 12.4 | 4.1 | 0.29 | 529 | 2.81 | 0.05 | 0.07 |
| L1958661-7 787-53 MM 142651 | | 3940 | 2.15 | 4.00 | 0.10 | 0.04 | <0.01 | 0.074 | 0.39 | 13.2 | 3.3 | 0.31 | 625 | 3.36 | 0.05 | 0.17 |
| L1958661-8 787-54 MM 142525 | | 7450 | 2.93 | 5.88 | 0.12 | 0.05 | <0.01 | 0.120 | 0.70 | 14.3 | 5.1 | 0.69 | 636 | 4.93 | 0.04 | 0.17 |
| L1958661-9 787-51 MM 142543 | | 1195 | 2.00 | 5.19 | 0.10 | 0.04 | <0.01 | 0.025 | 0.21 | 12.1 | 6.9 | 0.47 | 559 | 1.07 | 0.06 | 0.06 |
| L1958661-10 787-47 MM 142524 | | 2830 | 2.17 | 3.31 | 0.12 | 0.04 | <0.01 | 0.072 | 0.15 | 21.8 | 2.6 | 0.26 | 498 | 7.79 | 0.04 | 0.07 |
| L1958661-11 787-50 MM 142522 | | 1455 | 2.53 | 5.51 | 0.12 | 0.05 | 0.01 | 0.044 | 0.38 | 14.5 | 8.6 | 0.42 | 663 | 0.90 | 0.06 | 0.07 |
| L1958661-12 781-38 MM 142656 | | 739 | 2.35 | 5.74 | 0.12 | 0.04 | <0.01 | 0.035 | 0.36 | 14.7 | 7.3 | 0.69 | 604 | 0.60 | 0.07 | 0.16 |
| L1958661-13 781-44 MM 142655 | | 836 | 2.36 | 5.61 | 0.12 | 0.06 | <0.01 | 0.036 | 0.47 | 14.8 | 6.1 | 0.64 | 607 | 1.31 | 0.07 | 0.17 |
| L1958661-14 781-45 MM 142657 | | 426 | 2.33 | 6.05 | 0.11 | 0.05 | <0.01 | 0.026 | 0.31 | 10.6 | 7.5 | 0.73 | 567 | 0.80 | 0.08 | 0.14 |
| L1958661-15 781-45 MM 142658 | | >10000 | 4.35 | 8.85 | 0.14 | 0.06 | 0.01 | 0.136 | 0.81 | 9.2 | 7.2 | 0.83 | 670 | 2.16 | 0.05 | 0.32 |
| L1958661-16 781-46 MM 142659 | | 2780 | 3.18 | 7.55 | 0.13 | 0.05 | <0.01 | 0.060 | 0.57 | 11.3 | 7.5 | 0.76 | 880 | 2.23 | 0.07 | 0.31 |
| L1958661-17 781-46 MM 142518 | | 191.0 | 2.10 | 5.74 | 0.12 | 0.04 | <0.01 | 0.026 | 0.38 | 14.2 | 7.4 | 0.63 | 570 | 0.63 | 0.09 | 0.18 |

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CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|------------------------------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| | Analyte | Ni | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti |
| | Units LOR | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % |
| | | 0.2 | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 |
| L1958661-1 787-49 MM 142654 | | 2.6 | 600 | 4.7 | 12.7 | <0.001 | 0.01 | 0.06 | 6.0 | 0.8 | 0.6 | 51.2 | <0.01 | 0.02 | 2.6 | 0.018 |
| L1958661-2 787-52 MM 142652 | | 2.4 | 750 | 2.8 | 29.1 | <0.001 | 0.01 | <0.05 | 4.8 | 0.9 | 0.6 | 25.1 | <0.01 | 0.11 | 3.7 | 0.092 |
| L1958661-3 781-44 MM 142653 | | 2.7 | 720 | 3.2 | 18.4 | <0.001 | 0.06 | <0.05 | 4.6 | 0.9 | 0.6 | 93.6 | <0.01 | 0.06 | 3.7 | 0.053 |
| L1958661-4 787-48 MM 142521 | | 11.2 | 740 | 2.9 | 21.3 | 0.001 | 0.02 | <0.05 | 5.4 | 0.8 | 0.6 | 45.5 | <0.01 | 0.05 | 2.6 | 0.068 |
| L1958661-5 793-32A MM 142519 | | 2.6 | 670 | 3.5 | 16.2 | <0.001 | 0.01 | <0.05 | 5.0 | 0.7 | 0.6 | 22.7 | <0.01 | 0.09 | 4.0 | 0.039 |
| L1958661-6 793-32B MM 142520 | | 2.3 | 610 | 3.1 | 11.7 | <0.001 | 0.02 | <0.05 | 5.4 | 1.0 | 0.6 | 27.2 | <0.01 | 0.09 | 3.3 | 0.023 |
| L1958661-7 787-53 MM 142651 | | 2.1 | 760 | 4.8 | 22.9 | <0.001 | 0.04 | <0.05 | 4.7 | 2.1 | 0.6 | 22.5 | <0.01 | 0.14 | 5.5 | 0.054 |
| L1958661-8 787-54 MM 142525 | | 2.6 | 920 | 3.6 | 38.6 | 0.003 | 0.22 | <0.05 | 5.5 | 4.7 | 0.8 | 55.8 | <0.01 | 0.27 | 4.9 | 0.111 |
| L1958661-9 787-51 MM 142543 | | 2.2 | 550 | 2.9 | 11.1 | <0.001 | 0.01 | <0.05 | 4.2 | 0.5 | 0.5 | 38.4 | <0.01 | 0.02 | 2.1 | 0.027 |
| L1958661-10 787-47 MM 142524 | | 2.3 | 870 | 4.9 | 8.3 | 0.009 | 0.22 | 0.07 | 4.3 | 2.1 | 0.9 | 59.9 | <0.01 | 0.05 | 5.9 | 0.012 |
| L1958661-11 787-50 MM 142522 | | 2.9 | 720 | 3.1 | 19.3 | <0.001 | 0.01 | 0.05 | 6.0 | 0.5 | 0.6 | 36.4 | <0.01 | 0.04 | 2.8 | 0.051 |
| L1958661-12 781-38 MM 142656 | | 2.8 | 690 | 3.3 | 17.8 | 0.001 | 0.05 | 0.06 | 5.4 | 0.9 | 0.7 | 88.4 | <0.01 | 0.04 | 3.2 | 0.059 |
| L1958661-13 781-44 MM 142655 | | 3.4 | 690 | 2.7 | 22.9 | 0.001 | 0.06 | <0.05 | 4.6 | 0.9 | 0.6 | 72.8 | <0.01 | 0.04 | 2.9 | 0.085 |
| L1958661-14 781-45 MM 142657 | | 2.3 | 690 | 3.3 | 14.7 | 0.002 | 0.06 | <0.05 | 3.4 | 0.5 | 0.5 | 61.7 | <0.01 | 0.03 | 2.0 | 0.074 |
| L1958661-15 781-45 MM 142658 | | 6.2 | 970 | 4.3 | 40.0 | 0.005 | 0.67 | <0.05 | 4.9 | 8.5 | 0.7 | 36.6 | <0.01 | 0.52 | 5.0 | 0.144 |
| L1958661-16 781-46 MM 142659 | | 2.4 | 770 | 4.0 | 29.2 | 0.007 | 0.23 | <0.05 | 4.8 | 2.6 | 0.7 | 80.3 | <0.01 | 0.16 | 3.2 | 0.103 |
| L1958661-17 781-46 MM 142518 | | 2.8 | 590 | 2.9 | 18.7 | 0.001 | 0.01 | 0.05 | 4.0 | 0.7 | 0.6 | 76.9 | <0.01 | 0.01 | 3.0 | 0.069 |

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| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | Cu-OG46 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | OA-VOL08m | S-IR08 |
|------------------------------|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|------------|-----------|------------|------------|----------|-----------|--------|
| | | TI | U | V | W | Y | Zn | Zr | Cu | MPA | FIZZ RAT | NNP | NP | pH | Ratio (N | S |
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | tCaCO3/1Kt | Unity | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % |
| L1958661-1 787-49 MM 142654 | | 0.02 | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 0.001 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 |
| L1958661-2 787-52 MM 142652 | | 0.06 | 0.23 | 44 | 0.15 | 8.86 | 75 | 1.0 | | 0.3 | 1 | 32 | 32 | 8.4 | 102.40 | 0.01 |
| L1958661-3 781-44 MM 142653 | | 0.18 | 0.21 | 54 | 0.31 | 7.84 | 78 | 1.5 | | 0.3 | 1 | 9 | 9 | 8.3 | 28.80 | 0.01 |
| L1958661-4 787-48 MM 142521 | | 0.10 | 0.39 | 50 | 0.33 | 8.54 | 74 | 1.0 | | 1.6 | 2 | 32 | 34 | 8.5 | 21.76 | 0.05 |
| L1958661-5 793-32A MM 142519 | | 0.11 | 0.22 | 51 | 0.20 | 8.86 | 77 | 2.3 | | 0.3 | 2 | 18 | 18 | 8.3 | 57.60 | 0.01 |
| L1958661-6 793-32B MM 142520 | | 0.10 | 0.22 | 43 | 0.24 | 8.52 | 71 | 1.4 | | 0.3 | 1 | 7 | 7 | 8.2 | 22.40 | 0.01 |
| L1958661-7 787-53 MM 142651 | | 0.07 | 0.21 | 36 | 0.19 | 8.64 | 65 | 1.0 | | 0.3 | 1 | 7 | 7 | 8.2 | 22.40 | 0.01 |
| L1958661-8 787-54 MM 142525 | | 0.19 | 0.30 | 47 | 0.38 | 8.60 | 74 | 1.1 | | 0.9 | 1 | 7 | 8 | 8.3 | 8.53 | 0.03 |
| L1958661-9 787-51 MM 142543 | | 0.30 | 0.29 | 69 | 0.55 | 9.15 | 103 | 1.2 | | 5.9 | 2 | 17 | 23 | 8.5 | 3.87 | 0.19 |
| L1958661-10 787-47 MM 142524 | | 0.05 | 0.14 | 36 | 0.30 | 7.51 | 74 | 0.7 | | <0.3 | 2 | 15 | 15 | 8.5 | 96.00 | <0.01 |
| L1958661-11 787-50 MM 142522 | | 0.05 | 0.48 | 40 | 0.32 | 12.50 | 48 | 1.7 | | 5.6 | 2 | 27 | 33 | 8.5 | 5.87 | 0.18 |
| L1958661-12 781-38 MM 142656 | | 0.10 | 0.21 | 50 | 0.24 | 9.74 | 83 | 1.1 | | <0.3 | 1 | 8 | 8 | 8.2 | 51.20 | <0.01 |
| L1958661-13 781-44 MM 142655 | | 0.10 | 0.26 | 48 | 0.47 | 9.27 | 68 | 0.8 | | 0.9 | 2 | 28 | 29 | 8.5 | 30.93 | 0.03 |
| L1958661-14 781-45 MM 142657 | | 0.12 | 0.33 | 50 | 0.59 | 10.15 | 70 | 1.0 | | 1.3 | 2 | 24 | 25 | 8.5 | 20.00 | 0.04 |
| L1958661-15 781-45 MM 142658 | | 0.08 | 0.38 | 48 | 0.53 | 6.12 | 67 | 1.0 | | 1.3 | 2 | 27 | 28 | 8.7 | 22.40 | 0.04 |
| L1958661-16 781-46 MM 142659 | | 0.33 | 0.25 | 70 | 4.93 | 8.08 | 72 | 1.3 | 1.125 | 19.1 | 2 | 4 | 23 | 8.6 | 1.21 | 0.61 |
| L1958661-17 781-46 MM 142518 | | 0.20 | 0.56 | 57 | 0.73 | 10.75 | 89 | 1.0 | | 6.3 | 2 | 26 | 32 | 8.5 | 5.12 | 0.20 |
| | | 0.11 | 0.26 | 43 | 0.35 | 9.75 | 61 | 0.9 | | 0.3 | 2 | 21 | 21 | 8.7 | 67.20 | 0.01 |



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 Account: APN

Project: L1958661

CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method Analyte Units LOR | S-GRA06 | S-GRA06a | S-CAL06 | C-GAS05 | C-GAS05 |
|------------------------------|--------------------------|---------|----------|---------|---------|---------|
| | | S % | S % | S % | C % | CO2 % |
| | | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 |
| L1958661-1 787-49 MM 142654 | | 0.01 | 0.03 | <0.01 | 0.34 | 1.2 |
| L1958661-2 787-52 MM 142652 | | <0.01 | <0.01 | 0.01 | 0.05 | 0.2 |
| L1958661-3 781-44 MM 142653 | | <0.01 | <0.01 | 0.05 | 0.41 | 1.5 |
| L1958661-4 787-48 MM 142521 | | 0.01 | <0.01 | <0.01 | 0.12 | 0.4 |
| L1958661-5 793-32A MM 142519 | | <0.01 | <0.01 | 0.01 | <0.05 | <0.2 |
| L1958661-6 793-32B MM 142520 | | 0.01 | <0.01 | <0.01 | 0.05 | 0.2 |
| L1958661-7 787-53 MM 142651 | | 0.01 | <0.01 | 0.02 | <0.05 | 0.2 |
| L1958661-8 787-54 MM 142525 | | <0.01 | <0.01 | 0.19 | 0.25 | 0.9 |
| L1958661-9 787-51 MM 142543 | | <0.01 | <0.01 | <0.01 | 0.10 | 0.4 |
| L1958661-10 787-47 MM 142524 | | <0.01 | <0.01 | 0.18 | 0.38 | 1.4 |
| L1958661-11 787-50 MM 142522 | | <0.01 | <0.01 | <0.01 | <0.05 | <0.2 |
| L1958661-12 781-38 MM 142656 | | 0.01 | <0.01 | 0.02 | 0.33 | 1.2 |
| L1958661-13 781-44 MM 142655 | | 0.01 | <0.01 | 0.03 | 0.23 | 0.8 |
| L1958661-14 781-45 MM 142657 | | <0.01 | <0.01 | 0.04 | 0.29 | 1.1 |
| L1958661-15 781-45 MM 142658 | | 0.01 | <0.01 | 0.60 | 0.19 | 0.7 |
| L1958661-16 781-46 MM 142659 | | 0.01 | <0.01 | 0.19 | 0.38 | 1.4 |
| L1958661-17 781-46 MM 142518 | | <0.01 | <0.01 | 0.01 | 0.19 | 0.7 |



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CERTIFICATE OF ANALYSIS VA17152306

CERTIFICATE COMMENTS

| | | | | | | | | | | | | | | | | | |
|--------------------|--|-----------|----------|--------|---------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|
| | ANALYTICAL COMMENTS | | | | | | | | | | | | | | | | |
| Applies to Method: | Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41 | | | | | | | | | | | | | | | | |
| | LABORATORY ADDRESSES | | | | | | | | | | | | | | | | |
| Applies to Method: | <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">Cu-OG46</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> </tr> <tr> <td>ME-OG46</td> <td>OA-ELE07</td> <td>OA-VOL08m</td> <td>PUL-31</td> </tr> <tr> <td>PUL-QC</td> <td>S-CAL06</td> <td>S-GRA06</td> <td>S-GRA06a</td> </tr> <tr> <td>S-IR08</td> <td>SPL-21</td> <td>WEI-21</td> <td></td> </tr> </table> | C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | |
| C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | | | | | | | | | | | | | | |
| ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | | | | | | | | | | | | | | |
| PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | | | | | | | | | | | | | | |
| S-IR08 | SPL-21 | WEI-21 | | | | | | | | | | | | | | | |



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QC CERTIFICATE VA17152306

Project: L1958661
 P.O. No.: ALSM-CW16-102-APN
 This report is for 17 Other samples submitted to our lab in Vancouver, BC, Canada on 18-JUL-2017.
 The following have access to data associated with this certificate:

| | | |
|--------------------------|----------------------------|-------------|
| ELSE VANCOUVER WEBTRIEVE | SOFTWARE DEVELOPMENT GROUP | SHANE STACK |
|--------------------------|----------------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |
| PUL-QC | Pulverizing QC Test |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|------------|
| ALS CODE | DESCRIPTION | INSTRUMENT |
| ME-OG46 | Ore Grade Elements - AquaRegia | ICP-AES |
| Cu-OG46 | Ore Grade Cu - Aqua Regia | ICP-AES |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17152306

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Ag ppm | Al % | As ppm | Au ppm | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | |
| | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 4.10 | 2.56 | 33.0 | <0.02 | <10 | 430 | 0.82 | 0.63 | 1.03 | 2.24 | 72.3 | 18.8 | 88 | 10.50 | 597 | |
| Target Range - Lower Bound | 4.00 | 2.44 | 29.6 | <0.02 | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 | |
| Upper Bound | 4.92 | 3.00 | 36.4 | 0.04 | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 | |

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QC CERTIFICATE OF ANALYSIS VA17152306

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Fe % | Ga ppm | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | |
| | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 3.44 | 9.16 | 0.18 | 0.64 | 0.06 | 0.151 | 1.22 | 36.0 | 32.2 | 1.10 | 402 | 13.95 | 0.32 | 0.92 | 665 | |
| Target Range - Lower Bound | 3.22 | 8.73 | 0.07 | 0.64 | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 | |
| Upper Bound | 3.96 | 10.80 | 0.29 | 0.83 | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 | |

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QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | | |
|----------------------------|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|-------|------|--|
| | | | | | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | |
| | | | | | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | |
| | | | | | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | |
| STANDARDS | | | | | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | | |
| MRGeo08 | | | | | 990 | 1050 | 141.0 | 0.008 | 0.30 | 3.17 | 7.0 | 1.3 | 3.2 | 77.0 | 0.01 | 0.02 | 20.8 | 0.367 | 0.76 | |
| Target Range - Lower Bound | | | | | 900 | 959 | 132.0 | 0.006 | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 | |
| Upper Bound | | | | | 1130 | 1175 | 162.0 | 0.010 | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 | |

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QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm | Cu-OG46 Cu % | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % |
|----------------------------|--------------------------|---------------|---------------|---------------|---------------|----------------|----------------|--------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|
| | | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 0.001 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | 6.1 | | | |
| Buffer pH6 | | | | | | | | | | | | | 6.1 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 5.3 | | | |
| Upper Bound | | | | | | | | | | | | | 6.7 | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | 2.55 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 2.51 |
| Upper Bound | | | | | | | | | | | | | | | | 2.71 |
| GS310-10 | | | | | | | | | | | | | | | | 0.28 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 0.25 |
| Upper Bound | | | | | | | | | | | | | | | | 0.29 |
| GS313-8 | | | | | | | | | | | | | | | | 1.25 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 1.19 |
| Upper Bound | | | | | | | | | | | | | | | | 1.29 |
| KZK-1 | | | | | | | | | 25.0 | 2 | 33 | 58 | | | | 2.32 |
| KZK-1 | | | | | | | | | 25.0 | 2 | 33 | 58 | | | | 2.32 |
| Target Range - Lower Bound | | | | | | | | | 22.9 | <1 | 30 | 54 | | | | 2.18 |
| Upper Bound | | | | | | | | | 27.1 | >4 | 38 | 64 | | | | 2.53 |
| MA-1b | | | | | | | | | | | | | | | | 1.15 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 1.12 |
| Upper Bound | | | | | | | | | | | | | | | | 1.22 |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | | 5.14 | 98 | 2.64 | 19.05 | 754 | 21.4 | | | | | | | | | |
| Target Range - Lower Bound | | 4.93 | 90 | 2.44 | 17.50 | 708 | 18.1 | | | | | | | | | |
| Upper Bound | | 6.13 | 112 | 3.42 | 21.5 | 870 | 25.7 | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method Analyte Units | S-GRA06a | C-GAS05 | C-GAS05 |
|----------------------------|----------------------|----------|---------|----------|
| | LOR | S % | C % | CO2 % |
| | | 0.01 | 0.05 | 0.2 |
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| CO-ASSAY | | 0.48 | 1.8 | |
| Target Range - Lower Bound | | 0.42 | 1.5 | |
| Upper Bound | | 0.64 | 2.4 | |
| DS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS310-10 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS313-8 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-1b | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-2c | | 1.63 | 6.0 | |
| Target Range - Lower Bound | | 1.50 | 5.5 | |
| Upper Bound | | 1.84 | 6.8 | |
| MA-3a | | 2.34 | 8.6 | |
| Target Range - Lower Bound | | 2.31 | 8.4 | |
| Upper Bound | | 2.77 | 10.2 | |
| MRGeo08 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |



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QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method Analyte Units LOR | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | |
|--------------------|----------------------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--|
| | | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | | |
| OGGeo08 | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| OREAS 905 | | 0.49 | 0.82 | 33.4 | 0.37 | <10 | 250 | 0.96 | 5.53 | 0.32 | 0.36 | 82.4 | 14.0 | 17 | 1.29 | 1490 | |
| | Target Range - Lower Bound | 0.45 | 0.73 | 28.4 | 0.33 | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 | |
| | Upper Bound | 0.58 | 0.91 | 35.0 | 0.45 | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 | |
| OREAS 932 | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| OREAS-133b | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| OREAS-134b | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| SY-4 | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17152306

| Method Analyte Units LOR | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm |
|----------------------------|--------------|----------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | |
| OGGeo08 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OREAS 905 | 3.38 | 6.23 | 0.14 | 1.17 | 0.01 | 0.586 | 0.31 | 40.7 | 5.0 | 0.15 | 343 | 2.98 | 0.09 | 0.39 | 8.9 |
| Target Range - Lower Bound | 3.14 | 5.74 | <0.05 | 1.08 | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 |
| Upper Bound | 3.86 | 7.12 | 0.22 | 1.36 | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 |
| OREAS 932 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OREAS-133b | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OREAS-134b | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17152306

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | P ppm | Pb ppm | Rb ppm | Re ppm | S % | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm |
| | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 |

STANDARDS

| | | | | | | | | | | | | | | | | |
|----------------------------|-----|------|------|--------|------|------|-----|-----|-----|------|-------|------|------|-------|------|--|
| OGGeo08 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS 905 | 240 | 16.8 | 19.3 | <0.001 | 0.07 | 1.07 | 1.7 | 2.8 | 1.3 | 12.8 | <0.01 | 0.07 | 9.3 | 0.021 | 0.11 | |
| Target Range - Lower Bound | | 15.2 | 17.3 | <0.001 | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 | |
| Upper Bound | | 19.0 | 21.3 | 0.002 | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 | |
| OREAS 932 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS-133b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OREAS-134b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm | Cu-OG46 Cu % | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % |
|----------------------------|--------------------------|---------------|---------------|---------------|---------------|----------------|----------------|--------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|
| | | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 0.001 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 |
| STANDARDS | | | | | | | | | | | | | | | | |
| OGGeo08 | | | | | | | | 0.836 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.809 | | | | | | | | |
| Upper Bound | | | | | | | | 0.869 | | | | | | | | |
| OREAS 905 | | 2.27 | 6 | 0.59 | 7.40 | 65 | 48.6 | | | | | | | | | |
| Target Range - Lower Bound | | 2.08 | 4 | 0.44 | 6.32 | 58 | 39.9 | | | | | | | | | |
| Upper Bound | | 2.66 | 8 | 0.76 | 7.84 | 76 | 55.1 | | | | | | | | | |
| OREAS 932 | | | | | | | | 6.14 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 5.90 | | | | | | | | |
| Upper Bound | | | | | | | | 6.32 | | | | | | | | |
| OREAS-133b | | | | | | | | 0.033 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.031 | | | | | | | | |
| Upper Bound | | | | | | | | 0.035 | | | | | | | | |
| OREAS-134b | | | | | | | | 0.138 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.131 | | | | | | | | |
| Upper Bound | | | | | | | | 0.142 | | | | | | | | |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | 0.88 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 0.83 |
| Upper Bound | | | | | | | | | | | | | | | | 0.93 |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | 1.76 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 1.64 |
| Upper Bound | | | | | | | | | | | | | | | | 1.84 |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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| Sample Description | Method Analyte Units LOR | S-GRA06a S % 0.01 | C-GAS05 C % 0.05 | C-GAS05 CO2 % 0.2 |
|----------------------------|--------------------------|-------------------|------------------|-------------------|
| STANDARDS | | | | |
| OGGeo08 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OREAS 905 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OREAS 932 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OREAS-133b | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OREAS-134b | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| SY-4 | | | 0.85 | 3.1 |
| Target Range - Lower Bound | | | 0.84 | 3.0 |
| Upper Bound | | | 1.08 | 4.0 |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | 0.89 | | |
| Target Range - Lower Bound | | 0.81 | | |
| Upper Bound | | 0.95 | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | 1.73 | | |
| Target Range - Lower Bound | | 1.61 | | |
| Upper Bound | | 1.87 | | |

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|----------------------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--|
| Sample Description | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.01 | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | |
| Target Range - Lower Bound | <0.01 | <0.01 | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | |
| Upper Bound | 0.02 | 0.02 | 0.2 | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | 0.11 | 2.30 | 12.3 | <0.02 | <10 | 440 | 1.07 | 0.09 | 0.47 | 0.38 | 31.2 | 34.1 | 55 | 1.39 | 24.1 | |
| DUP | 0.11 | 2.41 | 12.3 | <0.02 | <10 | 450 | 1.02 | 0.09 | 0.48 | 0.35 | 30.5 | 33.7 | 57 | 1.37 | 24.9 | |
| Target Range - Lower Bound | 0.09 | 2.23 | 11.6 | <0.02 | <10 | 400 | 0.94 | 0.08 | 0.44 | 0.34 | 29.3 | 32.1 | 52 | 1.26 | 23.4 | |
| Upper Bound | 0.13 | 2.48 | 13.0 | 0.04 | 20 | 490 | 1.15 | 0.10 | 0.51 | 0.39 | 32.4 | 35.7 | 60 | 1.50 | 25.6 | |



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QC CERTIFICATE OF ANALYSIS VA17152306

| Method Analyte Units LOR | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm |
|----------------------------|--------------|----------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.05 | 0.08 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 |
| Upper Bound | 0.02 | 0.10 | 0.10 | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| ORIGINAL | 5.40 | 13.80 | 0.15 | 0.04 | 0.06 | 0.054 | 0.13 | 12.8 | 35.1 | 1.45 | 4470 | 0.68 | 0.01 | 1.10 | 29.9 |
| DUP | 5.63 | 14.00 | 0.16 | 0.04 | 0.05 | 0.052 | 0.13 | 12.6 | 32.6 | 1.49 | 4550 | 0.70 | 0.01 | 1.05 | 30.2 |
| Target Range - Lower Bound | 5.23 | 13.15 | 0.10 | <0.02 | 0.04 | 0.045 | 0.11 | 11.9 | 32.1 | 1.39 | 4280 | 0.61 | <0.01 | 0.97 | 28.3 |
| Upper Bound | 5.80 | 14.65 | 0.21 | 0.06 | 0.07 | 0.061 | 0.15 | 13.5 | 35.6 | 1.55 | 4740 | 0.77 | 0.02 | 1.18 | 31.8 |



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QC CERTIFICATE OF ANALYSIS VA17152306

| Method Analyte Units LOR | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 | ME-MS41 Rb ppm 0.1 | ME-MS41 Re ppm 0.001 | ME-MS41 S % 0.01 | ME-MS41 Sb ppm 0.05 | ME-MS41 Sc ppm 0.1 | ME-MS41 Se ppm 0.2 | ME-MS41 Sn ppm 0.2 | ME-MS41 Sr ppm 0.2 | ME-MS41 Ta ppm 0.01 | ME-MS41 Te ppm 0.01 | ME-MS41 Th ppm 0.2 | ME-MS41 Ti % 0.005 | ME-MS41 Tl ppm 0.02 |
|----------------------------|------------------|--------------------|--------------------|----------------------|------------------|---------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|--------------------|--------------------|---------------------|
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <10 | <0.2 | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | 0.01 | <0.2 | <0.005 | <0.02 |
| Target Range - Lower Bound | <10 | <0.2 | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 |
| Upper Bound | 20 | 0.4 | 0.2 | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| ORIGINAL | 1030 | 14.2 | 12.7 | <0.001 | 0.02 | 0.78 | 12.9 | 0.9 | 1.4 | 59.1 | <0.01 | 0.01 | 0.9 | 0.194 | 0.19 |
| DUP | 1050 | 12.4 | 12.7 | <0.001 | 0.02 | 0.78 | 13.1 | 1.1 | 1.4 | 57.8 | <0.01 | <0.01 | 0.8 | 0.210 | 0.18 |
| Target Range - Lower Bound | 980 | 12.4 | 12.0 | <0.001 | <0.01 | 0.67 | 12.3 | 0.8 | 1.1 | 55.3 | <0.01 | <0.01 | 0.6 | 0.187 | 0.15 |
| Upper Bound | 1100 | 14.2 | 13.4 | 0.002 | 0.03 | 0.89 | 13.8 | 1.3 | 1.7 | 61.6 | 0.02 | 0.02 | 1.1 | 0.217 | 0.22 |

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QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm 0.05 | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | Cu-OG46 Cu % 0.001 | OA-VOL08m MPA tCaCO3/1Kt 0.3 | OA-VOL08m FIZZ RAT Unity 1 | OA-VOL08m NNP tCaCO3/1Kt 1 | OA-VOL08m NP tCaCO3/1Kt 1 | OA-ELE07 pH Unity 0.1 | OA-VOL08m Ratio (N) Unity 0.01 | S-IR08 S % 0.01 | S-GRA06 S % 0.01 |
|----------------------------|--------------------------|--------------------|-----------------|--------------------|--------------------|------------------|--------------------|--------------------|------------------------------|----------------------------|----------------------------|---------------------------|-----------------------|--------------------------------|-----------------|------------------|
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | <0.001 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.001 | | | | | | | | |
| Upper Bound | | | | | | | | 0.002 | | | | | | | | |
| BLANK | | <0.05 | <1 | <0.05 | <0.05 | <2 | <0.5 | | | | | | | | | |
| Target Range - Lower Bound | | <0.05 | <1 | <0.05 | <0.05 | <2 | <0.5 | | | | | | | | | |
| Upper Bound | | 0.10 | 2 | 0.10 | 0.10 | 4 | 1.0 | | | | | | | | | |
| BLANK | | | | | | | | | | | | | 5.9 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 5.5 | | | |
| Upper Bound | | | | | | | | | | | | | 6.9 | | | |
| BLANK | | | | | | | | | | | | | | | | <0.01 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | <0.01 |
| Upper Bound | | | | | | | | | | | | | | | | 0.02 |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | <0.01 |
| BLANK | | | | | | | | | | | | | | | | 0.01 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | <0.01 |
| Upper Bound | | | | | | | | | | | | | | | | 0.02 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | 1.370 | | | | | | | | |
| DUP | | | | | | | | 1.405 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.350 | | | | | | | | |
| Upper Bound | | | | | | | | 1.425 | | | | | | | | |
| ORIGINAL | | 0.33 | 143 | 0.13 | 16.95 | 400 | 1.0 | | | | | | | | | |
| DUP | | 0.32 | 148 | 0.10 | 17.25 | 411 | 1.0 | | | | | | | | | |
| Target Range - Lower Bound | | 0.26 | 137 | 0.06 | 16.20 | 383 | <0.5 | | | | | | | | | |
| Upper Bound | | 0.39 | 154 | 0.17 | 18.00 | 428 | 1.6 | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method Analyte Units LOR | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % |
|----------------------------|--------------------------|--------------|-------------|---------------|
| | | 0.01 | 0.05 | 0.2 |
| BLANKS | | | | |
| BLANK | | | <0.05 | <0.2 |
| BLANK | | | <0.05 | <0.2 |
| Target Range - Lower Bound | | | <0.05 | <0.2 |
| Upper Bound | | | 0.10 | 0.4 |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | <0.01 | | |
| Target Range - Lower Bound | | <0.01 | | |
| Upper Bound | | 0.02 | | |
| BLANK | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DUPLICATES | | | | |
| ORIGINAL | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| ORIGINAL | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

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QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | |
|--|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|------|-----|
| | | | | | Ag | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu |
| | | | | | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| L1958661-10 787-47 MM 142524 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958661-16 781-46 MM 142659 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958661-17 781-46 MM 142518 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958669-7 142666 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958669-8 142667 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958669-9 142668 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | |
|--|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|------|-----|
| | | | | | Fe | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni |
| | | | | | % | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm |
| | | | | | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| L1958661-10 787-47 MM 142524 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958661-16 781-46 MM 142659 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958661-17 781-46 MM 142518 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958669-7 142666 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958669-8 142667 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958669-9 142668 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | | |
|------------------------------|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|-----|-------|------|
| | | | | | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl |
| | | | | | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| | | | | | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| L1958661-10 787-47 MM 142524 | | | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958661-16 781-46 MM 142659 | | | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958661-17 781-46 MM 142518 | | | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958669-7 142666 | | | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958669-8 142667 | | | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958669-9 142668 | | | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

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Project: L1958661

QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm 0.05 | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | Cu-OG46 Cu % 0.001 | OA-VOL08m MPA tCaCO3/1Kt 0.3 | OA-VOL08m FIZZ RAT Unity 1 | OA-VOL08m NNP tCaCO3/1Kt 1 | OA-VOL08m NP tCaCO3/1Kt 1 | OA-ELE07 pH Unity 0.1 | OA-VOL08m Ratio (N) Unity 0.01 | S-IR08 S % 0.01 | S-GRA06 S % 0.01 |
|-------------------------------------|--------------------------|--------------------|-----------------|--------------------|--------------------|------------------|--------------------|--------------------|------------------------------|----------------------------|----------------------------|---------------------------|-----------------------|--------------------------------|-----------------|------------------|
| DUPLICATES | | | | | | | | | | | | | | | | |
| L1958661-10 787-47 MM 142524 DUP | | | | | | | | | | | | | | | | 0.18 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 0.20 |
| Upper Bound | | | | | | | | | | | | | | | | 0.18 |
| L1958661-16 781-46 MM 142659 DUP | | | | | | | | | | | | | | | | 0.20 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | 0.19 |
| Upper Bound | | | | | | | | | | | | | | | | 0.18 |
| L1958661-17 781-46 MM 142518 DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1958669-7 142666 DUP | | | | | | | | | | | | | 8.5 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 8.5 | | | |
| Upper Bound | | | | | | | | | | | | | 8.0 | | | |
| L1958669-8 142667 DUP | | | | | | | | | 0.6 | 2 | 22 | 23 | | | 36.80 | |
| Target Range - Lower Bound | | | | | | | | 0.6 | 2 | 22 | 23 | | | | 36.80 | |
| Upper Bound | | | | | | | | <0.3 | <1 | 20 | 21 | | | | 34.95 | |
| | | | | | | | | 0.9 | 3 | 24 | 25 | | | | 38.65 | |
| L1958669-9 142668 DUP | | | | | | | | | | | | | | | | <0.01 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | <0.01 |
| Upper Bound | | | | | | | | | | | | | | | | 0.02 |

***** See Appendix Page for comments regarding this certificate *****



ALS Canada Ltd.
 2103 Dollarton Hwy
 North Vancouver BC V7H 0A7
 Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
 www.alsglobal.com

To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 5 - E
 Total # Pages: 5 (A - E)
 Plus Appendix Pages
 Finalized Date: 5-AUG-2017
 Account: APN

Project: L1958661

QC CERTIFICATE OF ANALYSIS VA17152306

| Sample Description | Method Analyte Units LOR | S-GRA06a S % 0.01 | C-GAS05 C % 0.05 | C-GAS05 CO2 % 0.2 |
|--|--------------------------|------------------------|------------------------|---------------------|
| DUPLICATES | | | | |
| L1958661-10 787-47 MM 142524 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1958661-16 781-46 MM 142659 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1958661-17 781-46 MM 142518 DUP Target Range - Lower Bound Upper Bound | | 0.19 0.13 0.25 | 0.7 0.5 0.9 | |
| L1958669-7 142666 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1958669-8 142667 DUP Target Range - Lower Bound Upper Bound | | | | |
| L1958669-9 142668 DUP Target Range - Lower Bound Upper Bound | | <0.01 <0.01 0.02 | <0.05 <0.05 0.10 | <0.2 <0.2 0.4 |
| | | | | |

***** See Appendix Page for comments regarding this certificate *****



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: Appendix 1
 Total # Appendix Pages: 1
 Finalized Date: 5-AUG-2017
 Account: APN

Project: L1958661

QC CERTIFICATE OF ANALYSIS VA17152306

| | CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | |
|--------------------|---|-----------|----------|--------|---------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|
| Applies to Method: | <p style="text-align: center;">ANALYTICAL COMMENTS</p> <p>Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41</p> | | | | | | | | | | | | | | | | |
| Applies to Method: | <p style="text-align: center;">LABORATORY ADDRESSES</p> <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">Cu-OG46</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> </tr> <tr> <td>ME-OG46</td> <td>OA-ELE07</td> <td>OA-VOL08m</td> <td>PUL-31</td> </tr> <tr> <td>PUL-QC</td> <td>S-CAL06</td> <td>S-GRA06</td> <td>S-GRA06a</td> </tr> <tr> <td>S-IR08</td> <td>SPL-21</td> <td>WEI-21</td> <td></td> </tr> </table> | C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | |
| C-GAS05 | Cu-OG46 | LOG-22 | ME-MS41 | | | | | | | | | | | | | | |
| ME-OG46 | OA-ELE07 | OA-VOL08m | PUL-31 | | | | | | | | | | | | | | |
| PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | | | | | | | | | | | | | | |
| S-IR08 | SPL-21 | WEI-21 | | | | | | | | | | | | | | | |



L1958661-COFC

COC Number: 17-21
Page 2 of 2

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Canada Toll Free: 1 800 688 9878

Report To: **Minto Explorations Ltd**
 Contact: **Minto Environment - Coordinator**
 Phone: **1-800-759-4655**
 City/Province: **Vancouver British Columbia**
 Postal Code: **V6B 0M3**

Report Format: Distribution
 Select Report Format: PDF EXCEL ESD (DIGITAL)
 Quality Control (QC) Report with Report: YES NO
 Select Invoice Distribution: EMAIL MAIL FAX
 Select Distribution: EMAIL MAIL FAX
 Email 1 or Fax: **minto.environment@mintoexpl.com**
 Email 2:
 Email 3:

Invoice Distribution
 Select Invoice Distribution: EMAIL MAIL FAX
 Email 1 or Fax: **als@minotone.com**
 Email 2:
 Email 3:

Project Information
 ALS Account # / Quote #: **781-45**
 Job #: **TRD**
 PO / A/E: **TRD**
 Location: **Ruth Cavellano**

ALS Lab Work Order # (lab use only): **142659**

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date | Time | Sampler | Sample Type | Total Metals - Aqua regia digestion (ICP) | Paste #1 | % Inorganic Carbonate | Total Carbon / Sulphur (Lucco) | AP determination by ³⁵ Sulphide sulphur | Modified NP (MEND 1991) | Number of Containers |
|-----------------------------|---|----------|------|---------|-------------|---|----------|-----------------------|--------------------------------|--|-------------------------|----------------------|
| 781-30 | MM 142522 | 11/06/17 | | | Composite | X | X | X | X | X | X | |
| 781-38 | MM 142659 | 21/06/17 | | | WASTE | X | X | X | X | X | X | |
| 781-41 | MM 142655 | 20/06/17 | | | WASTE | X | X | X | X | X | X | |
| 781-45 | MM 142657 | 24/06/17 | | | WASTE | X | X | X | X | X | X | |
| 781-45 | MM 142658 | 24/06/17 | | | WASTE | X | X | X | X | X | X | |
| 781-46 | MM 142659 | 25/06/17 | | | WASTE | X | X | X | X | X | X | |

Drinking Water (DW) Samples (client use)
 YES NO
 Are samples taken from a Regulated DW System?
 YES NO
 Are samples for human drinking water use?
 YES NO

Special Instructions: Specify criteria to add on report by clicking on the drop-down list below (Electronic COC only)

SHIPMENT RELEASE (client use)
 Released by: _____ Date: _____
 INITIAL SHIPMENT RECEPTION (lab use only)
 Received by: _____ Date: _____

WHITE - LABORATORY COPY YELLOW - CLIENT COPY
 Refer to BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Return to care of all persons of this form may copy, amend, reproduce or use the form LEGAL. By the use of this form the user acknowledges and agrees with the Terms and Conditions as set out on the back page of this form.
 If any other sections of this form are required, please contact ALS.

SHIPMENT RECEPTION (lab use only)
 Received by: _____ Date: _____
 FINAL SHIPMENT RECEPTION (lab use only)
 Received by: _____ Date: _____

REGULAR (R) Standard (S) Expedited (E)
 Regular (R) 4 day (P4)
 Standard (S) 1 day (P1)
 Expedited (E) 2 day (P2)
 Data and Time Required for all B&B Tests:
 dd/mm/yy hh:mm

Indicate Release of Pressure (P) or Sealed and Pressured (P&S) below
 Analysis Request

Freeze: Yes No
 Ice Packs: Yes No
 Cooling Inhibitor: Yes No
 Final COC at Temperature: _____
 Final COC at Temperature: _____



L1958661-COFC

17-21

WWW.alsglobal.com

Contact and company name below will appear on the final report

Report To: **Minto Explorations Ltd**
 Company: **Minto Environment - Coordinator**
 Contact: **1-604-759-4658**
 Phone: **2191-510 West Georgia St.**
 Street: **Vancouver, British Columbia**
 City/Province: **V8B 6M3**
 Postal Code: **Same as Report To** YES NO
 Invoice To: **Copy of Invoice with Report** YES NO
 Company: **Minto Explorations Ltd**
 Contact: **Ruth Cayetano**

Report Format / Distribution
 Selected Report Format: PDF EXCEL WORD (LIMITED)
 Quality Control (QC) Report with Report YES NO
 Generate Results to Criteria on Report - provide details below (see checked)
 Select Distribution: Email MAIL FAX
 Email 1 or Fax: **mailto:environment@mintoexpl.com**
 Email 2
 Email 3

Invoice Distribution
 Select Invoice Distribution: Email FAX
 Email 1 or Fax: **ap@mintoexpl.com**
 Email 2
 Email 3

Oil and Gas Required Fields (client use)
 Requester: **Requester**
 Location: **Location**

ALS Lab Work Order # (lab use only)
 ALS Account # / Quote #
 Job #
 PO / A/E: **TBD**
 LEO

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (To's description will appear on the report) | Date | Time (am/pm) | Sample Type | Composite | Total Metals | Aqua regia digestion (ICP) | Fluoride | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - Determination by % sulphide sulphur | Modified NP (MEND 1991) | Number of Containers |
|-----------------------------|---|----------|--------------|-------------|-----------|--------------|----------------------------|----------|-----------------------|-----------------------------|--|-------------------------|----------------------|
| 787-49 | MM 142654 | 19/06/17 | | YAS1B | X | X | X | X | X | X | X | X | |
| 787-52 | MM 142652 | 16/06/17 | | YAS1B | X | X | X | X | X | X | X | X | |
| 781-44 | MM 142653 | 18/06/17 | | YAS1B | X | X | X | X | X | X | X | X | |
| 787-48 | MM 142521 | 11/06/17 | | YAS1B | X | X | X | X | X | X | X | X | |
| 793-32A | MM 142519 | 08/06/17 | | YAS1B | X | X | X | X | X | X | X | X | |
| 793-32B | MM 142520 | 09/06/17 | | YAS1B | X | X | X | X | X | X | X | X | |
| 787-53 | MM 142651 | 15/06/17 | | YAS1B | X | X | X | X | X | X | X | X | |
| 787-54 | MM 142525 | 14/06/17 | | YAS1B | X | X | X | X | X | X | X | X | |
| 787-51 | MM 142543 | 12/06/17 | | YAS1B | X | X | X | X | X | X | X | X | |
| 787-47 | MM 142524 | 14/06/17 | | YAS1B | X | X | X | X | X | X | X | X | |

Drinking Water (DW) Samples (client use)
 Are samples taken from a Regulated DW System? YES NO
 Are samples for human drinking water use? YES NO

SHIPMENT RELEASE (client use)
 Released by: **ELF** Date: **14/06/17**
 INITIAL SHIPMENT RECEPTION (lab use only)
 Received by: **ELF** Date: **14/06/17**
 FINAL SHIPMENT RECEPTION (lab use only)
 Received by: **ELF** Date: **14/06/17**

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to provide all portions of this form may delay analysis. Please fill in the form LEGALLY. By the use of this form the user acknowledges and agrees with the terms and conditions as stated on the back page of the report copy.
 If any water samples are taken from a Regulated Drinking Water (RDW) System, please specify using pre-authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 14-JUL-17
Report Date: 08-AUG-17 18:22 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1958669
Project P.O. #: PO#226298
Job Reference:
C of C Numbers: 17 22
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1958669-1 Waste 04-JUL-17 142660 | L1958669-2 Waste 04-JUL-17 142661 | L1958669-3 Waste 04-JUL-17 142662 | L1958669-4 Waste 04-JUL-17 142663 | L1958669-5 Waste 04-JUL-17 142664 | |
|---|--|--|--|--|--|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.7 | 8.5 | 8.4 | 8.6 | 8.6 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.27 | 0.69 | 0.20 | 0.20 | 0.05 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 1 |
| | MPA (tCaCO3/1Kt) | 4.4 | 0.3 | 0.3 | 0.6 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 25 | 64 | 26 | 25 | 8 |
| | NNP (tCaCO3/1Kt) | 21 | 64 | 26 | 24 | 7 |
| | Ratio (NP/MPA) (Unity) | 5.71 | 204.80 | 83.20 | 40.00 | 12.80 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | 0.01 | 0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | 0.14 | <0.01 | <0.01 | 0.02 | 0.02 |
| | Total Sulfur (combustion) (%) | 0.14 | 0.01 | 0.01 | 0.02 | 0.02 |
| Total Metals | Aluminum (Al) (%) | 1.02 | 1.14 | 1.24 | 1.33 | 1.09 |
| | Antimony (Sb) (ppm) | <0.05 | 0.14 | 0.10 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 0.7 | 6.0 | 1.6 | 0.7 | 0.6 |
| | Barium (Ba) (ppm) | 150 | 80 | 180 | 220 | 290 |
| | Beryllium (Be) (ppm) | 0.21 | 0.63 | 0.40 | 0.36 | 0.23 |
| | Bismuth (Bi) (ppm) | 0.18 | 0.02 | 0.04 | 0.02 | 0.14 |
| | Boron (B) (ppm) | <10 | 10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.06 | 0.04 | 0.12 | 0.25 | 0.31 |
| | Calcium (Ca) (%) | 0.80 | 2.40 | 1.12 | 1.07 | 0.26 |
| | Cerium (Ce) (ppm) | 20.8 | 28.9 | 23.1 | 27.5 | 18.55 |
| | Cesium (Cs) (ppm) | 0.47 | 0.46 | 0.37 | 0.44 | 0.30 |
| | Chromium (Cr) (ppm) | 5 | 14 | 7 | 6 | 5 |
| | Cobalt (Co) (ppm) | 4.8 | 7.6 | 6.5 | 6.4 | 6.2 |
| | Copper (Cu) (ppm) | 1550 | 129.5 | 404 | 631 | 3890 |
| | Gallium (Ga) (ppm) | 5.18 | 6.25 | 6.39 | 6.51 | 5.71 |
| | Germanium (Ge) (ppm) | 0.09 | 0.09 | 0.11 | 0.11 | 0.09 |
| | Gold (Au) (ppm) | 0.02 | <0.02 | 0.03 | <0.02 | 0.07 |
| | Hafnium (Hf) (ppm) | 0.02 | 0.07 | 0.09 | 0.05 | 0.05 |
| | Indium (In) (ppm) | 0.042 | 0.040 | 0.029 | 0.027 | 0.058 |
| | Iron (Fe) (%) | 2.17 | 2.39 | 2.37 | 2.44 | 2.34 |
| | Lanthanum (La) (ppm) | 10.5 | 15.0 | 11.6 | 14.6 | 9.5 |
| | Lead (Pb) (ppm) | 3.1 | 6.2 | 3.2 | 3.2 | 3.2 |
| | Lithium (Li) (ppm) | 6.7 | 9.2 | 9.2 | 8.7 | 6.7 |
| | Magnesium (Mg) (%) | 0.63 | 0.85 | 0.71 | 0.74 | 0.52 |
| | Manganese (Mn) (ppm) | 373 | 649 | 600 | 630 | 560 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1958669-6 Waste 04-JUL-17 142665 | L1958669-7 Waste 04-JUL-17 142666 | L1958669-8 Waste 04-JUL-17 142667 | L1958669-9 Waste 04-JUL-17 142668 | L1958669-10 Waste 04-JUL-17 142669 |
|---|--|--|--|--|---|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.4 | 8.5 | 8.8 | 8.3 | 8.3 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.30 | <0.05 | 0.20 | <0.05 | 0.29 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 1 | 2 | 1 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 0.3 | 0.3 | 0.6 | 0.3 | 8.4 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 31 | 9 | 23 | 9 | 34 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 31 | 9 | 22 | 9 | 26 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 99.20 | 28.80 | 36.80 | 28.80 | 4.03 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | | | |
| | 0.01 | 0.01 | 0.02 | 0.01 | 0.26 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.01 | 0.01 | 0.02 | 0.01 | 0.27 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 0.93 | 1.20 | 1.13 | 1.32 | 1.27 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.09 | <0.05 | 0.08 | <0.05 | 0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 4.8 | 2.8 | 1.1 | 0.7 | 1.5 |
| | Barium (Ba) (ppm) | | | | |
| | 170 | 310 | 210 | 340 | 90 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.43 | 0.28 | 0.32 | 0.30 | 0.42 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.03 | 0.36 | 0.07 | 0.03 | 1.51 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.15 | 0.14 | 0.07 | 0.38 | 0.27 |
| | Calcium (Ca) (%) | | | | |
| | 1.22 | 0.41 | 1.11 | 0.46 | 1.40 |
| | Cerium (Ce) (ppm) | | | | |
| | 27.5 | 27.1 | 21.9 | 28.5 | 14.60 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.52 | 0.42 | 0.41 | 0.51 | 0.22 |
| | Chromium (Cr) (ppm) | | | | |
| | 4 | 6 | 7 | 5 | 4 |
| | Cobalt (Co) (ppm) | | | | |
| | 5.9 | 6.1 | 5.9 | 7.6 | 6.4 |
| | Copper (Cu) (ppm) | | | | |
| | 357 | 1875 | 356 | 382 | 5490 |
| | Gallium (Ga) (ppm) | | | | |
| | 5.09 | 6.07 | 5.75 | 6.15 | 8.34 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.10 | 0.12 | 0.08 | 0.08 | 0.06 |
| | Gold (Au) (ppm) | | | | |
| | <0.02 | 0.04 | 0.03 | <0.02 | 0.15 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.04 | 0.06 | 0.09 | 0.11 | 0.04 |
| | Indium (In) (ppm) | | | | |
| | 0.045 | 0.042 | 0.033 | 0.031 | 0.042 |
| | Iron (Fe) (%) | | | | |
| | 2.35 | 2.77 | 2.36 | 2.60 | 3.10 |
| | Lanthanum (La) (ppm) | | | | |
| | 14.1 | 13.9 | 10.9 | 15.1 | 7.2 |
| | Lead (Pb) (ppm) | | | | |
| | 3.8 | 3.3 | 2.6 | 1.8 | 5.9 |
| | Lithium (Li) (ppm) | | | | |
| | 7.1 | 7.6 | 5.7 | 5.9 | 9.0 |
| | Magnesium (Mg) (%) | | | | |
| | 0.39 | 0.57 | 0.68 | 0.61 | 0.71 |
| | Manganese (Mn) (ppm) | | | | |
| | 646 | 649 | 630 | 757 | 605 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1958669-11 | L1958669-12 | | |
|-----------------------------------|--|--------------|-------------|-------------|--|--|
| | | Description | Waste | Waste | | |
| | | Sampled Date | 04-JUL-17 | 04-JUL-17 | | |
| | | Sampled Time | | | | |
| | | Client ID | 142670 | 142671 | | |
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | | 8.8 | 8.7 | | |
| Organic / Inorganic Carbon | Carbon (C) (%) | | <0.05 | 0.35 | | |
| Acid Base Accounting | FIZZ RATING (Unity) | | 1 | 2 | | |
| | MPA (tCaCO3/1Kt) | | 0.3 | 1.3 | | |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | 8 | 29 | | |
| | NNP (tCaCO3/1Kt) | | 8 | 28 | | |
| | Ratio (NP/MPA) (Unity) | | 25.60 | 23.20 | | |
| | Sulfate Sulfur (carbonate leach) (%) | | <0.01 | <0.01 | | |
| | Sulfate Sulfur (HCl leach) (%) | | <0.01 | <0.01 | | |
| | Sulfide Sulfur (T minus carbonate leach) (%) | | 0.01 | 0.04 | | |
| | Total Sulfur (combustion) (%) | | 0.01 | 0.04 | | |
| Total Metals | Aluminum (Al) (%) | | 1.37 | 1.05 | | |
| | Antimony (Sb) (ppm) | | <0.05 | <0.05 | | |
| | Arsenic (As) (ppm) | | 0.8 | 1.2 | | |
| | Barium (Ba) (ppm) | | 450 | 150 | | |
| | Beryllium (Be) (ppm) | | 0.25 | 0.36 | | |
| | Bismuth (Bi) (ppm) | | 0.10 | 0.06 | | |
| | Boron (B) (ppm) | | <10 | <10 | | |
| | Cadmium (Cd) (ppm) | | 0.07 | 0.06 | | |
| | Calcium (Ca) (%) | | 0.27 | 1.28 | | |
| | Cerium (Ce) (ppm) | | 25.6 | 21.0 | | |
| | Cesium (Cs) (ppm) | | 0.48 | 0.32 | | |
| | Chromium (Cr) (ppm) | | 6 | 5 | | |
| | Cobalt (Co) (ppm) | | 6.7 | 5.5 | | |
| | Copper (Cu) (ppm) | | 1920 | 425 | | |
| | Gallium (Ga) (ppm) | | 6.62 | 5.62 | | |
| | Germanium (Ge) (ppm) | | 0.06 | 0.05 | | |
| | Gold (Au) (ppm) | | 0.02 | <0.02 | | |
| | Hafnium (Hf) (ppm) | | 0.04 | 0.05 | | |
| | Indium (In) (ppm) | | 0.034 | 0.026 | | |
| | Iron (Fe) (%) | | 2.38 | 2.21 | | |
| | Lanthanum (La) (ppm) | | 13.8 | 10.2 | | |
| | Lead (Pb) (ppm) | | 2.1 | 3.5 | | |
| | Lithium (Li) (ppm) | | 6.5 | 6.0 | | |
| | Magnesium (Mg) (%) | | 0.63 | 0.64 | | |
| | Manganese (Mn) (ppm) | | 581 | 534 | | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1958669-1 Waste 04-JUL-17 142660 | L1958669-2 Waste 04-JUL-17 142661 | L1958669-3 Waste 04-JUL-17 142662 | L1958669-4 Waste 04-JUL-17 142663 | L1958669-5 Waste 04-JUL-17 142664 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | 0.97 | 0.34 | 0.76 | 0.84 | 1.64 |
| | Nickel (Ni) (ppm) | 2.5 | 19.9 | 7.8 | 2.9 | 4.9 |
| | Niobium (Nb) (ppm) | 0.16 | <0.05 | 0.09 | 0.10 | 0.10 |
| | Phosphorus (P) (ppm) | 680 | 700 | 700 | 700 | 630 |
| | Potassium (K) (%) | 0.45 | 0.17 | 0.35 | 0.40 | 0.46 |
| | Rhenium (Re) (ppm) | 0.003 | 0.001 | <0.001 | 0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | 21.1 | 7.8 | 14.7 | 16.2 | 19.6 |
| | Scandium (Sc) (ppm) | 4.7 | 5.2 | 4.7 | 4.2 | 3.0 |
| | Selenium (Se) (ppm) | 1.5 | 0.6 | 0.7 | 0.7 | 1.2 |
| | Silver (Ag) (ppm) | 0.30 | 0.03 | 0.11 | 0.07 | 0.63 |
| | Sodium (Na) (%) | 0.07 | 0.05 | 0.08 | 0.10 | 0.08 |
| | Strontium (Sr) (ppm) | 82.9 | 116.0 | 71.2 | 77.7 | 31.1 |
| | Sulfur (S) (%) | 0.14 | 0.01 | <0.01 | <0.01 | 0.01 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.05 | <0.01 | 0.01 | 0.01 | 0.08 |
| | Thallium (Tl) (ppm) | 0.17 | 0.03 | 0.08 | 0.08 | 0.12 |
| | Thorium (Th) (ppm) | 2.8 | 2.5 | 2.1 | 2.8 | 2.9 |
| | Tin (Sn) (ppm) | 0.8 | 0.5 | 0.6 | 0.5 | 0.5 |
| | Titanium (Ti) (%) | 0.062 | <0.005 | 0.055 | 0.068 | 0.077 |
| | Tungsten (W) (ppm) | 0.41 | 0.10 | 0.26 | 0.53 | 0.35 |
| | Uranium (U) (ppm) | 0.37 | 0.41 | 0.21 | 0.23 | 0.25 |
| | Vanadium (V) (ppm) | 46 | 40 | 49 | 51 | 46 |
| | Yttrium (Y) (ppm) | 6.47 | 9.48 | 8.62 | 7.98 | 4.79 |
| | Zinc (Zn) (ppm) | 43 | 72 | 69 | 78 | 72 |
| | Zirconium (Zr) (ppm) | 0.8 | 1.6 | 1.8 | 0.9 | 1.6 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.0 | 2.5 | 0.7 | 0.7 | 0.2 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1958669-6 Waste 04-JUL-17 142665 | L1958669-7 Waste 04-JUL-17 142666 | L1958669-8 Waste 04-JUL-17 142667 | L1958669-9 Waste 04-JUL-17 142668 | L1958669-10 Waste 04-JUL-17 142669 |
|------------------------|--------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | 0.01 | <0.01 | <0.01 | 0.01 | |
| | Molybdenum (Mo) (ppm) | 1.53 | 1.13 | 0.81 | 1.60 | 0.60 | |
| | Nickel (Ni) (ppm) | 2.4 | 2.7 | 4.0 | 2.1 | 1.9 | |
| | Niobium (Nb) (ppm) | <0.05 | 0.15 | 0.16 | 0.07 | <0.05 | |
| | Phosphorus (P) (ppm) | 630 | 790 | 860 | 860 | 660 | |
| | Potassium (K) (%) | 0.22 | 0.59 | 0.42 | 0.59 | 0.15 | |
| | Rhenium (Re) (ppm) | 0.001 | <0.001 | <0.001 | <0.001 | 0.001 | |
| | Rubidium (Rb) (ppm) | 12.1 | 26.2 | 17.7 | 25.8 | 6.4 | |
| | Scandium (Sc) (ppm) | 6.2 | 4.0 | 5.2 | 6.1 | 3.5 | |
| | Selenium (Se) (ppm) | 0.7 | 1.0 | 0.5 | 0.6 | 5.4 | |
| | Silver (Ag) (ppm) | 0.09 | 0.45 | 0.17 | 0.07 | 2.89 | |
| | Sodium (Na) (%) | 0.06 | 0.09 | 0.14 | 0.09 | 0.06 | |
| | Strontium (Sr) (ppm) | 56.0 | 39.5 | 77.7 | 42.5 | 83.6 | |
| | Sulfur (S) (%) | <0.01 | <0.01 | 0.02 | 0.01 | 0.28 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.01 | 0.06 | 0.04 | 0.01 | 0.52 | |
| | Thallium (Tl) (ppm) | 0.05 | 0.16 | 0.09 | 0.14 | 0.04 | |
| | Thorium (Th) (ppm) | 3.0 | 2.9 | 1.9 | 2.5 | 1.5 | |
| | Tin (Sn) (ppm) | 0.6 | 0.6 | 0.7 | 0.7 | 0.6 | |
| | Titanium (Ti) (%) | 0.020 | 0.104 | 0.093 | 0.090 | 0.015 | |
| | Tungsten (W) (ppm) | 0.20 | 0.40 | 1.67 | 0.30 | 0.10 | |
| | Uranium (U) (ppm) | 0.28 | 0.21 | 0.28 | 0.23 | 0.40 | |
| | Vanadium (V) (ppm) | 49 | 57 | 51 | 57 | 51 | |
| | Yttrium (Y) (ppm) | 9.05 | 6.85 | 11.85 | 13.40 | 6.01 | |
| | Zinc (Zn) (ppm) | 73 | 85 | 69 | 79 | 79 | |
| | Zirconium (Zr) (ppm) | 1.1 | 1.0 | 1.3 | 2.2 | 1.0 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.1 | <0.2 | 0.7 | <0.2 | 1.1 | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1958669-11 | L1958669-12 | | |
|------------------------|--------------------------|--------------|-------------|-------------|--|--|
| | | Description | Waste | Waste | | |
| | | Sampled Date | 04-JUL-17 | 04-JUL-17 | | |
| | | Sampled Time | | | | |
| | | Client ID | 142670 | 142671 | | |
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | <0.01 | | |
| | Molybdenum (Mo) (ppm) | | 0.87 | 0.53 | | |
| | Nickel (Ni) (ppm) | | 3.0 | 2.3 | | |
| | Niobium (Nb) (ppm) | | 0.16 | 0.07 | | |
| | Phosphorus (P) (ppm) | | 730 | 610 | | |
| | Potassium (K) (%) | | 0.95 | 0.26 | | |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | | |
| | Rubidium (Rb) (ppm) | | 45.0 | 10.5 | | |
| | Scandium (Sc) (ppm) | | 4.1 | 4.2 | | |
| | Selenium (Se) (ppm) | | 0.3 | 0.5 | | |
| | Silver (Ag) (ppm) | | 0.35 | 0.15 | | |
| | Sodium (Na) (%) | | 0.09 | 0.09 | | |
| | Strontium (Sr) (ppm) | | 27.7 | 101.0 | | |
| | Sulfur (S) (%) | | 0.01 | 0.05 | | |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | | |
| | Tellurium (Te) (ppm) | | 0.10 | 0.04 | | |
| | Thallium (Tl) (ppm) | | 0.25 | 0.06 | | |
| | Thorium (Th) (ppm) | | 2.3 | 1.9 | | |
| | Tin (Sn) (ppm) | | 0.6 | 0.5 | | |
| | Titanium (Ti) (%) | | 0.177 | 0.040 | | |
| | Tungsten (W) (ppm) | | 0.53 | 0.30 | | |
| | Uranium (U) (ppm) | | 0.15 | 0.45 | | |
| | Vanadium (V) (ppm) | | 60 | 43 | | |
| | Yttrium (Y) (ppm) | | 5.35 | 8.72 | | |
| | Zinc (Zn) (ppm) | | 86 | 59 | | |
| | Zirconium (Zr) (ppm) | | 1.0 | 0.8 | | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | <0.2 | 1.3 | | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06-AX | Soil | Sulfide Sulfur Calc from Carbonate Leach | ALS Minerals S-CAL06 |
| Sulfide Sulfur (as S) is calculated by subtracting the Carbonate Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17 22

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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 Plus Appendix Pages
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 Account: APN

CERTIFICATE VA17152307

Project: L1958669
 P.O. No.: ALSM-CW16-102-APN
 This report is for 12 Other samples submitted to our lab in Vancouver, BC, Canada on 18-JUL-2017.
 The following have access to data associated with this certificate:

| | | |
|--------------------------|----------------------------|-------------|
| ELSE VANCOUVER WEBTRIEVE | SOFTWARE DEVELOPMENT GROUP | SHANE STACK |
|--------------------------|----------------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% < 75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: ALS ENVIRONMENTAL
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | S-CAL06 S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % |
|--------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|-------------|---------------|----------------|--------------|
| L1958669-1 142660 | | 0.02 | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 |
| L1958669-2 142661 | | 1.32 | 4.4 | 2 | 21 | 25 | 8.7 | 5.71 | 0.14 | <0.01 | <0.01 | 0.14 | 0.27 | 1.0 | 0.30 | 1.02 |
| L1958669-3 142662 | | 1.24 | 0.3 | 2 | 64 | 64 | 8.5 | 204.80 | 0.01 | 0.01 | <0.01 | <0.01 | 0.69 | 2.5 | 0.03 | 1.14 |
| L1958669-4 142663 | | 1.06 | 0.3 | 2 | 26 | 26 | 8.4 | 83.20 | 0.01 | 0.01 | <0.01 | <0.01 | 0.20 | 0.7 | 0.11 | 1.24 |
| L1958669-5 142664 | | 1.06 | 0.6 | 2 | 24 | 25 | 8.6 | 40.00 | 0.02 | <0.01 | <0.01 | 0.02 | 0.20 | 0.7 | 0.07 | 1.33 |
| L1958669-6 142665 | | 1.10 | 0.6 | 1 | 7 | 8 | 8.6 | 12.80 | 0.02 | <0.01 | <0.01 | 0.02 | 0.05 | 0.2 | 0.63 | 1.09 |
| L1958669-7 142666 | | 1.08 | 0.3 | 2 | 31 | 31 | 8.4 | 99.20 | 0.01 | <0.01 | <0.01 | 0.01 | 0.30 | 1.1 | 0.09 | 0.93 |
| L1958669-8 142667 | | 1.06 | 0.3 | 1 | 9 | 9 | 8.5 | 28.80 | 0.01 | <0.01 | <0.01 | 0.01 | <0.05 | <0.2 | 0.45 | 1.20 |
| L1958669-9 142668 | | 1.00 | 0.6 | 2 | 22 | 23 | 8.8 | 36.80 | 0.02 | <0.01 | <0.01 | 0.02 | 0.20 | 0.7 | 0.17 | 1.13 |
| L1958669-10 142669 | | 1.12 | 0.3 | 1 | 9 | 9 | 8.3 | 28.80 | 0.01 | <0.01 | <0.01 | 0.01 | <0.05 | <0.2 | 0.07 | 1.32 |
| L1958669-11 142670 | | 1.32 | 8.4 | 2 | 26 | 34 | 8.3 | 4.03 | 0.27 | 0.01 | <0.01 | 0.26 | 0.29 | 1.1 | 2.89 | 1.27 |
| L1958669-12 142671 | | 1.08 | 0.3 | 1 | 8 | 8 | 8.8 | 25.60 | 0.01 | <0.01 | <0.01 | 0.01 | <0.05 | <0.2 | 0.35 | 1.37 |
| | | 1.04 | 1.3 | 2 | 28 | 29 | 8.7 | 23.20 | 0.04 | <0.01 | <0.01 | 0.04 | 0.35 | 1.3 | 0.15 | 1.05 |

***** See Appendix Page for comments regarding this certificate *****



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CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga |
| | Units LOR | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| | | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 |
| L1958669-1 142660 | | 0.7 | 0.02 | <10 | 150 | 0.21 | 0.18 | 0.80 | 0.06 | 20.8 | 4.8 | 5 | 0.47 | 1550 | 2.17 | 5.18 |
| L1958669-2 142661 | | 6.0 | <0.02 | 10 | 80 | 0.63 | 0.02 | 2.40 | 0.04 | 28.9 | 7.6 | 14 | 0.46 | 129.5 | 2.39 | 6.25 |
| L1958669-3 142662 | | 1.6 | 0.03 | <10 | 180 | 0.40 | 0.04 | 1.12 | 0.12 | 23.1 | 6.5 | 7 | 0.37 | 404 | 2.37 | 6.39 |
| L1958669-4 142663 | | 0.7 | <0.02 | <10 | 220 | 0.36 | 0.02 | 1.07 | 0.25 | 27.5 | 6.4 | 6 | 0.44 | 631 | 2.44 | 6.51 |
| L1958669-5 142664 | | 0.6 | 0.07 | <10 | 290 | 0.23 | 0.14 | 0.26 | 0.31 | 18.55 | 6.2 | 5 | 0.30 | 3890 | 2.34 | 5.71 |
| L1958669-6 142665 | | 4.8 | <0.02 | <10 | 170 | 0.43 | 0.03 | 1.22 | 0.15 | 27.5 | 5.9 | 4 | 0.52 | 357 | 2.35 | 5.09 |
| L1958669-7 142666 | | 2.8 | 0.04 | <10 | 310 | 0.28 | 0.36 | 0.41 | 0.14 | 27.1 | 6.1 | 6 | 0.42 | 1875 | 2.77 | 6.07 |
| L1958669-8 142667 | | 1.1 | 0.03 | <10 | 210 | 0.32 | 0.07 | 1.11 | 0.07 | 21.9 | 5.9 | 7 | 0.41 | 356 | 2.36 | 5.75 |
| L1958669-9 142668 | | 0.7 | <0.02 | <10 | 340 | 0.30 | 0.03 | 0.46 | 0.38 | 28.5 | 7.6 | 5 | 0.51 | 382 | 2.60 | 6.15 |
| L1958669-10 142669 | | 1.5 | 0.15 | <10 | 90 | 0.42 | 1.51 | 1.40 | 0.27 | 14.60 | 6.4 | 4 | 0.22 | 5490 | 3.10 | 8.34 |
| L1958669-11 142670 | | 0.8 | 0.02 | <10 | 450 | 0.25 | 0.10 | 0.27 | 0.07 | 25.6 | 6.7 | 6 | 0.48 | 1920 | 2.38 | 6.62 |
| L1958669-12 142671 | | 1.2 | <0.02 | <10 | 150 | 0.36 | 0.06 | 1.28 | 0.06 | 21.0 | 5.5 | 5 | 0.32 | 425 | 2.21 | 5.62 |



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CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P | Pb |
| Units | | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm | ppm |
| LOR | | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 |
| L1958669-1 142660 | | 0.09 | 0.02 | <0.01 | 0.042 | 0.45 | 10.5 | 6.7 | 0.63 | 373 | 0.97 | 0.07 | 0.16 | 2.5 | 680 | 3.1 |
| L1958669-2 142661 | | 0.09 | 0.07 | <0.01 | 0.040 | 0.17 | 15.0 | 9.2 | 0.85 | 649 | 0.34 | 0.05 | <0.05 | 19.9 | 700 | 6.2 |
| L1958669-3 142662 | | 0.11 | 0.09 | <0.01 | 0.029 | 0.35 | 11.6 | 9.2 | 0.71 | 600 | 0.76 | 0.08 | 0.09 | 7.8 | 700 | 3.2 |
| L1958669-4 142663 | | 0.11 | 0.05 | <0.01 | 0.027 | 0.40 | 14.6 | 8.7 | 0.74 | 630 | 0.84 | 0.10 | 0.10 | 2.9 | 700 | 3.2 |
| L1958669-5 142664 | | 0.09 | 0.05 | <0.01 | 0.058 | 0.46 | 9.5 | 6.7 | 0.52 | 560 | 1.64 | 0.08 | 0.10 | 4.9 | 630 | 3.2 |
| L1958669-6 142665 | | 0.10 | 0.04 | <0.01 | 0.045 | 0.22 | 14.1 | 7.1 | 0.39 | 646 | 1.53 | 0.06 | <0.05 | 2.4 | 630 | 3.8 |
| L1958669-7 142666 | | 0.12 | 0.06 | 0.01 | 0.042 | 0.59 | 13.9 | 7.6 | 0.57 | 649 | 1.13 | 0.09 | 0.15 | 2.7 | 790 | 3.3 |
| L1958669-8 142667 | | 0.08 | 0.09 | <0.01 | 0.033 | 0.42 | 10.9 | 5.7 | 0.68 | 630 | 0.81 | 0.14 | 0.16 | 4.0 | 860 | 2.6 |
| L1958669-9 142668 | | 0.08 | 0.11 | <0.01 | 0.031 | 0.59 | 15.1 | 5.9 | 0.61 | 757 | 1.60 | 0.09 | 0.07 | 2.1 | 860 | 1.8 |
| L1958669-10 142669 | | 0.06 | 0.04 | 0.01 | 0.042 | 0.15 | 7.2 | 9.0 | 0.71 | 605 | 0.60 | 0.06 | <0.05 | 1.9 | 660 | 5.9 |
| L1958669-11 142670 | | 0.06 | 0.04 | <0.01 | 0.034 | 0.95 | 13.8 | 6.5 | 0.63 | 581 | 0.87 | 0.09 | 0.16 | 3.0 | 730 | 2.1 |
| L1958669-12 142671 | | 0.05 | 0.05 | <0.01 | 0.026 | 0.26 | 10.2 | 6.0 | 0.64 | 534 | 0.53 | 0.09 | 0.07 | 2.3 | 610 | 3.5 |

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Project: L1958669

CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm |
|--------------------|--------------------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|
| L1958669-1 142660 | | 21.1 | 0.003 | 0.14 | <0.05 | 4.7 | 1.5 | 0.8 | 82.9 | <0.01 | 0.05 | 2.8 | 0.062 | 0.17 | 0.37 | 46 |
| L1958669-2 142661 | | 7.8 | 0.001 | 0.01 | 0.14 | 5.2 | 0.6 | 0.5 | 116.0 | <0.01 | <0.01 | 2.5 | <0.005 | 0.03 | 0.41 | 40 |
| L1958669-3 142662 | | 14.7 | <0.001 | <0.01 | 0.10 | 4.7 | 0.7 | 0.6 | 71.2 | <0.01 | 0.01 | 2.1 | 0.055 | 0.08 | 0.21 | 49 |
| L1958669-4 142663 | | 16.2 | 0.001 | <0.01 | <0.05 | 4.2 | 0.7 | 0.5 | 77.7 | <0.01 | 0.01 | 2.8 | 0.068 | 0.08 | 0.23 | 51 |
| L1958669-5 142664 | | 19.6 | 0.001 | 0.01 | <0.05 | 3.0 | 1.2 | 0.5 | 31.1 | <0.01 | 0.08 | 2.9 | 0.077 | 0.12 | 0.25 | 46 |
| L1958669-6 142665 | | 12.1 | 0.001 | <0.01 | 0.09 | 6.2 | 0.7 | 0.6 | 56.0 | <0.01 | 0.01 | 3.0 | 0.020 | 0.05 | 0.28 | 49 |
| L1958669-7 142666 | | 26.2 | <0.001 | <0.01 | <0.05 | 4.0 | 1.0 | 0.6 | 39.5 | <0.01 | 0.06 | 2.9 | 0.104 | 0.16 | 0.21 | 57 |
| L1958669-8 142667 | | 17.7 | <0.001 | 0.02 | 0.08 | 5.2 | 0.5 | 0.7 | 77.7 | <0.01 | 0.04 | 1.9 | 0.093 | 0.09 | 0.28 | 51 |
| L1958669-9 142668 | | 25.8 | <0.001 | 0.01 | <0.05 | 6.1 | 0.6 | 0.7 | 42.5 | <0.01 | 0.01 | 2.5 | 0.090 | 0.14 | 0.23 | 57 |
| L1958669-10 142669 | | 6.4 | 0.001 | 0.28 | 0.05 | 3.5 | 5.4 | 0.6 | 83.6 | <0.01 | 0.52 | 1.5 | 0.015 | 0.04 | 0.40 | 51 |
| L1958669-11 142670 | | 45.0 | <0.001 | 0.01 | <0.05 | 4.1 | 0.3 | 0.6 | 27.7 | <0.01 | 0.10 | 2.3 | 0.177 | 0.25 | 0.15 | 60 |
| L1958669-12 142671 | | 10.5 | <0.001 | 0.05 | <0.05 | 4.2 | 0.5 | 0.5 | 101.0 | <0.01 | 0.04 | 1.9 | 0.040 | 0.06 | 0.45 | 43 |

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CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------|-----------------------------------|------------------|------------------|----------------|------------------|
| | | W ppm 0.05 | Y ppm 0.05 | Zn ppm 2 | Zr ppm 0.5 |
| L1958669-1 142660 | | 0.41 | 6.47 | 43 | 0.8 |
| L1958669-2 142661 | | 0.10 | 9.48 | 72 | 1.6 |
| L1958669-3 142662 | | 0.26 | 8.62 | 69 | 1.8 |
| L1958669-4 142663 | | 0.53 | 7.98 | 78 | 0.9 |
| L1958669-5 142664 | | 0.35 | 4.79 | 72 | 1.6 |
| L1958669-6 142665 | | 0.20 | 9.05 | 73 | 1.1 |
| L1958669-7 142666 | | 0.40 | 6.85 | 85 | 1.0 |
| L1958669-8 142667 | | 1.67 | 11.85 | 69 | 1.3 |
| L1958669-9 142668 | | 0.30 | 13.40 | 79 | 2.2 |
| L1958669-10 142669 | | 0.10 | 6.01 | 79 | 1.0 |
| L1958669-11 142670 | | 0.53 | 5.35 | 86 | 1.0 |
| L1958669-12 142671 | | 0.30 | 8.72 | 59 | 0.8 |

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CERTIFICATE OF ANALYSIS VA17152307

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
 ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|-----------|----------|---------|----------|
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



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QC CERTIFICATE VA17152307

Project: L1958669
 P.O. No.: ALSM-CW16-102-APN
 This report is for 12 Other samples submitted to our lab in Vancouver, BC, Canada on 18-JUL-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| S-CAL06 | Sulfide Sulfur (calculated) | LECO |

To: ALS ENVIRONMENTAL
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17152307

| Method Analyte Units LOR | OA-VOL08m MPA | OA-VOL08m FIZZ RAT | OA-VOL08m NNP | OA-VOL08m NP | OA-ELE07 pH | OA-VOL08m Ratio (N) | S-IR08 S | S-GRA06 S | S-GRA06a S | C-GAS05 C | C-GAS05 CO2 | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As | ME-MS41 Au |
|----------------------------|------------------|-----------------------|------------------|-----------------|----------------|------------------------|-------------|--------------|---------------|--------------|----------------|---------------|---------------|---------------|---------------|
| Sample Description | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | 6.1 | | | | | | | | | | |
| Buffer pH6 | | | | | 6.1 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.3 | | | | | | | | | | |
| Upper Bound | | | | | 6.7 | | | | | | | | | | |
| GS310-10 | | | | | | | | 0.27 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.25 | | | | | | | |
| Upper Bound | | | | | | | | 0.29 | | | | | | | |
| KZK-1 | 25.0 | 2 | 33 | 58 | | 2.32 | | | | | | | | | |
| KZK-1 | 25.0 | 2 | 33 | 58 | | 2.32 | | | | | | | | | |
| Target Range - Lower Bound | 22.9 | <1 | 30 | 54 | | 2.18 | | | | | | | | | |
| Upper Bound | 27.1 | >4 | 38 | 64 | | 2.53 | | | | | | | | | |
| MA-1b | | | | | | | | 1.16 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.12 | | | | | | | |
| Upper Bound | | | | | | | | 1.22 | | | | | | | |
| MA-3a | | | | | | | | | | 2.34 | 8.6 | | | | |
| Target Range - Lower Bound | | | | | | | | | | 2.31 | 8.4 | | | | |
| Upper Bound | | | | | | | | | | 2.77 | 10.2 | | | | |
| OGGeo08 | | | | | | | | | | | | 20.0 | 2.16 | 117.0 | 0.07 |
| OGGeo08 | | | | | | | | | | | | 19.30 | 2.30 | 121.5 | 0.07 |
| Target Range - Lower Bound | | | | | | | | | | | | 18.15 | 2.05 | 107.0 | 0.03 |
| Upper Bound | | | | | | | | | | | | 22.2 | 2.53 | 131.0 | 0.11 |
| OREAS 920 | | | | | | | | | | | | 0.09 | 2.36 | 4.8 | <0.02 |
| OREAS 920 | | | | | | | | | | | | 0.10 | 2.46 | 5.1 | <0.02 |
| Target Range - Lower Bound | | | | | | | | | | | | 0.07 | 2.18 | 3.8 | <0.02 |
| Upper Bound | | | | | | | | | | | | 0.12 | 2.68 | 4.9 | 0.04 |
| SY-4 | | | | | | | | | | 0.85 | 3.1 | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.84 | 3.0 | | | | |
| Upper Bound | | | | | | | | | | 1.08 | 4.0 | | | | |
| UTS-1 | | | | | | | | 0.88 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.83 | | | | | | | |
| Upper Bound | | | | | | | | 0.93 | | | | | | | |
| UTS-1 | | | | | | | | | | 0.89 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.81 | | | | | |
| Upper Bound | | | | | | | | | | 0.95 | | | | | |
| UTS-4 | | | | | | | | 1.76 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.64 | | | | | | | |
| Upper Bound | | | | | | | | 1.84 | | | | | | | |
| UTS-4 | | | | | | | | | | 1.73 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 1.61 | | | | | |
| Upper Bound | | | | | | | | | | 1.87 | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm | ME-MS41 Hf ppm |
|----------------------------|--------------------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|
| | | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | | <10 | 80 | 0.66 | 10.55 | 0.88 | 19.20 | 59.0 | 95.8 | 81 | 9.43 | 8300 | 4.97 | 8.26 | 0.12 | 0.75 |
| OGGeo08 | | <10 | 100 | 0.75 | 9.67 | 0.91 | 18.60 | 60.6 | 96.9 | 86 | 9.05 | 8830 | 5.19 | 8.26 | 0.21 | 0.78 |
| Target Range - Lower Bound | | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | 4.51 | 8.05 | 0.21 | 0.72 |
| Upper Bound | | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | 5.53 | 9.95 | 0.45 | 0.92 |
| OREAS 920 | | <10 | 80 | 0.70 | 0.51 | 0.31 | 0.06 | 72.8 | 14.0 | 43 | 1.94 | 107.0 | 3.55 | 6.71 | 0.08 | 0.55 |
| OREAS 920 | | <10 | 80 | 0.74 | 0.63 | 0.33 | 0.05 | 75.5 | 14.5 | 44 | 2.09 | 115.5 | 3.67 | 6.78 | 0.15 | 0.60 |
| Target Range - Lower Bound | | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | 3.26 | 6.12 | <0.05 | 0.53 |
| Upper Bound | | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | 4.00 | 7.60 | 0.22 | 0.69 |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm |
|----------------------------|--------------------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | | 0.46 | 1.400 | 1.08 | 27.9 | 29.8 | 0.92 | 388 | 884 | 0.29 | 0.94 | 8960 | 800 | 6990 | 116.5 | 1.375 |
| OGGeo08 | | 0.45 | 1.380 | 1.12 | 29.2 | 31.0 | 0.97 | 403 | 905 | 0.30 | 0.98 | 9180 | 850 | 7350 | 116.0 | 1.365 |
| Target Range - Lower Bound | | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 | 700 | 6520 | 109.5 | 1.295 |
| Upper Bound | | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 | 880 | 7970 | 134.5 | 1.585 |
| OREAS 920 | | 0.01 | 0.029 | 0.41 | 35.5 | 21.8 | 1.06 | 519 | 0.33 | 0.03 | 0.33 | 38.2 | 720 | 20.2 | 23.6 | <0.001 |
| OREAS 920 | | <0.01 | 0.029 | 0.45 | 37.1 | 22.2 | 1.09 | 530 | 0.36 | 0.02 | 0.34 | 39.2 | 760 | 20.7 | 23.9 | <0.001 |
| Target Range - Lower Bound | | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 | | 19.2 | 22.2 | <0.001 |
| Upper Bound | | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 | | 23.9 | 27.4 | 0.002 |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|----------------------------|--------------------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|---------------|
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | | 2.75 | 18.30 | 6.2 | 10.6 | 12.9 | 61.8 | 0.01 | 0.14 | 16.5 | 0.310 | 1.25 | 4.69 | 79 | 2.85 | 16.10 |
| OGGeo08 | | 2.88 | 18.35 | 6.2 | 11.4 | 12.5 | 68.0 | <0.01 | 0.15 | 15.8 | 0.319 | 1.33 | 4.53 | 83 | 3.09 | 15.60 |
| Target Range - Lower Bound | | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | 4.45 | 70 | 2.58 | 15.35 |
| Upper Bound | | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | 5.55 | 88 | 3.60 | 18.85 |
| OREAS 920 | | 0.03 | 0.56 | 2.9 | 0.7 | 1.1 | 16.9 | 0.01 | 0.01 | 15.5 | 0.126 | 0.13 | 2.03 | 25 | 0.42 | 17.30 |
| OREAS 920 | | 0.03 | 0.56 | 2.8 | 1.2 | 1.1 | 17.7 | 0.01 | 0.01 | 14.9 | 0.132 | 0.14 | 2.04 | 26 | 0.48 | 17.15 |
| Target Range - Lower Bound | | <0.01 | 0.45 | 2.5 | 0.4 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | 1.89 | 23 | 0.31 | 16.85 |
| Upper Bound | | 0.05 | 0.77 | 3.3 | 1.3 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | 2.42 | 30 | 0.61 | 20.7 |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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Project: L1958669

QC CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | |
|----------------------------|--------------------------|------------------|--------------------|--|
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS310-10 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-1b | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-3a | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OGGeo08 | | 6740 | 22.3 | |
| OGGeo08 | | 7150 | 22.5 | |
| Target Range - Lower Bound | | 6500 | 19.5 | |
| Upper Bound | | 7950 | 27.5 | |
| OREAS 920 | | 106 | 20.9 | |
| OREAS 920 | | 108 | 22.3 | |
| Target Range - Lower Bound | | 93 | 17.6 | |
| Upper Bound | | 119 | 25.0 | |
| SY-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

***** See Appendix Page for comments regarding this certificate *****



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QC CERTIFICATE OF ANALYSIS VA17152307

| Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|---------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | <0.05 | <0.2 | | | |
| Target Range - Lower Bound | | | | | | | | | | | <0.05 | <0.2 | | | |
| Upper Bound | | | | | | | | | | | 0.10 | 0.4 | | | |
| BLANK | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | <0.02 |
| BLANK | | | | | | | | | | | | <0.01 | <0.01 | 0.1 | <0.02 |
| Target Range - Lower Bound | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | <0.02 |
| Upper Bound | | | | | | | | | | | | 0.02 | 0.02 | 0.2 | 0.04 |
| BLANK | | | | | 5.9 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 5.5 | | | | | | | | | | |
| Upper Bound | | | | | 6.9 | | | | | | | | | | |
| BLANK | | | | | | | | <0.01 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.01 | | | | | | | |
| Upper Bound | | | | | | | | 0.02 | | | | | | | |
| BLANK | | | | | | | | | | <0.01 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.01 | | | | | |
| Upper Bound | | | | | | | | | | 0.02 | | | | | |
| BLANK | | | | | | | | | 0.01 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | <0.01 | | | | | | |
| Upper Bound | | | | | | | | | 0.02 | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | 0.05 | 0.72 | 8.2 | <0.02 |
| DUP | | | | | | | | | | | | 0.05 | 0.75 | 8.1 | <0.02 |
| Target Range - Lower Bound | | | | | | | | | | | | 0.04 | 0.69 | 7.6 | <0.02 |
| Upper Bound | | | | | | | | | | | | 0.06 | 0.78 | 8.7 | 0.04 |
| ORIGINAL | | | | | | | | | | | | 0.45 | 0.73 | 0.2 | 0.09 |
| DUP | | | | | | | | | | | | 0.89 | 0.74 | 0.4 | 0.06 |
| Target Range - Lower Bound | | | | | | | | | | | | 0.63 | 0.69 | 0.2 | 0.05 |
| Upper Bound | | | | | | | | | | | | 0.71 | 0.78 | 0.4 | 0.10 |
| L1958669-7 142666 | | | | | 8.5 | | | | | | | | | | |
| DUP | | | | | 8.5 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | 8.0 | | | | | | | | | | |
| Upper Bound | | | | | 9.0 | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17152307

| Method Analyte Units LOR | ME-MS41 B ppm 10 | ME-MS41 Ba ppm 10 | ME-MS41 Be ppm 0.05 | ME-MS41 Bi ppm 0.01 | ME-MS41 Ca % 0.01 | ME-MS41 Cd ppm 0.01 | ME-MS41 Ce ppm 0.02 | ME-MS41 Co ppm 0.1 | ME-MS41 Cr ppm 1 | ME-MS41 Cs ppm 0.05 | ME-MS41 Cu ppm 0.2 | ME-MS41 Fe % 0.01 | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 |
|----------------------------|------------------|-------------------|---------------------|---------------------|-------------------|---------------------|---------------------|--------------------|------------------|---------------------|--------------------|-------------------|---------------------|---------------------|---------------------|
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | <0.02 |
| BLANK | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | 0.05 | <0.02 |
| Target Range - Lower Bound | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | <0.02 |
| Upper Bound | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 | 0.04 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | <10 | 90 | 0.78 | 0.06 | 17.70 | 0.09 | 50.7 | 4.3 | 7 | 9.38 | 9.7 | 1.24 | 2.44 | 0.05 | 0.18 |
| DUP | <10 | 90 | 0.84 | 0.06 | 17.75 | 0.10 | 50.9 | 4.3 | 8 | 9.69 | 9.6 | 1.26 | 2.51 | 0.05 | 0.18 |
| Target Range - Lower Bound | <10 | 70 | 0.72 | 0.05 | 16.85 | 0.08 | 48.2 | 4.0 | 6 | 9.01 | 9.1 | 1.18 | 2.30 | <0.05 | 0.15 |
| Upper Bound | 20 | 110 | 0.90 | 0.07 | 18.60 | 0.11 | 53.4 | 4.6 | 9 | 10.05 | 10.2 | 1.32 | 2.65 | 0.10 | 0.21 |
| ORIGINAL | <10 | 50 | 0.10 | 0.92 | 2.34 | 0.03 | 11.15 | 3.9 | 20 | 0.38 | 36.5 | 1.74 | 3.88 | 0.06 | 0.05 |
| DUP | <10 | 60 | 0.09 | 1.05 | 2.36 | 0.03 | 11.45 | 4.0 | 20 | 0.40 | 38.3 | 1.77 | 3.94 | 0.06 | 0.06 |
| Target Range - Lower Bound | <10 | 40 | <0.05 | 0.93 | 2.22 | 0.02 | 10.70 | 3.7 | 18 | 0.32 | 35.9 | 1.66 | 3.66 | <0.05 | 0.03 |
| Upper Bound | 20 | 70 | 0.10 | 1.04 | 2.48 | 0.04 | 11.90 | 4.2 | 22 | 0.46 | 38.9 | 1.85 | 4.16 | 0.10 | 0.08 |
| L1958669-7 142666 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm |
|----------------------------|----------------------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|
| | | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | <0.01 | <0.005 | <0.01 | <0.2 | 0.1 | <0.01 | <5 | <0.05 | 0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | <0.001 |
| | Upper Bound | <0.01 | <0.005 | <0.01 | <0.2 | 0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | <0.001 |
| BLANK | Target Range - Lower Bound | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | <0.001 |
| | Upper Bound | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 | 0.002 |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 0.03 | 0.018 | 0.33 | 25.2 | 7.0 | 0.45 | 555 | 1.07 | 0.02 | 0.07 | 3.5 | 380 | 7.5 | 23.6 | 0.001 |
| DUP | | 0.03 | 0.019 | 0.34 | 25.5 | 7.1 | 0.45 | 553 | 1.12 | 0.02 | 0.07 | 3.5 | 380 | 8.0 | 24.6 | 0.001 |
| Target Range - Lower Bound | | 0.02 | 0.013 | 0.31 | 23.9 | 6.6 | 0.42 | 521 | 0.99 | <0.01 | <0.05 | 3.1 | 350 | 7.2 | 22.8 | <0.001 |
| Upper Bound | | 0.04 | 0.024 | 0.36 | 26.8 | 7.5 | 0.48 | 587 | 1.20 | 0.03 | 0.10 | 3.9 | 410 | 8.3 | 25.4 | 0.002 |
| ORIGINAL | | <0.01 | 0.038 | 0.17 | 5.4 | 11.5 | 0.50 | 236 | 0.38 | 0.04 | 0.06 | 26.5 | 300 | 1.8 | 5.7 | <0.001 |
| DUP | | <0.01 | 0.039 | 0.17 | 5.5 | 10.2 | 0.50 | 242 | 0.41 | 0.04 | 0.06 | 27.0 | 300 | 1.9 | 5.8 | <0.001 |
| Target Range - Lower Bound | | <0.01 | 0.032 | 0.15 | 5.0 | 10.2 | 0.47 | 222 | 0.33 | 0.03 | <0.05 | 25.2 | 280 | 1.6 | 5.4 | <0.001 |
| Upper Bound | | 0.02 | 0.045 | 0.19 | 5.9 | 11.5 | 0.54 | 256 | 0.46 | 0.05 | 0.10 | 28.3 | 330 | 2.1 | 6.1 | 0.002 |
| L1958669-7 142666 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17152307

| Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|----------------------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|---------------|
| Sample Description | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Upper Bound | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | 0.10 |
| BLANK | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Upper Bound | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | 0.10 |
| BLANK | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Upper Bound | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | 0.10 |
| BLANK | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Upper Bound | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | 0.10 |
| BLANK | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Upper Bound | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | 0.10 |
| BLANK | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 |
| Upper Bound | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | 0.10 |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | 0.15 | 0.41 | 4.3 | 0.4 | 0.3 | 134.0 | <0.01 | <0.01 | 8.9 | 0.027 | 0.17 | 1.01 | 22 | 0.16 | 8.94 |
| DUP | 0.15 | 0.43 | 4.2 | 0.2 | 0.4 | 134.5 | <0.01 | 0.01 | 9.1 | 0.027 | 0.17 | 1.02 | 22 | 0.16 | 8.58 |
| Target Range - Lower Bound | 0.13 | 0.34 | 3.9 | <0.2 | <0.2 | 127.5 | <0.01 | <0.01 | 8.4 | 0.021 | 0.14 | 0.91 | 20 | 0.10 | 8.27 |
| Upper Bound | 0.17 | 0.50 | 4.6 | 0.4 | 0.4 | 141.0 | 0.02 | 0.02 | 9.7 | 0.033 | 0.20 | 1.12 | 24 | 0.22 | 9.25 |
| ORIGINAL | 0.15 | 0.08 | 1.0 | 0.3 | <0.2 | 48.1 | <0.01 | 0.47 | 0.3 | 0.081 | 0.03 | <0.05 | 14 | 0.26 | 1.82 |
| DUP | 0.15 | 0.09 | 1.0 | 0.2 | <0.2 | 48.6 | <0.01 | 0.75 | 0.3 | 0.082 | 0.03 | <0.05 | 14 | 0.27 | 1.87 |
| Target Range - Lower Bound | 0.13 | <0.05 | 0.9 | <0.2 | <0.2 | 45.7 | <0.01 | 0.57 | <0.2 | 0.072 | <0.02 | <0.05 | 12 | 0.20 | 1.70 |
| Upper Bound | 0.17 | 0.10 | 1.2 | 0.4 | 0.4 | 51.0 | 0.02 | 0.65 | 0.4 | 0.091 | 0.04 | 0.10 | 16 | 0.33 | 1.99 |
| L1958669-7 142666 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 3 - E
 Total # Pages: 4 (A - E)
 Plus Appendix Pages
 Finalized Date: 5-AUG-2017
 Account: APN

Project: L1958669

QC CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm | ME-MS41 Zr ppm |
|----------------------------|--------------------------|----------------|----------------|
| | | 2 | 0.5 |
| BLANKS | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | <2 | <0.5 |
| BLANK | | <2 | <0.5 |
| Target Range - Lower Bound | | <2 | <0.5 |
| Upper Bound | | 4 | 1.0 |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| BLANK | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| DUPLICATES | | | |
| ORIGINAL | | 22 | 5.0 |
| DUP | | 22 | 5.0 |
| Target Range - Lower Bound | | 19 | 4.1 |
| Upper Bound | | 25 | 5.9 |
| ORIGINAL | | 27 | 1.8 |
| DUP | | 28 | 1.8 |
| Target Range - Lower Bound | | 24 | 1.2 |
| Upper Bound | | 31 | 2.4 |
| L1958669-7 142666 | | | |
| DUP | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |

***** See Appendix Page for comments regarding this certificate *****



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 Finalized Date: 5-AUG-2017
 Account: APN

Project: L1958669

QC CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m FIZZ RAT Unity | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-ELE07 pH Unity | OA-VOL08m Ratio (N) Unity | S-IR08 S % | S-GRA06 S % | S-GRA06a S % | C-GAS05 C % | C-GAS05 CO2 % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------|---------------------------|------------|-------------|--------------|-------------|---------------|----------------|--------------|----------------|----------------|
| | | 0.3 | 1 | 1 | 1 | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.1 | 0.02 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L1958669-8 142667 | | 0.6 | 2 | 22 | 23 | | 36.80 | | | | | | | | | |
| DUP | | 0.6 | 2 | 22 | 23 | | 36.80 | | | | | | | | | |
| Target Range - Lower Bound | | <0.3 | <1 | 20 | 21 | | 34.95 | | | | | | | | | |
| Upper Bound | | 0.9 | 3 | 24 | 25 | | 38.65 | | | | | | | | | |
| L1958669-9 142668 | | | | | | | | | <0.01 | <0.01 | <0.05 | <0.2 | | | | |
| DUP | | | | | | | | | <0.01 | 0.02 | <0.05 | <0.2 | | | | |
| Target Range - Lower Bound | | | | | | | | | <0.01 | <0.01 | <0.05 | <0.2 | | | | |
| Upper Bound | | | | | | | | | 0.02 | 0.02 | 0.10 | 0.4 | | | | |
| L1958669-10 142669 | | | | | | | | 0.27 | | | | | | | | |
| DUP | | | | | | | | 0.27 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.25 | | | | | | | | |
| Upper Bound | | | | | | | | 0.29 | | | | | | | | |

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 Finalized Date: 5-AUG-2017
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QC CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | | |
|--|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|------|------|------|
| | | | | | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga | Ge | Hf |
| | | | | | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm |
| | | | | | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| L1958669-8 142667 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958669-9 142668 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1958669-10 142669 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm |
|--|--------------------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|
| | | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 |
| L1958669-8 142667 DUP Target Range - Lower Bound Upper Bound | DUPLICATES | | | | | | | | | | | | | | | |
| L1958669-9 142668 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1958669-10 142669 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

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Project: L1958669

QC CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm |
|--|--------------------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|---------------|
| | | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | 0.05 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L1958669-8 142667 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1958669-9 142668 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1958669-10 142669 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

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 Finalized Date: 5-AUG-2017
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QC CERTIFICATE OF ANALYSIS VA17152307

| Sample Description | Method Analyte Units LOR | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|--|-----------------------------------|---------------------------|-----------------------------|
| DUPLICATES | | | |
| L1958669-8 142667 DUP Target Range - Lower Bound Upper Bound | | | |
| L1958669-9 142668 DUP Target Range - Lower Bound Upper Bound | | | |
| L1958669-10 142669 DUP Target Range - Lower Bound Upper Bound | | | |
| | | | |



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QC CERTIFICATE OF ANALYSIS VA17152307

| | CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | |
|--------------------|---|---------|----------|---------|----------|-----------|--------|--------|---------|---------|----------|--------|--------|--------|--|--|--|
| Applies to Method: | <p style="text-align: center;">ANALYTICAL COMMENTS</p> <p>Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41</p> | | | | | | | | | | | | | | | | |
| Applies to Method: | <p style="text-align: center;">LABORATORY ADDRESSES</p> <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> <td style="width: 33%;">OA-ELE07</td> </tr> <tr> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> <td>S-CAL06</td> </tr> <tr> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> <td>SPL-21</td> </tr> <tr> <td>WEI-21</td> <td></td> <td></td> <td></td> </tr> </table> | C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | | |
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 | | | | | | | | | | | | | | |
| OA-VOL08m | PUL-31 | PUL-QC | S-CAL06 | | | | | | | | | | | | | | |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | | | | | | | | | | | | | | |
| WEI-21 | | | | | | | | | | | | | | | | | |



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Chain of Custody (COC) / Analytical Request Form



L1958669-COFC

COC Number

17 22

Page 1 of 1

Report to: Contact and company name below will appear on the final report

Company: Minto Explorations Ltd.

Contact: Minto Environment - Coordinator

Phone: 1-804-759-4639

Street: 2100-5-10 West Georgia St.

City/Province: Vancouver, British Columbia

Postal Code: V6B 0M3

Invoice To: Same as Report To

Company: Minto Explorations Ltd.

Contact: Ruth Cayetano

ALS Account # / Quote #:

Job #:

PO / A/E: TBD

LSD:

ALS Lab Work Order # (lab use only)

Sample Identification and/or Coordinates (This description will appear on the report)

ALS Sample # (lab use only)

142660

142661

142662

142663

142664

142665

142666

142667

142668

142669

142670

142671

142672

142673

142674

142675

142676

142677

142678

142679

142680

142681

142682

142683

142684

142685

Report Format / Distribution

Select Report Format: PDF, EXCEL, PDF (DIGITAL)

Quality Control (QC) Report with Report

Compare Results to Criteria on Report

Select Distribution: EMAIL, MAIL, FAX

Email 1 or Fax: minto_environment@mintonline.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: EMAIL, MAIL, FAX

Email 1 or Fax: ap@mintonline.com

Email 2

Oil and Gas Required Fields (client use)

A/E/Coast Center

Map/Marker Code

Requester

Location

ALS Contact

Sampler

Date (dd-mm-yy)

Time (hr:mn)

Sample Type

Composite

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

WASTE

Send Samples to Lab Below - Please confirm all EAP YATS with your A/E - surcharges will apply

Regular (R) Standard TAT if received by 3 pm - business days - no surcharges apply

4 day (P4) 3 day (P3) 2 day (P2)

1 Business day (E1) Same Day Weekend or Statutory holiday (E0)

EMERGENCY

Data and Time Required for all EAP YATS: dd-mm-yy thrm

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below

Analysis Request

Total Metals- Aqua regia digestion (ICP)

Paste pH

% Inorganic Carbonate

Total Carbon/Sulphur (Leco)

AP - determination by % sulphide sulphur

Modified NP - (MEND 1991)

Number of Containers

Frozen

Ice Packs

Cooling Inhibited

INITIAL COOLER TEMPERATURES °C

INITIAL SHIPMENT RECEPTION (lab use only)

Received by:

Date:

Time:

Final Shipment Reception (lab use only)

Received by:

Date:

Time:

SIF Observations

Custody seal intact

Final Cooler Temperature °C

Final Shipment Reception (lab use only)

Received by:

Date:

Time:

Shipping Release (client use)

Date:

Time:

Initial Shipment Reception (lab use only)

Received by:

Date:

Time:

Shipping Release (client use)

Date:

Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

If any water samples are taken from Sterilized Drinking Water (SDW) System please submit using authorized DW COC form.

Drinking Water (DW) Samples (client use)

Are samples taken from a Regulated DW System? YES NO



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 02-AUG-17
Report Date: 18-SEP-17 19:13 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1968927
Project P.O. #: 226298
Job Reference:
C of C Numbers: 17-23
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1968927-1 WASTE 10-JUL-17 142672 775-43 | L1968927-2 WASTE 10-JUL-17 142673 775-43 | L1968927-3 WASTE 11-JUL-17 142674 775-45A | L1968927-4 WASTE 11-JUL-17 142675 775-45A | L1968927-5 WASTE 13-JUL-17 129726 775-45B |
|---|---|---|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 9.1 | 9.0 | 9.1 | 8.7 | 8.7 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.27 | 0.23 | 0.22 | 0.56 | 0.25 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 0.9 | 1.6 | 0.6 | 0.3 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 28 | 24 | 24 | 53 | 27 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 27 | 22 | 23 | 53 | 26 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 29.87 | 15.36 | 38.40 | 169.60 | 43.20 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | <0.01 | 0.01 | 0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | 0.01 | <0.01 | 0.02 | 0.02 | 0.02 |
| | Sulfide Sulfur (T minus HCl leach) (%) | | | | |
| | 0.02 | 0.05 | <0.01 | <0.01 | <0.01 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.03 | 0.05 | 0.02 | 0.01 | 0.02 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.02 | 1.17 | 1.21 | 1.10 | 1.10 |
| | Antimony (Sb) (ppm) | | | | |
| | <0.05 | 0.07 | <0.05 | 0.12 | 0.06 |
| | Arsenic (As) (ppm) | | | | |
| | 0.9 | 0.7 | 0.8 | 1.5 | 1.4 |
| | Barium (Ba) (ppm) | | | | |
| | 210 | 230 | 200 | 60 | 240 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.31 | 0.32 | 0.34 | 0.48 | 0.31 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.07 | 0.19 | 0.03 | 0.02 | 0.05 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.05 | 0.06 | 0.04 | 0.05 | 0.13 |
| | Calcium (Ca) (%) | | | | |
| | 1.21 | 0.96 | 1.16 | 2.09 | 1.10 |
| | Cerium (Ce) (ppm) | | | | |
| | 18.55 | 23.9 | 21.5 | 25.1 | 26.2 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.41 | 0.52 | 0.50 | 0.47 | 0.48 |
| | Chromium (Cr) (ppm) | | | | |
| | 5 | 292 | 5 | 4 | 5 |
| | Cobalt (Co) (ppm) | | | | |
| | 5.0 | 7.3 | 5.7 | 5.6 | 6.3 |
| | Copper (Cu) (ppm) | | | | |
| | 324 | 770 | 145.0 | 46.2 | 702 |
| | Gallium (Ga) (ppm) | | | | |
| | 4.99 | 6.13 | 6.28 | 6.33 | 5.97 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.06 | 0.08 | 0.06 | 0.05 | 0.06 |
| | Gold (Au) (ppm) | | | | |
| | <0.02 | 0.02 | <0.02 | <0.02 | 0.02 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.06 | 0.05 | 0.05 | 0.04 | 0.06 |
| | Indium (In) (ppm) | | | | |
| | 0.026 | 0.034 | 0.028 | 0.036 | 0.034 |
| | Iron (Fe) (%) | | | | |
| | 2.05 | 2.54 | 2.27 | 2.15 | 2.30 |
| | Lanthanum (La) (ppm) | | | | |
| | 9.1 | 12.8 | 11.1 | 12.8 | 14.2 |
| | Lead (Pb) (ppm) | | | | |
| | 2.5 | 2.7 | 3.2 | 5.2 | 2.9 |
| | Lithium (Li) (ppm) | | | | |
| | 5.4 | 6.4 | 7.1 | 7.9 | 7.3 |
| | Magnesium (Mg) (%) | | | | |
| | 0.60 | 0.68 | 0.70 | 0.68 | 0.63 |
| | Manganese (Mn) (ppm) | | | | |
| | 560 | 584 | 581 | 629 | 662 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1968927-6 WASTE 18-JUL-17 129730 775-45C | L1968927-7 WASTE 18-JUL-17 129731 775-45C | L1968927-8 WASTE 15-JUL-17 129729 775-44 | L1968927-9 WASTE 15-JUL-17 142628 775-44 | L1968927-10 WASTE 20-JUL-17 129732 775-46 |
|-----------------------------------|---|--|--|---|---|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.9 | 9.1 | 9.2 | 9.1 | 8.8 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.56 | 0.59 | 0.43 | 0.13 | 0.68 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 15.3 | 7.5 | 2.5 | 15.6 | 16.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 39 | 35 | 37 | 16 | 39 |
| | NNP (tCaCO3/1Kt) | 24 | 28 | 35 | 0 | 23 |
| | Ratio (NP/MPA) (Unity) | 2.55 | 4.67 | 14.80 | 1.02 | 2.40 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | 0.03 | <0.01 | 0.01 | 0.03 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.48 | 0.21 | 0.08 | 0.49 | 0.49 |
| | Total Sulfur (combustion) (%) | 0.49 | 0.24 | 0.08 | 0.50 | 0.52 |
| Total Metals | Aluminum (Al) (%) | 0.80 | 0.53 | 1.10 | 1.17 | 0.62 |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 1.3 | 1.3 | 0.8 | 0.7 | 0.8 |
| | Barium (Ba) (ppm) | 100 | 80 | 210 | 290 | 80 |
| | Beryllium (Be) (ppm) | 0.27 | 0.36 | 0.37 | 0.23 | 0.31 |
| | Bismuth (Bi) (ppm) | 0.67 | 0.09 | 0.19 | 0.25 | 0.35 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.32 | 0.16 | 0.06 | 0.13 | 0.17 |
| | Calcium (Ca) (%) | 1.19 | 1.02 | 1.52 | 0.68 | 1.13 |
| | Cerium (Ce) (ppm) | 36.6 | 12.65 | 24.4 | 38.3 | 36.9 |
| | Cesium (Cs) (ppm) | 0.55 | 0.42 | 0.39 | 0.44 | 0.32 |
| | Chromium (Cr) (ppm) | 3 | 4 | 5 | 5 | 5 |
| | Cobalt (Co) (ppm) | 4.4 | 5.7 | 5.3 | 6.4 | 4.9 |
| | Copper (Cu) (ppm) | 5410 | 2240 | 1090 | 3400 | 3960 |
| | Gallium (Ga) (ppm) | 4.82 | 2.85 | 5.89 | 6.06 | 3.82 |
| | Germanium (Ge) (ppm) | 0.09 | 0.05 | 0.07 | 0.08 | 0.07 |
| | Gold (Au) (ppm) | 0.07 | 0.03 | 0.03 | 0.02 | 0.06 |
| | Hafnium (Hf) (ppm) | 0.06 | 0.04 | 0.04 | 0.04 | 0.03 |
| | Indium (In) (ppm) | 0.137 | 0.065 | 0.041 | 0.124 | 0.105 |
| | Iron (Fe) (%) | 2.45 | 2.34 | 2.33 | 2.46 | 2.35 |
| | Lanthanum (La) (ppm) | 18.0 | 6.0 | 12.7 | 20.9 | 18.3 |
| | Lead (Pb) (ppm) | 3.6 | 3.0 | 3.1 | 2.3 | 3.7 |
| | Lithium (Li) (ppm) | 4.5 | 2.6 | 7.0 | 7.1 | 3.4 |
| | Magnesium (Mg) (%) | 0.78 | 0.54 | 0.67 | 0.69 | 0.64 |
| | Manganese (Mn) (ppm) | 386 | 473 | 609 | 325 | 400 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1968927-1 | L1968927-2 | L1968927-3 | L1968927-4 | L1968927-5 |
|------------------------|--------------------------|--------------|---------------|---------------|----------------|----------------|----------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 10-JUL-17 | 10-JUL-17 | 11-JUL-17 | 11-JUL-17 | 13-JUL-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 142672 775-43 | 142673 775-43 | 142674 775-45A | 142675 775-45A | 129726 775-45B |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | | 0.46 | 1.65 | 0.51 | 0.40 | 1.80 |
| | Nickel (Ni) (ppm) | | 2.5 | 81.9 | 2.5 | 2.1 | 3.5 |
| | Niobium (Nb) (ppm) | | 0.12 | 0.17 | 0.12 | <0.05 | 0.09 |
| | Phosphorus (P) (ppm) | | 580 | 660 | 690 | 650 | 670 |
| | Potassium (K) (%) | | 0.44 | 0.61 | 0.36 | 0.12 | 0.39 |
| | Rhenium (Re) (ppm) | | 0.001 | 0.001 | 0.001 | <0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | | 19.5 | 29.7 | 16.7 | 6.2 | 18.6 |
| | Scandium (Sc) (ppm) | | 3.7 | 3.5 | 3.6 | 5.0 | 5.3 |
| | Selenium (Se) (ppm) | | 0.5 | 0.7 | 0.2 | 0.2 | 0.4 |
| | Silver (Ag) (ppm) | | 0.10 | 0.36 | 0.05 | 0.02 | 0.11 |
| | Sodium (Na) (%) | | 0.08 | 0.07 | 0.10 | 0.04 | 0.06 |
| | Strontium (Sr) (ppm) | | 88.3 | 68.5 | 66.0 | 116.0 | 73.5 |
| | Sulfur (S) (%) | | 0.01 | 0.03 | <0.01 | <0.01 | <0.01 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.01 | 0.07 | 0.01 | <0.01 | 0.01 |
| | Thallium (Tl) (ppm) | | 0.12 | 0.17 | 0.09 | 0.03 | 0.10 |
| | Thorium (Th) (ppm) | | 1.8 | 2.6 | 2.3 | 2.5 | 2.8 |
| | Tin (Sn) (ppm) | | 0.5 | 0.6 | 0.5 | 0.5 | 0.6 |
| | Titanium (Ti) (%) | | 0.078 | 0.105 | 0.079 | 0.006 | 0.058 |
| | Tungsten (W) (ppm) | | 0.66 | 0.64 | 1.01 | 0.23 | 0.63 |
| | Uranium (U) (ppm) | | 0.66 | 0.24 | 0.31 | 0.37 | 0.25 |
| | Vanadium (V) (ppm) | | 44 | 53 | 45 | 38 | 48 |
| | Yttrium (Y) (ppm) | | 9.40 | 7.61 | 7.03 | 11.35 | 9.06 |
| | Zinc (Zn) (ppm) | | 58 | 65 | 69 | 67 | 67 |
| | Zirconium (Zr) (ppm) | | 0.8 | 0.8 | 0.8 | 0.7 | 1.1 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 1.0 | 0.9 | 0.8 | 2.0 | 0.9 |
| Miscellaneous | Carbon (C) (%) | | 0.36 | 0.34 | 0.30 | 0.67 | 0.31 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1968927-6 WASTE 18-JUL-17 129730 775-45C | L1968927-7 WASTE 18-JUL-17 129731 775-45C | L1968927-8 WASTE 15-JUL-17 129729 775-44 | L1968927-9 WASTE 15-JUL-17 142628 775-44 | L1968927-10 WASTE 20-JUL-17 129732 775-46 |
|------------------------|--------------------------|---|--|--|---|---|--|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | 4.59 | 3.94 | 1.04 | 43.4 | 4.19 | 4.19 |
| | Nickel (Ni) (ppm) | 2.6 | 2.5 | 2.2 | 2.2 | 2.5 | 2.5 |
| | Niobium (Nb) (ppm) | 0.37 | 0.12 | 0.15 | 0.28 | 0.26 | 0.26 |
| | Phosphorus (P) (ppm) | 960 | 650 | 610 | 880 | 850 | 850 |
| | Potassium (K) (%) | 0.52 | 0.24 | 0.42 | 0.73 | 0.28 | 0.28 |
| | Rhenium (Re) (ppm) | 0.018 | 0.006 | 0.002 | 0.152 | 0.009 | 0.009 |
| | Rubidium (Rb) (ppm) | 28.3 | 13.0 | 19.8 | 36.1 | 15.0 | 15.0 |
| | Scandium (Sc) (ppm) | 6.7 | 3.2 | 4.1 | 4.3 | 4.9 | 4.9 |
| | Selenium (Se) (ppm) | 4.8 | 2.2 | 1.1 | 2.5 | 3.9 | 3.9 |
| | Silver (Ag) (ppm) | 0.99 | 0.50 | 0.36 | 0.69 | 0.81 | 0.81 |
| | Sodium (Na) (%) | 0.05 | 0.05 | 0.07 | 0.08 | 0.05 | 0.05 |
| | Strontium (Sr) (ppm) | 105.0 | 112.0 | 116.5 | 42.5 | 133.0 | 133.0 |
| | Sulfur (S) (%) | 0.51 | 0.24 | 0.07 | 0.55 | 0.53 | 0.53 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.16 | 0.05 | 0.05 | 0.10 | 0.13 | 0.13 |
| | Thallium (Tl) (ppm) | 0.24 | 0.07 | 0.12 | 0.25 | 0.13 | 0.13 |
| | Thorium (Th) (ppm) | 5.1 | 1.4 | 3.1 | 4.6 | 4.1 | 4.1 |
| | Tin (Sn) (ppm) | 1.2 | 0.7 | 0.6 | 2.1 | 1.3 | 1.3 |
| | Titanium (Ti) (%) | 0.089 | 0.032 | 0.066 | 0.128 | 0.036 | 0.036 |
| | Tungsten (W) (ppm) | 0.62 | 0.62 | 0.31 | 0.85 | 0.71 | 0.71 |
| | Uranium (U) (ppm) | 0.36 | 0.29 | 0.41 | 0.35 | 0.89 | 0.89 |
| | Vanadium (V) (ppm) | 62 | 45 | 45 | 68 | 49 | 49 |
| | Yttrium (Y) (ppm) | 12.65 | 5.18 | 7.51 | 7.67 | 11.85 | 11.85 |
| | Zinc (Zn) (ppm) | 54 | 75 | 65 | 50 | 46 | 46 |
| | Zirconium (Zr) (ppm) | 2.0 | 1.4 | 0.9 | 1.1 | 1.3 | 1.3 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 2.1 | 2.2 | 1.6 | 0.5 | 2.5 | 2.5 |
| Miscellaneous | Carbon (C) (%) | 0.69 | 0.74 | 0.52 | 0.19 | 0.81 | 0.81 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-23

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page: 1
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 Plus Appendix Pages
 Finalized Date: 2-SEP-2017
 Account: APN

CERTIFICATE VA17165021

Project: L1968927
 P.O. No.: ALSM-CW16-102-APN
 This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 6-AUG-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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 Total # Pages: 2 (A - E)
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 Finalized Date: 2-SEP-2017
 Account: APN

Project: L1968927

CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm |
|---------------------------|-----------------------------------|---------------------------|----------------------|--------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| L1968927-1-142672 775-43 | | 0.02 | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 |
| L1968927-2-142673 775-43 | | 1.04 | 0.10 | 1.02 | 0.9 | <0.02 | <10 | 210 | 0.31 | 0.07 | 1.21 | 0.05 | 18.55 | 5.0 | 5 | 0.41 |
| L1968927-3-142674 775-43 | | 1.06 | 0.36 | 1.17 | 0.7 | 0.02 | <10 | 230 | 0.32 | 0.19 | 0.96 | 0.06 | 23.9 | 7.3 | 292 | 0.52 |
| L1968927-3-142674 775-45A | | 1.06 | 0.05 | 1.21 | 0.8 | <0.02 | <10 | 200 | 0.34 | 0.03 | 1.16 | 0.04 | 21.5 | 5.7 | 5 | 0.50 |
| L1968927-4-142675 775-45A | | 0.98 | 0.02 | 1.10 | 1.5 | <0.02 | <10 | 60 | 0.48 | 0.02 | 2.09 | 0.05 | 25.1 | 5.6 | 4 | 0.47 |
| L1968927-5-129726 775-45B | | 1.06 | 0.11 | 1.10 | 1.4 | 0.02 | <10 | 240 | 0.31 | 0.05 | 1.10 | 0.13 | 26.2 | 6.3 | 5 | 0.48 |
| L1968927-6-129730 775-45C | | 1.08 | 0.99 | 0.80 | 1.3 | 0.07 | <10 | 100 | 0.27 | 0.67 | 1.19 | 0.32 | 36.6 | 4.4 | 3 | 0.55 |
| L1968927-7-129731 775-45C | | 1.06 | 0.50 | 0.53 | 1.3 | 0.03 | <10 | 80 | 0.36 | 0.09 | 1.02 | 0.16 | 12.65 | 5.7 | 4 | 0.42 |
| L1968927-8-129729 775-44 | | 1.12 | 0.36 | 1.10 | 0.8 | 0.03 | <10 | 210 | 0.37 | 0.19 | 1.52 | 0.06 | 24.4 | 5.3 | 5 | 0.39 |
| L1968927-9-142628 775-44 | | 1.06 | 0.69 | 1.17 | 0.7 | 0.02 | <10 | 290 | 0.23 | 0.25 | 0.68 | 0.13 | 38.3 | 6.4 | 5 | 0.44 |
| L1968927-10-129732 775-46 | | 1.10 | 0.81 | 0.62 | 0.8 | 0.06 | <10 | 80 | 0.31 | 0.35 | 1.13 | 0.17 | 36.9 | 4.9 | 5 | 0.32 |



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 Account: APN

Project: L1968927

CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method Analyte Units LOR | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm |
|---------------------------|-----------------------------------|----------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|
| L1968927-1-142672 775-43 | | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 |
| L1968927-2-142673 775-43 | | 324 | 2.05 | 4.99 | 0.06 | 0.06 | <0.01 | 0.026 | 0.44 | 9.1 | 5.4 | 0.60 | 560 | 0.46 | 0.08 | 0.12 |
| L1968927-3-142674 775-45A | | 770 | 2.54 | 6.13 | 0.08 | 0.05 | <0.01 | 0.034 | 0.61 | 12.8 | 6.4 | 0.68 | 584 | 1.65 | 0.07 | 0.17 |
| L1968927-4-142675 775-45A | | 145.0 | 2.27 | 6.28 | 0.06 | 0.05 | <0.01 | 0.028 | 0.36 | 11.1 | 7.1 | 0.70 | 581 | 0.51 | 0.10 | 0.12 |
| L1968927-5-129726 775-45B | | 46.2 | 2.15 | 6.33 | 0.05 | 0.04 | <0.01 | 0.036 | 0.12 | 12.8 | 7.9 | 0.68 | 629 | 0.40 | 0.04 | <0.05 |
| L1968927-6-129730 775-45C | | 702 | 2.30 | 5.97 | 0.06 | 0.06 | <0.01 | 0.034 | 0.39 | 14.2 | 7.3 | 0.63 | 662 | 1.80 | 0.06 | 0.09 |
| L1968927-7-129731 775-45C | | 5410 | 2.45 | 4.82 | 0.09 | 0.06 | <0.01 | 0.137 | 0.52 | 18.0 | 4.5 | 0.78 | 386 | 4.59 | 0.05 | 0.37 |
| L1968927-8-129729 775-44 | | 2240 | 2.34 | 2.85 | 0.05 | 0.04 | 0.01 | 0.065 | 0.24 | 6.0 | 2.6 | 0.54 | 473 | 3.94 | 0.05 | 0.12 |
| L1968927-9-142628 775-44 | | 1090 | 2.33 | 5.89 | 0.07 | 0.04 | 0.01 | 0.041 | 0.42 | 12.7 | 7.0 | 0.67 | 609 | 1.04 | 0.07 | 0.15 |
| L1968927-10-129732 775-46 | | 3400 | 2.46 | 6.06 | 0.08 | 0.04 | 0.01 | 0.124 | 0.73 | 20.9 | 7.1 | 0.69 | 325 | 43.4 | 0.08 | 0.28 |
| | | 3960 | 2.35 | 3.82 | 0.07 | 0.03 | 0.01 | 0.105 | 0.28 | 18.3 | 3.4 | 0.64 | 400 | 4.19 | 0.05 | 0.26 |



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CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| | Analyte | Ni | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti |
| Units | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % |
| LOR | | 0.2 | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 |
| L1968927-1-142672 775-43 | | 2.5 | 580 | 2.5 | 19.5 | 0.001 | 0.01 | <0.05 | 3.7 | 0.5 | 0.5 | 88.3 | <0.01 | 0.01 | 1.8 | 0.078 |
| L1968927-2-142673 775-43 | | 81.9 | 660 | 2.7 | 29.7 | 0.001 | 0.03 | 0.07 | 3.5 | 0.7 | 0.6 | 68.5 | <0.01 | 0.07 | 2.6 | 0.105 |
| L1968927-3-142674 775-45A | | 2.5 | 690 | 3.2 | 16.7 | 0.001 | <0.01 | <0.05 | 3.6 | 0.2 | 0.5 | 66.0 | <0.01 | 0.01 | 2.3 | 0.079 |
| L1968927-4-142675 775-45A | | 2.1 | 650 | 5.2 | 6.2 | <0.001 | <0.01 | 0.12 | 5.0 | 0.2 | 0.5 | 116.0 | <0.01 | <0.01 | 2.5 | 0.006 |
| L1968927-5-129726 775-45B | | 3.5 | 670 | 2.9 | 18.6 | 0.001 | <0.01 | 0.06 | 5.3 | 0.4 | 0.6 | 73.5 | <0.01 | 0.01 | 2.8 | 0.058 |
| L1968927-6-129730 775-45C | | 2.6 | 960 | 3.6 | 28.3 | 0.018 | 0.51 | <0.05 | 6.7 | 4.8 | 1.2 | 105.0 | <0.01 | 0.16 | 5.1 | 0.089 |
| L1968927-7-129731 775-45C | | 2.5 | 650 | 3.0 | 13.0 | 0.006 | 0.24 | <0.05 | 3.2 | 2.2 | 0.7 | 112.0 | <0.01 | 0.05 | 1.4 | 0.032 |
| L1968927-8-129729 775-44 | | 2.2 | 610 | 3.1 | 19.8 | 0.002 | 0.07 | <0.05 | 4.1 | 1.1 | 0.6 | 116.5 | <0.01 | 0.05 | 3.1 | 0.066 |
| L1968927-9-142628 775-44 | | 2.2 | 880 | 2.3 | 36.1 | 0.152 | 0.55 | <0.05 | 4.3 | 2.5 | 2.1 | 42.5 | <0.01 | 0.10 | 4.6 | 0.128 |
| L1968927-10-129732 775-46 | | 2.5 | 850 | 3.7 | 15.0 | 0.009 | 0.53 | <0.05 | 4.9 | 3.9 | 1.3 | 133.0 | <0.01 | 0.13 | 4.1 | 0.036 |

***** See Appendix Page for comments regarding this certificate *****



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CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method Analyte Units LOR | ME-MS41 TI ppm 0.02 | ME-MS41 U ppm 0.05 | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | OA-VOL08m FIZZ RAT Unity 1 | OA-VOL08m MPA tCaCO3/1Kt 0.3 | OA-VOL08m NNP tCaCO3/1Kt 1 | OA-VOL08m NP tCaCO3/1Kt 1 | OA-VOL08m Ratio (N) Unity 0.01 | OA-ELE07 pH Unity 0.1 | S-IR08 S % 0.01 | S-CAL06a S % 0.01 |
|---------------------------|--------------------------|------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|-------------------------------------|---------------------------------------|-------------------------------------|------------------------------------|---|--------------------------------|--------------------------|----------------------------|
| L1968927-1-142672 775-43 | | 0.12 | 0.66 | 44 | 0.66 | 9.40 | 58 | 0.8 | 2 | 0.9 | 27 | 28 | 29.87 | 9.1 | 0.03 | 0.02 |
| L1968927-2-142673 775-43 | | 0.17 | 0.24 | 53 | 0.64 | 7.61 | 65 | 0.8 | 2 | 1.6 | 22 | 24 | 15.36 | 9.0 | 0.05 | 0.05 |
| L1968927-3-142674 775-45A | | 0.09 | 0.31 | 45 | 1.01 | 7.03 | 69 | 0.8 | 2 | 0.6 | 23 | 24 | 38.40 | 9.1 | 0.02 | <0.01 |
| L1968927-4-142675 775-45A | | 0.03 | 0.37 | 38 | 0.23 | 11.35 | 67 | 0.7 | 2 | 0.3 | 53 | 53 | 169.60 | 8.7 | 0.01 | <0.01 |
| L1968927-5-129726 775-45B | | 0.10 | 0.25 | 48 | 0.63 | 9.06 | 67 | 1.1 | 2 | 0.6 | 26 | 27 | 43.20 | 8.7 | 0.02 | <0.01 |
| L1968927-6-129730 775-45C | | 0.24 | 0.36 | 62 | 0.62 | 12.65 | 54 | 2.0 | 2 | 15.3 | 24 | 39 | 2.55 | 8.9 | 0.49 | 0.48 |
| L1968927-7-129731 775-45C | | 0.07 | 0.29 | 45 | 0.62 | 5.18 | 75 | 1.4 | 2 | 7.5 | 28 | 35 | 4.67 | 9.1 | 0.24 | 0.21 |
| L1968927-8-129729 775-44 | | 0.12 | 0.41 | 45 | 0.31 | 7.51 | 65 | 0.9 | 2 | 2.5 | 35 | 37 | 14.80 | 9.2 | 0.08 | 0.08 |
| L1968927-9-142628 775-44 | | 0.25 | 0.35 | 68 | 0.85 | 7.67 | 50 | 1.1 | 2 | 15.6 | 0 | 16 | 1.02 | 9.1 | 0.50 | 0.49 |
| L1968927-10-129732 775-46 | | 0.13 | 0.89 | 49 | 0.71 | 11.85 | 46 | 1.3 | 2 | 16.3 | 23 | 39 | 2.40 | 8.8 | 0.52 | 0.49 |



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| |
|---|
| CERTIFICATE OF ANALYSIS VA17165021 |
|---|

| | Method | C-GAS05 | C-GAS05 | S-GRA06a | C-IR07 | S-GRA06 |
|---------------------------|---------|---------|---------|----------|--------|---------|
| Sample Description | Analyte | C | CO2 | S | C | S |
| | Units | % | % | % | % | % |
| | LOR | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 |
| L1968927-1-142672 775-43 | | 0.27 | 1.0 | 0.01 | 0.36 | <0.01 |
| L1968927-2-142673 775-43 | | 0.23 | 0.9 | <0.01 | 0.34 | 0.01 |
| L1968927-3-142674 775-45A | | 0.22 | 0.8 | 0.02 | 0.30 | 0.01 |
| L1968927-4-142675 775-45A | | 0.56 | 2.0 | 0.02 | 0.67 | <0.01 |
| L1968927-5-129726 775-45B | | 0.25 | 0.9 | 0.02 | 0.31 | <0.01 |
| L1968927-6-129730 775-45C | | 0.56 | 2.1 | 0.01 | 0.69 | 0.01 |
| L1968927-7-129731 775-45C | | 0.59 | 2.2 | 0.03 | 0.74 | 0.01 |
| L1968927-8-129729 775-44 | | 0.43 | 1.6 | <0.01 | 0.52 | 0.01 |
| L1968927-9-142628 775-44 | | 0.13 | 0.5 | 0.01 | 0.19 | 0.01 |
| L1968927-10-129732 775-46 | | 0.68 | 2.5 | 0.03 | 0.81 | 0.01 |
| | | | | | | |



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CERTIFICATE OF ANALYSIS VA17165021

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|--------|----------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | S-CAL06a |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



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QC CERTIFICATE VA17165021

Project: L1968927
 P.O. No.: ALSM-CW16-102-APN
 This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 6-AUG-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17165021

| Method Analyte Units LOR | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm |
|----------------------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Sample Description | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 4.13 | 2.50 | 31.3 | <0.02 | <10 | 420 | 0.70 | 0.62 | 1.00 | 2.14 | 76.0 | 18.0 | 87 | 11.05 | 601 |
| Target Range - Lower Bound | 4.00 | 2.44 | 29.6 | <0.02 | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 |
| Upper Bound | 4.92 | 3.00 | 36.4 | 0.04 | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 |
| OGGeo08 | 18.45 | 2.16 | 119.0 | 0.06 | <10 | 120 | 0.75 | 8.92 | 0.86 | 18.05 | 57.7 | 90.1 | 80 | 9.32 | 8240 |
| Target Range - Lower Bound | 18.15 | 2.05 | 107.0 | 0.03 | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 |
| Upper Bound | 22.2 | 2.53 | 131.0 | 0.11 | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 |
| OREAS 905 | 0.46 | 0.74 | 29.7 | 0.37 | <10 | 230 | 0.93 | 5.30 | 0.32 | 0.30 | 74.4 | 12.8 | 16 | 1.16 | 1515 |
| Target Range - Lower Bound | 0.45 | 0.73 | 28.4 | 0.33 | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 |
| Upper Bound | 0.58 | 0.91 | 35.0 | 0.45 | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 |
| OREAS 920 | 0.09 | 2.41 | 4.9 | <0.02 | <10 | 80 | 0.83 | 0.65 | 0.32 | 0.06 | 70.8 | 13.5 | 43 | 1.93 | 113.0 |
| Target Range - Lower Bound | 0.07 | 2.18 | 3.8 | <0.02 | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 |
| Upper Bound | 0.12 | 2.68 | 4.9 | 0.04 | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 |



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| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Fe % | Ga ppm | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | |
| | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 3.45 | 9.46 | 0.13 | 0.71 | 0.05 | 0.153 | 1.20 | 37.3 | 30.3 | 1.08 | 394 | 14.40 | 0.31 | 1.05 | 671 | |
| Target Range - Lower Bound | 3.22 | 8.73 | 0.07 | 0.64 | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 | |
| Upper Bound | 3.96 | 10.80 | 0.29 | 0.83 | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 | |
| OGGeo08 | 5.03 | 8.55 | 0.22 | 0.80 | 0.43 | 1.410 | 1.04 | 27.7 | 28.9 | 0.93 | 383 | 868 | 0.28 | 1.69 | 8740 | |
| Target Range - Lower Bound | 4.51 | 8.05 | 0.21 | 0.72 | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 | |
| Upper Bound | 5.53 | 9.95 | 0.45 | 0.92 | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 | |
| OREAS 905 | 3.38 | 5.60 | 0.08 | 1.09 | 0.01 | 0.523 | 0.29 | 37.4 | 4.9 | 0.14 | 332 | 2.77 | 0.08 | 0.29 | 8.2 | |
| Target Range - Lower Bound | 3.14 | 5.74 | <0.05 | 1.08 | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 | |
| Upper Bound | 3.86 | 7.12 | 0.22 | 1.36 | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 | |
| OREAS 920 | 3.65 | 6.68 | 0.10 | 0.55 | 0.01 | 0.034 | 0.41 | 35.0 | 23.2 | 1.07 | 519 | 0.34 | 0.02 | 0.34 | 37.7 | |
| Target Range - Lower Bound | 3.26 | 6.12 | <0.05 | 0.53 | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 | |
| Upper Bound | 4.00 | 7.60 | 0.22 | 0.69 | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 | |



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|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | |
| | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | |
| | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 960 | 1005 | 136.5 | 0.007 | 0.27 | 3.18 | 7.1 | 1.3 | 3.3 | 73.5 | 0.02 | 0.02 | 20.1 | 0.353 | 0.76 | |
| Target Range - Lower Bound | 900 | 959 | 132.0 | 0.006 | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 | |
| Upper Bound | 1130 | 1175 | 162.0 | 0.010 | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 | |
| OGGeo08 | 770 | 6990 | 119.0 | 1.305 | 2.68 | 18.20 | 6.6 | 10.6 | 12.7 | 64.0 | 0.05 | 0.12 | 16.1 | 0.300 | 1.23 | |
| Target Range - Lower Bound | 700 | 6520 | 109.5 | 1.295 | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | |
| Upper Bound | 880 | 7970 | 134.5 | 1.585 | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | |
| OREAS 905 | 240 | 15.6 | 16.4 | <0.001 | 0.05 | 0.97 | 1.7 | 2.3 | 1.2 | 11.1 | <0.01 | 0.06 | 7.9 | 0.018 | 0.10 | |
| Target Range - Lower Bound | | 15.2 | 17.3 | <0.001 | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 | |
| Upper Bound | | 19.0 | 21.3 | 0.002 | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 | |
| OREAS 920 | 710 | 19.8 | 23.5 | <0.001 | 0.02 | 0.59 | 2.6 | 0.8 | 1.0 | 16.6 | 0.01 | 0.01 | 15.4 | 0.122 | 0.14 | |
| Target Range - Lower Bound | | 19.2 | 22.2 | <0.001 | <0.01 | 0.45 | 2.5 | 0.4 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | |
| Upper Bound | | 23.9 | 27.4 | 0.002 | 0.05 | 0.77 | 3.3 | 1.3 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | |



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Project: L1968927

QC CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % |
|----------------------------|--------------------------|---------------|---------------|---------------|---------------|----------------|----------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|-------------|---------------|
| | | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | 6.1 | | | |
| Buffer pH6 | | | | | | | | | | | | | 6.0 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 5.3 | | | |
| Upper Bound | | | | | | | | | | | | | 6.7 | | | |
| CO-ASSAY | | | | | | | | | | | | | | | 0.50 | 1.8 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 0.42 | 1.5 |
| Upper Bound | | | | | | | | | | | | | | | 0.64 | 2.4 |
| DS-1 | | | | | | | | | | | | | | 2.68 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | 2.51 | | |
| Upper Bound | | | | | | | | | | | | | | 2.71 | | |
| GS313-8 | | | | | | | | | | | | | | | 1.26 | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 1.19 | |
| Upper Bound | | | | | | | | | | | | | | | 1.29 | |
| KZK-1 | | | | | | | | 2 | 25.0 | 31 | 56 | 2.24 | | | | |
| Target Range - Lower Bound | | | | | | | | 2 | 25.0 | 30 | 55 | 2.20 | | | | |
| Upper Bound | | | | | | | | <1 | 22.9 | 30 | 54 | 2.18 | | | | |
| MA-2c | | | | | | | | >4 | 27.1 | 38 | 64 | 2.53 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 1.54 | 5.6 |
| Upper Bound | | | | | | | | | | | | | | | 1.50 | 5.5 |
| MRGeo08 | | 5.43 | 96 | 2.92 | 19.45 | 725 | 21.4 | | | | | | | | 1.84 | 6.8 |
| Target Range - Lower Bound | | 4.93 | 90 | 2.44 | 17.50 | 708 | 18.1 | | | | | | | | | |
| Upper Bound | | 6.13 | 112 | 3.42 | 21.5 | 870 | 25.7 | | | | | | | | | |
| OGGeo08 | | 4.55 | 78 | 2.80 | 15.75 | 6870 | 24.4 | | | | | | | | | |
| Target Range - Lower Bound | | 4.45 | 70 | 2.58 | 15.35 | 6500 | 19.5 | | | | | | | | | |
| Upper Bound | | 5.55 | 88 | 3.60 | 18.85 | 7950 | 27.5 | | | | | | | | | |
| OREAS 905 | | 2.18 | 6 | 0.60 | 6.34 | 60 | 40.3 | | | | | | | | | |
| Target Range - Lower Bound | | 2.08 | 4 | 0.44 | 6.32 | 58 | 39.9 | | | | | | | | | |
| Upper Bound | | 2.66 | 8 | 0.76 | 7.84 | 76 | 55.1 | | | | | | | | | |
| OREAS 920 | | 2.05 | 25 | 0.41 | 17.20 | 102 | 22.0 | | | | | | | | | |
| Target Range - Lower Bound | | 1.89 | 23 | 0.31 | 16.85 | 93 | 17.6 | | | | | | | | | |
| Upper Bound | | 2.42 | 30 | 0.61 | 20.7 | 119 | 25.0 | | | | | | | | | |



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Project: L1968927

QC CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method Analyte Units LOR | S-GRA06a S % | C-IR07 C % | S-GRA06 S % |
|--------------------|-----------------------------------|--------------------|------------------|-------------------|
| | | 0.01 | 0.01 | 0.01 |

STANDARDS

Buffer pH6
 Buffer pH6
 Target Range - Lower Bound
 Upper Bound
 CO-ASSAY
 Target Range - Lower Bound
 Upper Bound
 DS-1
 Target Range - Lower Bound
 Upper Bound
 GS313-8
 Target Range - Lower Bound
 Upper Bound
 KZK-1
 KZK-1
 Target Range - Lower Bound
 Upper Bound
 MA-2c
 Target Range - Lower Bound
 Upper Bound
 MRGeo08
 Target Range - Lower Bound
 Upper Bound
 OGGeo08
 Target Range - Lower Bound
 Upper Bound
 OREAS 905
 Target Range - Lower Bound
 Upper Bound
 OREAS 920
 Target Range - Lower Bound
 Upper Bound

| |
|------|
| 3.13 |
| 3.01 |
| 3.25 |
| 0.95 |
| 0.90 |
| 0.98 |



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QC CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | |
|----------------------------|--------|---------|-------|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|------|-----|
| | | | | | Ag | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu |
| | | | | | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.01 | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | | |
| BLANK | <0.01 | <0.01 | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | | |
| Target Range - Lower Bound | <0.01 | <0.01 | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | | |
| Upper Bound | 0.02 | 0.02 | 0.2 | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | | |
| BLANK | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17165021

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | Fe % | Ga ppm | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm |
| | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.01 | 0.06 | <0.05 | <0.02 | <0.01 | 0.005 | <0.01 | <0.2 | 0.2 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 |
| BLANK | <0.01 | <0.05 | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 |
| Upper Bound | 0.02 | 0.10 | 0.10 | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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Project: L1968927

QC CERTIFICATE OF ANALYSIS VA17165021

| Method Analyte Units LOR | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 | ME-MS41 Rb ppm 0.1 | ME-MS41 Re ppm 0.001 | ME-MS41 S % 0.01 | ME-MS41 Sb ppm 0.05 | ME-MS41 Sc ppm 0.1 | ME-MS41 Se ppm 0.2 | ME-MS41 Sn ppm 0.2 | ME-MS41 Sr ppm 0.2 | ME-MS41 Ta ppm 0.01 | ME-MS41 Te ppm 0.01 | ME-MS41 Th ppm 0.2 | ME-MS41 Ti % 0.005 | ME-MS41 Tl ppm 0.02 |
|----------------------------|------------------|--------------------|--------------------|----------------------|------------------|---------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|--------------------|--------------------|---------------------|
| STANDARDS | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <10 | <0.2 | <0.1 | <0.001 | <0.01 | <0.05 | 0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 |
| BLANK | <10 | <0.2 | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 |
| Target Range - Lower Bound | <10 | <0.2 | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 |
| Upper Bound | 20 | 0.4 | 0.2 | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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Project: L1968927

QC CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm 0.05 | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | OA-VOL08m FIZZ RAT Unity 1 | OA-VOL08m MPA tCaCO3/1Kt 0.3 | OA-VOL08m NNP tCaCO3/1Kt 1 | OA-VOL08m NP tCaCO3/1Kt 1 | OA-VOL08m Ratio (N) Unity 0.01 | OA-ELE07 pH Unity 0.1 | S-IR08 S % 0.01 | C-GAS05 C % 0.05 | C-GAS05 CO2 % 0.2 |
|----------------------------|--------------------------|--------------------|-----------------|--------------------|--------------------|------------------|--------------------|----------------------------|------------------------------|----------------------------|---------------------------|--------------------------------|-----------------------|-----------------|------------------|-------------------|
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | <0.05 | <0.2 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | <0.05 | <0.2 |
| Upper Bound | | | | | | | | | | | | | | | 0.10 | 0.4 |
| BLANK | | <0.05 | <1 | <0.05 | <0.05 | <2 | <0.5 | | | | | | | | | |
| BLANK | | <0.05 | <1 | <0.05 | <0.05 | <2 | <0.5 | | | | | | | | | |
| Target Range - Lower Bound | | <0.05 | <1 | <0.05 | <0.05 | <2 | <0.5 | | | | | | | | | |
| Upper Bound | | 0.10 | 2 | 0.10 | 0.10 | 4 | 1.0 | | | | | | | | | |
| BLANK | | | | | | | | | | | | | 6.3 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 5.5 | | | |
| Upper Bound | | | | | | | | | | | | | 6.9 | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method Analyte Units LOR | S-GRA06a S % | C-IR07 C % | S-GRA06 S % |
|----------------------------|-----------------------------------|--------------------|------------------|-------------------|
| STANDARDS | | | | |
| UTS-1 | | | | 0.93 |
| UTS-1 | | | | 0.87 |
| UTS-1 | | | | 0.88 |
| Target Range - Lower Bound | | | | 0.83 |
| Upper Bound | | | | 0.93 |
| UTS-1 | | 0.90 | | |
| UTS-1 | | 0.91 | | |
| UTS-1 | | 0.90 | | |
| Target Range - Lower Bound | | 0.81 | | |
| Upper Bound | | 0.95 | | |
| UTS-4 | | | | 1.79 |
| Target Range - Lower Bound | | | | 1.64 |
| Upper Bound | | | | 1.84 |
| UTS-4 | | 1.73 | | |
| Target Range - Lower Bound | | 1.61 | | |
| Upper Bound | | 1.87 | | |
| BLANKS | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | <0.01 |
| BLANK | | | | <0.01 |
| Target Range - Lower Bound | | | | <0.01 |
| Upper Bound | | | | 0.02 |
| BLANK | | <0.01 | | |
| BLANK | | <0.01 | | |
| Target Range - Lower Bound | | <0.01 | | |
| Upper Bound | | 0.02 | | |
| BLANK | | | | <0.01 |
| Target Range - Lower Bound | | | | <0.01 |
| Upper Bound | | | | 0.02 |



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QC CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method Analyte Units LOR | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm |
|---|--------------------------|------------------------------|------------------------------|----------------------------|---------------------------------|-------------------------|--------------------------|------------------------------|------------------------------|------------------------------|------------------------------|----------------------------------|------------------------------|----------------------|------------------------------|------------------------------|
| | | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | 0.04 0.05 0.03 0.06 | 1.52 1.52 1.43 1.61 | 9.9 10.3 9.5 10.7 | <0.02 <0.02 <0.02 0.04 | <10 <10 <10 20 | 140 140 120 160 | 1.12 1.09 1.00 1.21 | 0.04 0.04 0.03 0.05 | 0.21 0.21 0.19 0.23 | 0.06 0.06 0.05 0.07 | 16.30 17.70 16.15 17.85 | 11.9 12.9 11.7 13.1 | 14 14 12 16 | 0.31 0.33 0.25 0.39 | 6.6 7.8 6.7 7.7 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968927-4-142675 775-45A DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968927-6-129730 775-45C DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968927-8-129729 775-44 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968927-10-129732 775-46 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | 0.04 0.04 0.03 0.05 | 1.22 1.24 1.16 1.30 | 7.9 8.6 7.7 8.8 | <0.02 <0.02 <0.02 0.04 | <10 <10 <10 20 | 120 120 100 140 | 0.28 0.27 0.21 0.34 | 0.06 0.06 0.05 0.07 | 0.64 0.66 0.61 0.69 | 0.06 0.08 0.06 0.08 | 9.15 9.34 8.76 9.73 | 7.6 8.2 7.4 8.4 | 32 33 30 35 | 0.49 0.51 0.43 0.58 | 24.2 26.0 24.0 26.2 |



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QC CERTIFICATE OF ANALYSIS VA17165021

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | Fe % | Ga ppm | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm |
| | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| ORIGINAL | 3.26 | 5.09 | <0.05 | 0.10 | 0.19 | 0.032 | 0.09 | 7.4 | 3.6 | 0.37 | 274 | 1.88 | 0.02 | 0.15 | 5.9 |
| DUP | 3.21 | 5.43 | <0.05 | 0.10 | 0.19 | 0.033 | 0.09 | 8.3 | 3.2 | 0.37 | 277 | 1.96 | 0.02 | 0.16 | 6.0 |
| Target Range - Lower Bound | 3.06 | 4.95 | <0.05 | 0.08 | 0.17 | 0.026 | 0.08 | 7.3 | 3.1 | 0.34 | 257 | 1.77 | <0.01 | 0.10 | 5.5 |
| Upper Bound | 3.41 | 5.57 | 0.10 | 0.13 | 0.21 | 0.039 | 0.10 | 8.4 | 3.7 | 0.40 | 294 | 2.07 | 0.03 | 0.21 | 6.4 |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L1968927-4-142675 775-45A | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L1968927-6-129730 775-45C | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L1968927-8-129729 775-44 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L1968927-10-129732 775-46 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| ORIGINAL | 1.97 | 3.65 | <0.05 | 0.04 | 0.02 | 0.017 | 0.09 | 3.9 | 8.1 | 0.57 | 415 | 0.55 | 0.03 | 0.76 | 17.1 |
| DUP | 2.00 | 3.94 | <0.05 | 0.05 | 0.02 | 0.017 | 0.09 | 3.9 | 8.7 | 0.59 | 428 | 0.58 | 0.03 | 0.80 | 18.5 |
| Target Range - Lower Bound | 1.88 | 3.56 | <0.05 | <0.02 | <0.01 | 0.011 | 0.08 | 3.5 | 7.9 | 0.54 | 395 | 0.49 | 0.02 | 0.69 | 16.7 |
| Upper Bound | 2.09 | 4.03 | 0.10 | 0.07 | 0.03 | 0.023 | 0.10 | 4.3 | 8.9 | 0.62 | 448 | 0.64 | 0.04 | 0.87 | 18.9 |



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QC CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method Analyte Units LOR | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm |
|---|--------------------------|--------------------------|--------------------------|----------------------------|-------------------------------------|--------------------------------|------------------------------|--------------------------|---------------------------|---------------------------|------------------------------|---------------------------------|-------------------------------|--------------------------|-----------------------------------|------------------------------|
| | | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | 210 210 190 230 | 6.0 6.1 5.5 6.6 | 6.7 7.1 6.5 7.3 | <0.001 <0.001 <0.001 0.002 | 0.03 0.03 0.02 0.04 | 0.31 0.32 0.24 0.39 | 5.0 5.2 4.7 5.5 | 0.5 0.9 0.5 0.9 | 0.6 0.6 0.4 0.8 | 38.9 41.5 38.0 42.4 | <0.01 <0.01 <0.01 0.02 | 0.18 0.22 0.18 0.22 | 2.7 2.9 2.5 3.1 | 0.005 0.005 <0.005 0.010 | 0.11 0.12 0.09 0.14 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968927-4-142675 775-45A DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968927-6-129730 775-45C DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968927-8-129729 775-44 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968927-10-129732 775-46 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | 270 270 250 290 | 3.8 3.6 3.3 4.1 | 9.9 10.5 9.6 10.8 | <0.001 <0.001 <0.001 0.002 | <0.01 0.01 <0.01 0.02 | 0.24 0.24 0.17 0.31 | 3.8 4.2 3.7 4.3 | 0.4 0.4 <0.2 0.6 | 0.3 0.3 <0.2 0.4 | 46.5 50.1 45.7 50.9 | <0.01 <0.01 <0.01 0.02 | 0.02 0.01 <0.01 0.02 | 0.8 0.8 0.6 1.0 | 0.058 0.060 0.051 0.067 | 0.06 0.06 0.04 0.08 |



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Project: L1968927

QC CERTIFICATE OF ANALYSIS VA17165021

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % |
|---|------------------------------|----------------------|-------------------------------|------------------------------|----------------------|--------------------------|----------------|--------------------------|--------------------------|--------------------------|-------------------------|----------------------------------|--------------------------|-------------------------------|------------------------------|--------------------------|
| | | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | 0.86 0.94 0.81 1.00 | 66 65 61 70 | 0.08 0.09 <0.05 0.10 | 6.33 6.94 6.25 7.02 | 25 25 22 28 | 2.4 2.6 1.8 3.2 | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968927-4-142675 775-45A DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | 0.01 0.01 <0.01 0.02 | | |
| L1968927-6-129730 775-45C DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | 8.9 8.9 8.4 9.4 | | | |
| L1968927-8-129729 775-44 DUP Target Range - Lower Bound Upper Bound | | | | | | | | 2 2 <1 3 | 2.5 2.5 2.1 2.9 | 35 35 32 38 | 37 37 34 40 | 14.80 14.80 14.05 15.55 | | | | |
| L1968927-10-129732 775-46 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | 0.68 0.68 0.60 0.76 | 2.5 2.5 2.2 2.8 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | 0.34 0.36 0.28 0.42 | 46 48 44 50 | 0.09 0.10 <0.05 0.10 | 2.35 2.46 2.23 2.58 | 28 29 25 32 | 1.5 1.6 0.9 2.2 | | | | | | | | | | |



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 4 - E
 Total # Pages: 4 (A - E)
 Plus Appendix Pages
 Finalized Date: 2-SEP-2017
 Account: APN

Project: L1968927

| |
|--|
| QC CERTIFICATE OF ANALYSIS VA17165021 |
|--|

| Method Analyte Units LOR | S-GRA06a S % | C-IR07 C % | S-GRA06 S % |
|-----------------------------------|--------------------|------------------|-------------------|
| Sample Description | 0.01 | 0.01 | 0.01 |
| DUPLICATES | | | |
| ORIGINAL | | | 0.18 |
| DUP | | | 0.20 |
| Target Range - Lower Bound | | | 0.17 |
| Upper Bound | | | 0.21 |
| ORIGINAL | | | |
| DUP | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| ORIGINAL | | | 0.01 |
| DUP | | | 0.01 |
| Target Range - Lower Bound | | | <0.01 |
| Upper Bound | | | 0.02 |
| L1968927-4-142675 775-45A | | 0.67 | |
| DUP | | 0.68 | |
| Target Range - Lower Bound | | 0.65 | |
| Upper Bound | | 0.70 | |
| L1968927-6-129730 775-45C | | | |
| DUP | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |
| L1968927-8-129729 775-44 | <0.01 | | |
| DUP | <0.01 | | |
| Target Range - Lower Bound | <0.01 | | |
| Upper Bound | 0.02 | | |
| L1968927-10-129732 775-46 | 0.03 | | |
| DUP | 0.04 | | |
| Target Range - Lower Bound | 0.02 | | |
| Upper Bound | 0.05 | | |
| ORIGINAL | | | |
| DUP | | | |
| Target Range - Lower Bound | | | |
| Upper Bound | | | |



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Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 2-SEP-2017
Account: APN

Project: L1968927

QC CERTIFICATE OF ANALYSIS VA17165021

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|--------|----------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | S-CAL06a |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



Chain of Custody (COC) / Analytical Request Form



COC Number: *WV #7-23*

Canada Toll Free: 1 800 668 9878

L1968927-COFC

Page of

www.alsglobal.com

| | | | | | | | | | | | |
|--|---|--|-----------------|-------------------|---|-------------------------------------|-----------------------|------------------------------|--|---------------------------|----------------------|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | dd-mmm-yy hh:mm | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Analysis Request | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | PO# | | | | | | | | |
| Job #: | | Major/Minor Code: | Routing Code: | | | | | | | | |
| PO / AFE: | TBD | Requisitioner: | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Sampler: | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers |
| | | | | Composite | R | R | R | R | R | R | |
| | 142672 775-43 | 10-Jul-17 | | WASTE | X | X | X | X | X | X | |
| | 142673 775-43 | 10-Jul-17 | | WASTE | X | X | X | X | X | X | |
| | 142674 775-45A | 11-Jul-17 | | WASTE | X | X | X | X | X | X | |
| | 142675 775-45A | 11-Jul-17 | | WASTE | X | X | X | X | X | X | |
| | 129726 775-45B | 13-Jul-17 | | WASTE | X | X | X | X | X | X | |
| | 129730 775-45C | 18-Jul-17 | | WASTE | X | X | X | X | X | X | |
| | 129731 775-45C | 18-Jul-17 | | WASTE | X | X | X | X | X | X | |
| | 129729 775-44 | 15-Jul-17 | | WASTE | X | X | X | X | X | X | |
| | 129728 775-44 | 15-Jul-17 | | WASTE | X | X | X | X | X | X | |
| | 129732 775-46 | 20/07/17 | | WASTE | X | X | X | X | X | X | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | FINAL COOLER TEMPERATURES °C | | | |
| | | | | | 10.0 | | | 5.4 7.5 9.5 | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | |
| Released by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | | | |
| | | | <i>E.H.F.</i> | <i>2 Aug 2017</i> | <i>13:30</i> | <i>Shayan</i> | <i>Aug. 3</i> | <i>11:30</i> | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 02-AUG-17
Report Date: 18-SEP-17 19:29 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L1968933
Project P.O. #: 226298
Job Reference:
C of C Numbers: 17-24
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1968933-1 Waste 20-JUL-17 129733 775-46 | L1968933-2 Waste 20-JUL-17 129734 775-46 | L1968933-3 Waste 22-JUL-17 129735 775-50 | L1968933-4 Waste 25-JUL-17 129739 | L1968933-5 Waste 17-JUL-17 129727 | |
|---|---|---|---|--|--|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.8 | 9.0 | 8.7 | 9.0 | 9.1 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.74 | 0.23 | 0.48 | 0.07 | 0.28 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 3.4 | 0.3 | 0.9 | 0.3 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 48 | 24 | 44 | 12 | 26 |
| | NNP (tCaCO3/1Kt) | 45 | 24 | 43 | 12 | 25 |
| | Ratio (NP/MPA) (Unity) | 13.96 | 76.80 | 46.93 | 38.40 | 41.60 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | 0.01 | <0.01 | <0.01 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.10 | 0.01 | 0.03 | 0.01 | 0.02 |
| | Total Sulfur (combustion) (%) | 0.11 | 0.01 | 0.03 | 0.01 | 0.02 |
| Total Metals | Aluminum (Al) (%) | 0.84 | 1.36 | 0.60 | 1.34 | 1.05 |
| | Antimony (Sb) (ppm) | 0.06 | 0.06 | 0.07 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 1.2 | 2.1 | 2.5 | 1.6 | 0.8 |
| | Barium (Ba) (ppm) | 90 | 70 | 90 | 350 | 250 |
| | Beryllium (Be) (ppm) | 0.33 | 0.47 | 0.44 | 0.25 | 0.30 |
| | Bismuth (Bi) (ppm) | 0.06 | 0.02 | 0.15 | 0.05 | 0.02 |
| | Boron (B) (ppm) | <10 | 10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.14 | 0.02 | 0.17 | 0.05 | 0.07 |
| | Calcium (Ca) (%) | 2.02 | 1.13 | 1.79 | 0.55 | 1.10 |
| | Cerium (Ce) (ppm) | 28.3 | 29.0 | 30.5 | 30.6 | 21.5 |
| | Cesium (Cs) (ppm) | 0.33 | 0.40 | 0.56 | 0.46 | 0.49 |
| | Chromium (Cr) (ppm) | 5 | 11 | 3 | 7 | 5 |
| | Cobalt (Co) (ppm) | 5.4 | 6.1 | 5.6 | 6.3 | 5.4 |
| | Copper (Cu) (ppm) | 857 | 41.9 | 1315 | 289 | 221 |
| | Gallium (Ga) (ppm) | 4.79 | 6.95 | 3.63 | 6.71 | 5.20 |
| | Germanium (Ge) (ppm) | <0.05 | 0.05 | 0.05 | 0.07 | 0.07 |
| | Gold (Au) (ppm) | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.03 | 0.05 | 0.05 | 0.04 | 0.06 |
| | Indium (In) (ppm) | 0.045 | 0.023 | 0.056 | 0.026 | 0.024 |
| | Iron (Fe) (%) | 2.41 | 2.29 | 2.41 | 2.71 | 2.27 |
| | Lanthanum (La) (ppm) | 14.8 | 16.1 | 16.3 | 16.0 | 10.8 |
| | Lead (Pb) (ppm) | 4.0 | 3.7 | 6.0 | 1.8 | 2.1 |
| | Lithium (Li) (ppm) | 5.1 | 12.6 | 2.4 | 7.9 | 4.8 |
| | Magnesium (Mg) (%) | 0.63 | 1.03 | 0.22 | 0.78 | 0.66 |
| | Manganese (Mn) (ppm) | 578 | 550 | 720 | 775 | 617 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1968933-6 Waste 22-JUL-17 129737 | L1968933-7 Waste 22-JUL-17 129738 | L1968933-8 Waste 22-JUL-17 129736 | | |
|---|--|--|--|-------|--|
| Grouping | | | | | |
| Analyte | | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | 8.8 | 8.9 | 9.0 | |
| Organic / Inorganic Carbon | Carbon (C) (%) | <0.05 | 0.11 | 0.17 | |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | 2 | 2 | |
| | MPA (tCaCO3/1Kt) | 0.6 | <0.3 | 0.3 | |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 8 | 17 | 18 | |
| | NNP (tCaCO3/1Kt) | 7 | 17 | 18 | |
| | Ratio (NP/MPA) (Unity) | 12.80 | 108.80 | 57.60 | |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | 0.01 | |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.02 | <0.01 | <0.01 | |
| | Total Sulfur (combustion) (%) | 0.02 | <0.01 | 0.01 | |
| Total Metals | Aluminum (Al) (%) | 0.97 | 1.21 | 1.22 | |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | <0.05 | |
| | Arsenic (As) (ppm) | 0.7 | 1.8 | 0.6 | |
| | Barium (Ba) (ppm) | 260 | 220 | 260 | |
| | Beryllium (Be) (ppm) | 0.21 | 0.28 | 0.25 | |
| | Bismuth (Bi) (ppm) | 0.04 | 0.02 | 0.04 | |
| | Boron (B) (ppm) | <10 | <10 | <10 | |
| | Cadmium (Cd) (ppm) | 0.18 | 0.11 | 0.14 | |
| | Calcium (Ca) (%) | 0.31 | 0.82 | 0.83 | |
| | Cerium (Ce) (ppm) | 23.2 | 25.1 | 27.8 | |
| | Cesium (Cs) (ppm) | 0.34 | 0.35 | 0.42 | |
| | Chromium (Cr) (ppm) | 6 | 5 | 7 | |
| | Cobalt (Co) (ppm) | 5.1 | 6.0 | 6.0 | |
| | Copper (Cu) (ppm) | 969 | 274 | 715 | |
| | Gallium (Ga) (ppm) | 4.85 | 5.93 | 6.11 | |
| | Germanium (Ge) (ppm) | 0.05 | 0.06 | 0.05 | |
| | Gold (Au) (ppm) | 0.13 | <0.02 | 0.03 | |
| | Hafnium (Hf) (ppm) | 0.04 | 0.08 | 0.04 | |
| | Indium (In) (ppm) | 0.023 | 0.024 | 0.028 | |
| | Iron (Fe) (%) | 2.12 | 2.38 | 2.51 | |
| | Lanthanum (La) (ppm) | 12.5 | 13.2 | 14.9 | |
| | Lead (Pb) (ppm) | 1.8 | 1.8 | 2.2 | |
| | Lithium (Li) (ppm) | 4.7 | 7.2 | 6.7 | |
| | Magnesium (Mg) (%) | 0.46 | 0.66 | 0.70 | |
| | Manganese (Mn) (ppm) | 533 | 703 | 628 | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1968933-1 Waste 20-JUL-17 129733 775-46 | L1968933-2 Waste 20-JUL-17 129734 775-46 | L1968933-3 Waste 22-JUL-17 129735 775-50 | L1968933-4 Waste 25-JUL-17 129739 | L1968933-5 Waste 17-JUL-17 129727 |
|---|--------------------------|---|---|---|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | <0.01 | 0.01 | <0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | 0.92 | 2.04 | 3.51 | 0.55 | 0.39 |
| | Nickel (Ni) (ppm) | 2.3 | 10.4 | 2.0 | 3.0 | 2.1 |
| | Niobium (Nb) (ppm) | 0.05 | <0.05 | 0.05 | 0.16 | 0.20 |
| | Phosphorus (P) (ppm) | 700 | 710 | 730 | 710 | 670 |
| | Potassium (K) (%) | 0.16 | 0.12 | 0.17 | 0.76 | 0.53 |
| | Rhenium (Re) (ppm) | 0.002 | 0.007 | 0.002 | <0.001 | <0.001 |
| | Rubidium (Rb) (ppm) | 7.9 | 6.3 | 9.6 | 36.6 | 23.9 |
| | Scandium (Sc) (ppm) | 4.4 | 3.1 | 4.5 | 4.4 | 4.4 |
| | Selenium (Se) (ppm) | 1.1 | 0.5 | 1.0 | 0.3 | 0.5 |
| | Silver (Ag) (ppm) | 0.22 | 0.05 | 0.24 | 0.06 | 0.06 |
| | Sodium (Na) (%) | 0.05 | 0.05 | 0.04 | 0.06 | 0.08 |
| | Strontium (Sr) (ppm) | 111.5 | 159.0 | 74.7 | 34.7 | 80.2 |
| | Sulfur (S) (%) | 0.11 | 0.01 | 0.03 | <0.01 | 0.02 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.02 | 0.01 | 0.06 | 0.01 | 0.01 |
| | Thallium (Tl) (ppm) | 0.05 | 0.03 | 0.05 | 0.21 | 0.13 |
| | Thorium (Th) (ppm) | 3.3 | 2.9 | 4.4 | 3.5 | 2.0 |
| | Tin (Sn) (ppm) | 0.7 | 0.4 | 0.6 | 0.6 | 0.5 |
| | Titanium (Ti) (%) | 0.012 | 0.012 | 0.012 | 0.134 | 0.092 |
| | Tungsten (W) (ppm) | 0.44 | 0.49 | 0.28 | 0.39 | 0.47 |
| | Uranium (U) (ppm) | 0.68 | 0.41 | 0.51 | 0.14 | 0.22 |
| | Vanadium (V) (ppm) | 46 | 42 | 46 | 61 | 47 |
| | Yttrium (Y) (ppm) | 9.32 | 6.64 | 8.16 | 6.81 | 10.00 |
| | Zinc (Zn) (ppm) | 59 | 72 | 74 | 87 | 65 |
| | Zirconium (Zr) (ppm) | 1.0 | 1.3 | 1.5 | 0.7 | 1.1 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 2.7 | 0.8 | 1.8 | 0.3 | 1.0 |
| Miscellaneous | Carbon (C) (%) | 0.80 | 0.31 | 0.57 | 0.12 | 0.37 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1968933-6 | L1968933-7 | L1968933-8 |
|------------------------|--------------------------|--------------|------------|------------|------------|
| | | Description | Waste | Waste | Waste |
| | | Sampled Date | 22-JUL-17 | 22-JUL-17 | 22-JUL-17 |
| | | Sampled Time | | | |
| | | Client ID | 129737 | 129738 | 129736 |
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | | 0.99 | 0.64 | 0.78 |
| | Nickel (Ni) (ppm) | | 2.5 | 3.3 | 4.7 |
| | Niobium (Nb) (ppm) | | 0.10 | 0.16 | 0.13 |
| | Phosphorus (P) (ppm) | | 570 | 780 | 730 |
| | Potassium (K) (%) | | 0.52 | 0.48 | 0.55 |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | <0.001 |
| | Rubidium (Rb) (ppm) | | 24.8 | 21.6 | 25.4 |
| | Scandium (Sc) (ppm) | | 3.0 | 4.7 | 4.3 |
| | Selenium (Se) (ppm) | | 0.4 | 0.3 | 0.6 |
| | Silver (Ag) (ppm) | | 0.15 | 0.08 | 0.15 |
| | Sodium (Na) (%) | | 0.06 | 0.08 | 0.07 |
| | Strontium (Sr) (ppm) | | 28.2 | 49.9 | 64.9 |
| | Sulfur (S) (%) | | 0.02 | <0.01 | 0.01 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.02 | <0.01 | 0.03 |
| | Thallium (Tl) (ppm) | | 0.13 | 0.12 | 0.15 |
| | Thorium (Th) (ppm) | | 2.4 | 2.6 | 2.8 |
| | Tin (Sn) (ppm) | | 0.5 | 0.6 | 0.5 |
| | Titanium (Ti) (%) | | 0.084 | 0.086 | 0.091 |
| | Tungsten (W) (ppm) | | 0.34 | 0.44 | 0.99 |
| | Uranium (U) (ppm) | | 0.14 | 0.20 | 0.20 |
| | Vanadium (V) (ppm) | | 45 | 53 | 52 |
| | Yttrium (Y) (ppm) | | 7.20 | 9.16 | 7.29 |
| | Zinc (Zn) (ppm) | | 63 | 70 | 81 |
| | Zirconium (Zr) (ppm) | | 0.8 | 1.8 | 0.7 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | <0.2 | 0.4 | 0.6 |
| Miscellaneous | Carbon (C) (%) | | 0.05 | 0.16 | 0.22 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-24

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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BURNABY BC V5A 1W9

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 Plus Appendix Pages
 Finalized Date: 1-SEP-2017
 Account: APN

CERTIFICATE VA17166066

Project: L1968933
 P.O. No.: ALSM-CW16-102-APN
 This report is for 8 Other samples submitted to our lab in Vancouver, BC, Canada on 9-AUG-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |

To: **ALS ENVIRONMENTAL**
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17166066

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm |
|--------------------------|-----------------------------------|---------------------------|----------------------|--------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | | 0.02 | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 |
| L1968933-1-129733-775-46 | | 1.06 | 0.22 | 0.84 | 1.2 | <0.02 | <10 | 90 | 0.33 | 0.06 | 2.02 | 0.14 | 28.3 | 5.4 | 5 | 0.33 |
| L1968933-2-129734-775-46 | | 1.08 | 0.05 | 1.36 | 2.1 | <0.02 | 10 | 70 | 0.47 | 0.02 | 1.13 | 0.02 | 29.0 | 6.1 | 11 | 0.40 |
| L1968933-3-129735-775-50 | | 1.08 | 0.24 | 0.60 | 2.5 | <0.02 | <10 | 90 | 0.44 | 0.15 | 1.79 | 0.17 | 30.5 | 5.6 | 3 | 0.56 |
| L1968933-4-129739 | | 1.04 | 0.06 | 1.34 | 1.6 | <0.02 | <10 | 350 | 0.25 | 0.05 | 0.55 | 0.05 | 30.6 | 6.3 | 7 | 0.46 |
| L1968933-5-129727 | | 1.14 | 0.06 | 1.05 | 0.8 | <0.02 | <10 | 250 | 0.30 | 0.02 | 1.10 | 0.07 | 21.5 | 5.4 | 5 | 0.49 |
| L1968933-6-129737 | | 1.10 | 0.15 | 0.97 | 0.7 | 0.13 | <10 | 260 | 0.21 | 0.04 | 0.31 | 0.18 | 23.2 | 5.1 | 6 | 0.34 |
| L1968933-7-129738 | | 1.08 | 0.08 | 1.21 | 1.8 | <0.02 | <10 | 220 | 0.28 | 0.02 | 0.82 | 0.11 | 25.1 | 6.0 | 5 | 0.35 |
| L1968933-8-129736 | | 1.06 | 0.15 | 1.22 | 0.6 | 0.03 | <10 | 260 | 0.25 | 0.04 | 0.83 | 0.14 | 27.8 | 6.0 | 7 | 0.42 |



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Project: L1968933

CERTIFICATE OF ANALYSIS VA17166066

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| | Analyte | Cu | Fe | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | |
| Units | | ppm | % | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | |
| LOR | | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | |
| L1968933-1-129733-775-46 | | 857 | 2.41 | 4.79 | <0.05 | 0.03 | <0.01 | 0.045 | 0.16 | 14.8 | 5.1 | 0.63 | 578 | 0.92 | 0.05 | 0.05 |
| L1968933-2-129734-775-46 | | 41.9 | 2.29 | 6.95 | 0.05 | 0.05 | <0.01 | 0.023 | 0.12 | 16.1 | 12.6 | 1.03 | 550 | 2.04 | 0.05 | <0.05 |
| L1968933-3-129735-775-50 | | 1315 | 2.41 | 3.63 | 0.05 | 0.05 | 0.01 | 0.056 | 0.17 | 16.3 | 2.4 | 0.22 | 720 | 3.51 | 0.04 | 0.05 |
| L1968933-4-129739 | | 289 | 2.71 | 6.71 | 0.07 | 0.04 | <0.01 | 0.026 | 0.76 | 16.0 | 7.9 | 0.78 | 775 | 0.55 | 0.06 | 0.16 |
| L1968933-5-129727 | | 221 | 2.27 | 5.20 | 0.07 | 0.06 | 0.01 | 0.024 | 0.53 | 10.8 | 4.8 | 0.66 | 617 | 0.39 | 0.08 | 0.20 |
| L1968933-6-129737 | | 969 | 2.12 | 4.85 | 0.05 | 0.04 | <0.01 | 0.023 | 0.52 | 12.5 | 4.7 | 0.46 | 533 | 0.99 | 0.06 | 0.10 |
| L1968933-7-129738 | | 274 | 2.38 | 5.93 | 0.06 | 0.08 | <0.01 | 0.024 | 0.48 | 13.2 | 7.2 | 0.66 | 703 | 0.64 | 0.08 | 0.16 |
| L1968933-8-129736 | | 715 | 2.51 | 6.11 | 0.05 | 0.04 | <0.01 | 0.028 | 0.55 | 14.9 | 6.7 | 0.70 | 628 | 0.78 | 0.07 | 0.13 |

***** See Appendix Page for comments regarding this certificate *****



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Project: L1968933

CERTIFICATE OF ANALYSIS VA17166066

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------------|-----------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| | | Ni | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti |
| | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % |
| | | 0.2 | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 |
| L1968933-1-129733-775-46 | | 2.3 | 700 | 4.0 | 7.9 | 0.002 | 0.11 | 0.06 | 4.4 | 1.1 | 0.7 | 111.5 | <0.01 | 0.02 | 3.3 | 0.012 |
| L1968933-2-129734-775-46 | | 10.4 | 710 | 3.7 | 6.3 | 0.007 | 0.01 | 0.06 | 3.1 | 0.5 | 0.4 | 159.0 | <0.01 | 0.01 | 2.9 | 0.012 |
| L1968933-3-129735-775-50 | | 2.0 | 730 | 6.0 | 9.6 | 0.002 | 0.03 | 0.07 | 4.5 | 1.0 | 0.6 | 74.7 | <0.01 | 0.06 | 4.4 | 0.012 |
| L1968933-4-129739 | | 3.0 | 710 | 1.8 | 36.6 | <0.001 | <0.01 | <0.05 | 4.4 | 0.3 | 0.6 | 34.7 | <0.01 | 0.01 | 3.5 | 0.134 |
| L1968933-5-129727 | | 2.1 | 670 | 2.1 | 23.9 | <0.001 | 0.02 | <0.05 | 4.4 | 0.5 | 0.5 | 80.2 | <0.01 | 0.01 | 2.0 | 0.092 |
| L1968933-6-129737 | | 2.5 | 570 | 1.8 | 24.8 | <0.001 | 0.02 | <0.05 | 3.0 | 0.4 | 0.5 | 28.2 | <0.01 | 0.02 | 2.4 | 0.084 |
| L1968933-7-129738 | | 3.3 | 780 | 1.8 | 21.6 | <0.001 | <0.01 | <0.05 | 4.7 | 0.3 | 0.6 | 49.9 | <0.01 | <0.01 | 2.6 | 0.086 |
| L1968933-8-129736 | | 4.7 | 730 | 2.2 | 25.4 | <0.001 | 0.01 | <0.05 | 4.3 | 0.6 | 0.5 | 64.9 | <0.01 | 0.03 | 2.8 | 0.091 |

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Project: L1968933

CERTIFICATE OF ANALYSIS VA17166066

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | S-IR08 | S-CAL06a |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|-----------|------------|------------|------------|-----------|----------|--------|----------|
| | Analyte | TI | U | V | W | Y | Zn | Zr | FIZZ RAT | MPA | NNP | NP | Ratio (N | pH | S | S |
| Units | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | Unity | tCaCO3/1Kt | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % |
| LOR | | 0.02 | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 |
| L1968933-1-129733-775-46 | | 0.05 | 0.68 | 46 | 0.44 | 9.32 | 59 | 1.0 | 2 | 3.4 | 45 | 48 | 13.96 | 8.8 | 0.11 | 0.10 |
| L1968933-2-129734-775-46 | | 0.03 | 0.41 | 42 | 0.49 | 6.64 | 72 | 1.3 | 2 | 0.3 | 24 | 24 | 76.80 | 9.0 | 0.01 | 0.01 |
| L1968933-3-129735-775-50 | | 0.05 | 0.51 | 46 | 0.28 | 8.16 | 74 | 1.5 | 2 | 0.9 | 43 | 44 | 46.93 | 8.7 | 0.03 | 0.03 |
| L1968933-4-129739 | | 0.21 | 0.14 | 61 | 0.39 | 6.81 | 87 | 0.7 | 2 | 0.3 | 12 | 12 | 38.40 | 9.0 | 0.01 | 0.01 |
| L1968933-5-129727 | | 0.13 | 0.22 | 47 | 0.47 | 10.00 | 65 | 1.1 | 2 | 0.6 | 25 | 26 | 41.60 | 9.1 | 0.02 | 0.02 |
| L1968933-6-129737 | | 0.13 | 0.14 | 45 | 0.34 | 7.20 | 63 | 0.8 | 1 | 0.6 | 7 | 8 | 12.80 | 8.8 | 0.02 | 0.02 |
| L1968933-7-129738 | | 0.12 | 0.20 | 53 | 0.44 | 9.16 | 70 | 1.8 | 2 | <0.3 | 17 | 17 | 108.80 | 8.9 | <0.01 | <0.01 |
| L1968933-8-129736 | | 0.15 | 0.20 | 52 | 0.99 | 7.29 | 81 | 0.7 | 2 | 0.3 | 18 | 18 | 57.60 | 9.0 | 0.01 | <0.01 |

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CERTIFICATE OF ANALYSIS VA17166066

| Sample Description | Method | C-GAS05 | C-GAS05 | S-GRA06a | C-IR07 | S-GRA06 |
|--------------------------|---------|---------|---------|----------|--------|---------|
| | Analyte | C | CO2 | S | C | S |
| Units | | % | % | % | % | % |
| LOR | | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 |
| L1968933-1-129733-775-46 | | 0.74 | 2.7 | 0.01 | 0.80 | 0.01 |
| L1968933-2-129734-775-46 | | 0.23 | 0.8 | <0.01 | 0.31 | 0.01 |
| L1968933-3-129735-775-50 | | 0.48 | 1.8 | <0.01 | 0.57 | <0.01 |
| L1968933-4-129739 | | 0.07 | 0.3 | <0.01 | 0.12 | <0.01 |
| L1968933-5-129727 | | 0.28 | 1.0 | <0.01 | 0.37 | 0.01 |
| L1968933-6-129737 | | <0.05 | <0.2 | <0.01 | 0.05 | <0.01 |
| L1968933-7-129738 | | 0.11 | 0.4 | <0.01 | 0.16 | <0.01 |
| L1968933-8-129736 | | 0.17 | 0.6 | 0.01 | 0.22 | <0.01 |



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CERTIFICATE OF ANALYSIS VA17166066

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|--------|----------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | S-CAL06a |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



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QC CERTIFICATE VA17166066

Project: L1968933
 P.O. No.: ALSM-CW16-102-APN
 This report is for 8 Other samples submitted to our lab in Vancouver, BC, Canada on 9-AUG-2017.
 The following have access to data associated with this certificate:
 ELSE VANCOUVER WEBTRIEVE SOFTWARE DEVELOPMENT GROUP SHANE STACK

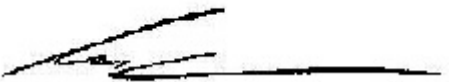
| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |
| SPL-21 | Split sample - riffle splitter |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |

To: **ALS ENVIRONMENTAL**
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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Project: L1968933

QC CERTIFICATE OF ANALYSIS VA17166066

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | Ag ppm | Al % | As ppm | Au ppm | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm |
| | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 |

STANDARDS

| | | | | | | | | | | | | | | | | |
|----------------------------|-------|------|-------|-------|-----|-----|------|-------|------|-------|------|-------|----|-------|-------|--|
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | 19.55 | 2.19 | 119.5 | 0.07 | <10 | 80 | 0.68 | 10.30 | 0.88 | 18.75 | 60.1 | 92.7 | 81 | 9.12 | 8350 | |
| Target Range - Lower Bound | 18.15 | 2.05 | 107.0 | 0.03 | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | |
| Upper Bound | 22.2 | 2.53 | 131.0 | 0.11 | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | |
| OREAS 920 | 0.10 | 2.49 | 4.5 | <0.02 | <10 | 80 | 0.70 | 0.66 | 0.35 | 0.07 | 76.9 | 14.1 | 43 | 2.12 | 108.5 | |
| Target Range - Lower Bound | 0.07 | 2.18 | 3.8 | <0.02 | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | |
| Upper Bound | 0.12 | 2.68 | 4.9 | 0.04 | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17166066

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | Fe % | Ga ppm | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm |
| | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OGGeo08 | 5.05 | 8.34 | 0.12 | 0.73 | 0.45 | 1.375 | 1.04 | 28.9 | 30.0 | 0.94 | 385 | 876 | 0.28 | 0.99 | 8810 |
| Target Range - Lower Bound | 4.51 | 8.05 | 0.21 | 0.72 | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 |
| Upper Bound | 5.53 | 9.95 | 0.45 | 0.92 | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 |
| OREAS 920 | 3.68 | 6.84 | 0.07 | 0.59 | <0.01 | 0.032 | 0.44 | 38.3 | 19.8 | 1.10 | 533 | 0.33 | 0.02 | 0.38 | 36.8 |
| Target Range - Lower Bound | 3.26 | 6.12 | <0.05 | 0.53 | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 |
| Upper Bound | 4.00 | 7.60 | 0.22 | 0.69 | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |



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Project: L1968933

QC CERTIFICATE OF ANALYSIS VA17166066

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl |
| | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 |

STANDARDS

| | | | | | | | | | | | | | | | | |
|----------------------------|-----|------|-------|--------|-------|-------|-----|------|------|------|-------|-------|------|-------|------|--|
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | 780 | 7130 | 115.5 | 1.335 | 2.70 | 20.0 | 6.1 | 10.2 | 12.2 | 62.1 | 0.01 | 0.14 | 16.1 | 0.302 | 1.33 | |
| Target Range - Lower Bound | 700 | 6520 | 109.5 | 1.295 | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | |
| Upper Bound | 880 | 7970 | 134.5 | 1.585 | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | |
| OREAS 920 | 730 | 23.8 | 24.9 | <0.001 | 0.03 | 0.63 | 2.9 | 0.7 | 1.1 | 17.4 | 0.01 | 0.02 | 16.1 | 0.137 | 0.16 | |
| Target Range - Lower Bound | | 19.2 | 22.2 | <0.001 | <0.01 | 0.45 | 2.5 | 0.4 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | |
| Upper Bound | | 23.9 | 27.4 | 0.002 | 0.05 | 0.77 | 3.3 | 1.3 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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Project: L1968933

QC CERTIFICATE OF ANALYSIS VA17166066

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % |
|----------------------------|--------------------------|---------------|---------------|---------------|---------------|----------------|----------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|-------------|---------------|
| | | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | 6.1 | | | |
| Buffer pH6 | | | | | | | | | | | | | 6.0 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 5.3 | | | |
| Upper Bound | | | | | | | | | | | | | 6.7 | | | |
| CO-ASSAY | | | | | | | | | | | | | | | 0.52 | 1.9 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 0.42 | 1.5 |
| Upper Bound | | | | | | | | | | | | | | | 0.64 | 2.4 |
| GS310-10 | | | | | | | | | | | | | | 0.27 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | 0.25 | | |
| Upper Bound | | | | | | | | | | | | | | 0.29 | | |
| KZK-1 | | | | | | | | 2 | 25.0 | 31 | 56 | 2.24 | | | | |
| KZK-1 | | | | | | | | 2 | 25.0 | 30 | 55 | 2.20 | | | | |
| Target Range - Lower Bound | | | | | | | | <1 | 22.9 | 30 | 54 | 2.18 | | | | |
| Upper Bound | | | | | | | | >4 | 27.1 | 38 | 64 | 2.53 | | | | |
| MA-1b | | | | | | | | | | | | | | 1.12 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | 1.12 | | |
| Upper Bound | | | | | | | | | | | | | | 1.22 | | |
| MA-2c | | | | | | | | | | | | | | | 1.55 | 5.7 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 1.50 | 5.5 |
| Upper Bound | | | | | | | | | | | | | | | 1.84 | 6.8 |
| MA-3a | | | | | | | | | | | | | | | 2.40 | 8.8 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 2.31 | 8.4 |
| Upper Bound | | | | | | | | | | | | | | | 2.77 | 10.2 |
| OGGeo08 | | 4.56 | 78 | 2.89 | 16.25 | 6790 | 22.5 | | | | | | | | | |
| Target Range - Lower Bound | | 4.45 | 70 | 2.58 | 15.35 | 6500 | 19.5 | | | | | | | | | |
| Upper Bound | | 5.55 | 88 | 3.60 | 18.85 | 7950 | 27.5 | | | | | | | | | |
| OREAS 920 | | 2.10 | 26 | 0.49 | 18.95 | 107 | 23.8 | | | | | | | | | |
| Target Range - Lower Bound | | 1.89 | 23 | 0.31 | 16.85 | 93 | 17.6 | | | | | | | | | |
| Upper Bound | | 2.42 | 30 | 0.61 | 20.7 | 119 | 25.0 | | | | | | | | | |
| SY-4 | | | | | | | | | | | | | | | 0.91 | 3.3 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 0.84 | 3.0 |
| Upper Bound | | | | | | | | | | | | | | | 1.08 | 4.0 |



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Project: L1968933

QC CERTIFICATE OF ANALYSIS VA17166066

| Sample Description | Method Analyte Units LOR | S-GRA06a S % | C-IR07 C % | S-GRA06 S % |
|----------------------------|-----------------------------------|--------------------|------------------|-------------------|
| | | 0.01 | 0.01 | 0.01 |
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| CO-ASSAY | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS310-10 | | | 1.09 | |
| Target Range - Lower Bound | | | 1.03 | |
| Upper Bound | | | 1.13 | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-1b | | | 2.53 | |
| Target Range - Lower Bound | | | 2.34 | |
| Upper Bound | | | 2.54 | |
| MA-2c | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-3a | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OGGeo08 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OREAS 920 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| SY-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

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QC CERTIFICATE OF ANALYSIS VA17166066

| Method Analyte Units LOR | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | |
|----------------------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--|
| Sample Description | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.01 | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | |
| Target Range - Lower Bound | <0.01 | <0.01 | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | |
| Upper Bound | 0.02 | 0.02 | 0.2 | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Fe % | Ga ppm | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | |
| | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.05 | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | 0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | |
| Target Range - Lower Bound | <0.01 | <0.05 | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | |
| Upper Bound | 0.02 | 0.10 | 0.10 | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17166066

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | |
| | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | |
| | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <10 | <0.2 | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | |
| Target Range - Lower Bound | <10 | <0.2 | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | |
| Upper Bound | 20 | 0.4 | 0.2 | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17166066

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm 0.05 | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | OA-VOL08m FIZZ RAT Unity 1 | OA-VOL08m MPA tCaCO3/1Kt 0.3 | OA-VOL08m NNP tCaCO3/1Kt 1 | OA-VOL08m NP tCaCO3/1Kt 1 | OA-VOL08m Ratio (N Unity 0.01 | OA-ELE07 pH Unity 0.1 | S-IR08 S % 0.01 | C-GAS05 C % 0.05 | C-GAS05 CO2 % 0.2 |
|----------------------------|--------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|-------------------------------------|---------------------------------------|-------------------------------------|------------------------------------|--|--------------------------------|--------------------------|---------------------------|----------------------------|
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | <0.05 | <0.2 |
| BLANK | | | | | | | | | | | | | | | <0.05 | <0.2 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | <0.05 | <0.2 |
| Upper Bound | | | | | | | | | | | | | | | 0.10 | 0.4 |
| BLANK | | <0.05 | <1 | <0.05 | <0.05 | <2 | <0.5 | | | | | | | | | |
| Target Range - Lower Bound | | <0.05 | <1 | <0.05 | <0.05 | <2 | <0.5 | | | | | | | | | |
| Upper Bound | | 0.10 | 2 | 0.10 | 0.10 | 4 | 1.0 | | | | | | | | | |
| BLANK | | | | | | | | | | | | | 6.3 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 5.5 | | | |
| Upper Bound | | | | | | | | | | | | | 6.9 | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | 0.01 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | <0.01 | | |
| Upper Bound | | | | | | | | | | | | | | 0.02 | | |

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QC CERTIFICATE OF ANALYSIS VA17166066

| Sample Description | Method Analyte Units LOR | S-GRA06a S % | C-IR07 C % | S-GRA06 S % |
|----------------------------|-----------------------------------|--------------------|------------------|-------------------|
| STANDARDS | | | | |
| UTS-1 | | | | 0.93 |
| UTS-1 | | | | 0.87 |
| UTS-1 | | | | 0.88 |
| Target Range - Lower Bound | | | | 0.83 |
| Upper Bound | | | | 0.93 |
| UTS-1 | | 0.90 | | |
| UTS-1 | | 0.89 | | |
| UTS-1 | | 0.87 | | |
| Target Range - Lower Bound | | 0.81 | | |
| Upper Bound | | 0.95 | | |
| UTS-4 | | | | 1.79 |
| Target Range - Lower Bound | | | | 1.64 |
| Upper Bound | | | | 1.84 |
| UTS-4 | | 1.73 | | |
| Target Range - Lower Bound | | 1.61 | | |
| Upper Bound | | 1.87 | | |
| BLANKS | | | | |
| BLANK | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | <0.01 |
| BLANK | | | | <0.01 |
| Target Range - Lower Bound | | | | <0.01 |
| Upper Bound | | | | 0.02 |
| BLANK | | <0.01 | | |
| BLANK | | <0.01 | | |
| Target Range - Lower Bound | | <0.01 | | |
| Upper Bound | | 0.02 | | |
| BLANK | | | | <0.01 |
| Target Range - Lower Bound | | | | <0.01 |
| Upper Bound | | | | 0.02 |



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|----------------------------|------------|
| QC CERTIFICATE OF ANALYSIS | VA17166066 |
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| Sample Description | Method Analyte Units LOR | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | |
|---|--------------------------|------------------------------|------------------------------|--------------------------|---------------------------------|-------------------------|--------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------------------|------------------|------------------------------|--------------------------|--|
| | | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | |
| DUPLICATES | | | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | |
| L1968927-6-129730 775-45C DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | |
| L1968927-8-129729 775-44 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | |
| L1968933-1-129733-775-46 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | |
| L1968933-4-129739 DUP Target Range - Lower Bound Upper Bound | | 0.06 0.06 0.05 0.07 | 1.34 1.36 1.27 1.43 | 1.6 1.5 1.4 1.7 | <0.02 <0.02 <0.02 0.04 | <10 <10 <10 20 | 350 360 320 390 | 0.25 0.22 0.17 0.30 | 0.05 0.06 0.04 0.07 | 0.55 0.55 0.51 0.59 | 0.05 0.06 0.04 0.07 | 30.6 31.5 29.5 32.6 | 6.3 6.5 6.0 6.8 | 7 7 6 8 | 0.46 0.46 0.39 0.53 | 289 300 284 305 | |
| L1968933-8-129736 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | |



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| QC CERTIFICATE OF ANALYSIS VA17166066 |
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| Method Analyte Units LOR | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm |
|---|------------------------------|------------------------------|-------------------------------|-------------------------------|---------------------------------|----------------------------------|------------------------------|------------------------------|--------------------------|------------------------------|--------------------------|------------------------------|------------------------------|------------------------------|--------------------------|
| Sample Description | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | DUPLICATES | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | |
| L1968927-6-129730 775-45C DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | |
| L1968927-8-129729 775-44 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | |
| L1968933-1-129733-775-46 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | |
| L1968933-4-129739 DUP Target Range - Lower Bound Upper Bound | 2.71 2.74 2.58 2.87 | 6.71 6.86 6.40 7.17 | 0.07 0.07 <0.05 0.10 | 0.04 0.04 <0.02 0.06 | <0.01 <0.01 <0.01 0.02 | 0.026 0.026 0.020 0.032 | 0.76 0.76 0.71 0.81 | 16.0 16.6 15.3 17.3 | 7.9 8.5 7.7 8.7 | 0.78 0.79 0.74 0.83 | 775 775 731 819 | 0.55 0.56 0.48 0.63 | 0.06 0.07 0.05 0.08 | 0.16 0.19 0.12 0.23 | 3.0 3.1 2.7 3.4 |
| L1968933-8-129736 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | |

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|----------------------------|------------|
| QC CERTIFICATE OF ANALYSIS | VA17166066 |
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| Sample Description | Method Analyte Units LOR | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 | ME-MS41 Rb ppm 0.1 | ME-MS41 Re ppm 0.001 | ME-MS41 S % 0.01 | ME-MS41 Sb ppm 0.05 | ME-MS41 Sc ppm 0.1 | ME-MS41 Se ppm 0.2 | ME-MS41 Sn ppm 0.2 | ME-MS41 Sr ppm 0.2 | ME-MS41 Ta ppm 0.01 | ME-MS41 Te ppm 0.01 | ME-MS41 Th ppm 0.2 | ME-MS41 Ti % 0.005 | ME-MS41 Tl ppm 0.02 |
|---|--------------------------|---------------------------|------------------------------|-------------------------------------|---------------------------------|---------------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|---------------------------------|-------------------------------|------------------------------|----------------------------------|------------------------------|------------------------------|
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968927-6-129730 775-45C DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968927-8-129729 775-44 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968933-1-129733-775-46 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| L1968933-4-129739 DUP Target Range - Lower Bound Upper Bound | 710 710 660 760 | 1.8 2.0 1.6 2.2 | 36.6 36.9 34.8 38.7 | <0.001 <0.001 <0.001 0.002 | <0.01 <0.01 <0.01 0.02 | <0.05 <0.05 <0.05 0.10 | 4.4 4.6 4.2 4.8 | 0.3 0.3 <0.2 0.4 | 0.6 0.6 0.4 0.8 | 34.7 35.7 33.2 37.2 | <0.01 <0.01 <0.01 0.02 | 0.01 0.02 <0.01 0.02 | 3.5 3.6 3.2 3.9 | 0.134 0.135 0.123 0.146 | 0.21 0.22 0.18 0.25 | |
| L1968933-8-129736 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17166066

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % | |
|-------------------------------|--------------------------|-------------------|---------------|---------------|---------------|----------------|----------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|-------------|---------------|-------|
| | | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | |
| ORIGINAL DUP | | DUPLICATES | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| ORIGINAL DUP | | | | | | | | | | | | | 0.01 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.01 | | | | |
| Upper Bound | | | | | | | | | | | | | <0.01 | | | | |
| ORIGINAL DUP | | | | | | | | | | | | | 0.02 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| L1968927-6-129730 775-45C DUP | | | | | | | | | | | | | 8.9 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 8.9 | | | | |
| Upper Bound | | | | | | | | | | | | | 8.4 | | | | |
| L1968927-8-129729 775-44 DUP | | | | | | | | | | | | | 2 | 2.5 | 35 | 37 | 14.80 |
| Target Range - Lower Bound | | | | | | | | | | | | | 2 | 2.5 | 35 | 37 | 14.80 |
| Upper Bound | | | | | | | | | | | | | <1 | 2.1 | 32 | 34 | 14.05 |
| L1968933-1-129733-775-46 DUP | | | | | | | | | | | | | 3 | 2.9 | 38 | 40 | 15.55 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| L1968933-1-129733-775-46 DUP | | | | | | | | | | | | | | | 0.74 | 2.7 | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 0.76 | 2.8 | |
| Upper Bound | | | | | | | | | | | | | | | 0.66 | 2.4 | |
| L1968933-4-129739 DUP | | 0.14 | 61 | 0.39 | 6.81 | 87 | 0.7 | | | | | | | | | | |
| Target Range - Lower Bound | | 0.14 | 62 | 0.42 | 6.97 | 87 | 0.7 | | | | | | | | | | |
| Upper Bound | | 0.08 | 57 | 0.32 | 6.50 | 81 | <0.5 | | | | | | | | | | |
| L1968933-8-129736 DUP | | 0.20 | 66 | 0.49 | 7.28 | 93 | 1.0 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 0.17 | 0.6 | |
| Upper Bound | | | | | | | | | | | | | | | 0.18 | 0.7 | |
| L1968933-8-129736 DUP | | | | | | | | | | | | | | | 0.12 | 0.4 | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 0.23 | 0.9 | |
| Upper Bound | | | | | | | | | | | | | | | | | |



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 4 - E
 Total # Pages: 4 (A - E)
 Plus Appendix Pages
 Finalized Date: 1-SEP-2017
 Account: APN

Project: L1968933

| |
|--|
| QC CERTIFICATE OF ANALYSIS VA17166066 |
|--|

| Sample Description | Method Analyte Units LOR | S-GRA06a S % | C-IR07 C % | S-GRA06 S % |
|----------------------------------|--------------------------|--------------------|------------------|-------------------|
| | | 0.01 | 0.01 | 0.01 |
| DUPLICATES | | | | |
| ORIGINAL | | | | 0.18 |
| DUP | | | | 0.20 |
| Target Range - Lower Bound | | | | 0.17 |
| Upper Bound | | | | 0.21 |
| ORIGINAL | | | 5.81 | |
| DUP | | | 5.58 | |
| Target Range - Lower Bound | | | 5.54 | |
| Upper Bound | | | 5.85 | |
| ORIGINAL | | | | 0.01 |
| DUP | | | | 0.01 |
| Target Range - Lower Bound | | | | <0.01 |
| Upper Bound | | | | 0.02 |
| L1968927-6-129730 775-45C DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L1968927-8-129729 775-44 DUP | | <0.01 | | |
| Target Range - Lower Bound | | <0.01 | | |
| Upper Bound | | 0.02 | | |
| L1968933-1-129733-775-46 DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L1968933-4-129739 DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L1968933-8-129736 DUP | | 0.01 | | |
| Target Range - Lower Bound | | <0.01 | | |
| Upper Bound | | 0.02 | | |



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To: ALS ENVIRONMENTAL
100 - 8081 LOUGHEED HWY.
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Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 1-SEP-2017
Account: APN

Project: L1968933

QC CERTIFICATE OF ANALYSIS VA17166066

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|--------|----------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | S-CAL06a |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



Chain of Custody (COC) / Analytical Request Form



COC Number: **1549 17-24**

Page of

Canada Toll Free: 1 800 668 9878

L1968933-COFC

www.alsglobal.com

| | | | | | |
|---|--|---|---------------------|---|-----------------------------|
| Report To Contact and company name below will appear on the final report Company: Minto Explorations Ltd. Contact: Minto Environment - Coordinator Phone: 1-604-759-4659 Company address below will appear on the final report Street: 2100-510 West Georgia St. City/Province: Vancouver, British Columbia Postal Code: V6B 0M3 | | Report Format / Distribution Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax minto_environment@mintomine.com Email 2 Email 3 | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply PRIORITY (Business Days) 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm For tests that can not be performed according to the service level selected, you will be contacted. | |
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Company: Minto Explorations Ltd. Contact: Ruth Cayetano | | Invoice Distribution Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax ap@mintomine.com Email 2 | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | |
| Project Information ALS Account # / Quote #: Job #: PO / AFE: TBD LSD: | | Oil and Gas Required Fields (client use) AFE/Cost Center: PO# Major/Minor Code: Routing Code: Requisitioner: Location: | | Total Metals- Aqua regia digestion (ICP) Paste pH % Inorganic Carbonate Total Carbon/Sulphur (Leco) AP - determination by % sulphide sulphur Modified NP - (MEND 1991) | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Number of Containers |
| | 129733 775-46 | 20/07/17 | | Composite | |
| | 129734 775-46 | 20/07/17 | | WASTE | |
| | 129735 775-50 | 22/07/17 | | WASTE | |
| | 129739 | 25/07/17 | | WASTE | |
| | 129727 | 17/07/17 | | WASTE | |
| | 129737 | 22/07/17 | | WASTE | |
| | 129738 | 22/07/17 | | WASTE | |
| | 129736 | 22/07/17 | | WASTE | |
| Drinking Water (DW) Samples¹ (client use) Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input checked="" type="checkbox"/> INITIAL COOLER TEMPERATURES °C: 10.0 FINAL COOLER TEMPERATURES °C: 17.4 | |
| SHIPMENT RELEASE (client use) Released by: Date: Time: | | INITIAL SHIPMENT RECEPTION (lab use only) Received by: Date: Time: | | FINAL SHIPMENT RECEPTION (lab use only) Received by: Date: Time: | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1: If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form

WHITE - LABORATORY COPY YELLOW - CLIENT COPY



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 03-AUG-17
Report Date: 03-OCT-17 17:02 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1969816
Project P.O. #: 220826
Job Reference:
C of C Numbers: 17-25
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1969816-1 Tails 05-JUN-17 JUN TAL 2017 | L1969816-2 Tails 12-JUN-17 JUN TAL 2017 | L1969816-3 Tails 21-JUN-17 JUN TAL 2017 | L1969816-4 Waste 01-AUG-17 129740 | L1969816-5 Waste 01-AUG-17 129741 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 7.8 | 7.9 | 7.8 | 8.7 | 8.7 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.20 | 0.25 | 0.25 | 0.15 | 0.28 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 2.8 | 3.8 | 3.4 | 0.3 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 21 | 23 | 23 | 19 | 27 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 18 | 19 | 20 | 19 | 27 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 7.47 | 6.13 | 6.69 | 60.80 | 86.40 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | 0.04 | 0.04 | 0.04 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | 0.04 | 0.06 | 0.05 | 0.01 | 0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | | | | |
| | 0.05 | 0.06 | 0.06 | <0.01 | <0.01 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.09 | 0.12 | 0.11 | 0.01 | 0.01 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.14 | 1.14 | 1.02 | 1.18 | 1.14 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.05 | 0.06 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 1.0 | 1.3 | 1.7 | 0.8 | 1.0 |
| | Barium (Ba) (ppm) | | | | |
| | 170 | 210 | 190 | 340 | 210 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.26 | 0.25 | 0.25 | 0.22 | 0.39 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.68 | 0.52 | 0.42 | 0.04 | 0.01 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.25 | 0.40 | 0.28 | 0.12 | 0.13 |
| | Calcium (Ca) (%) | | | | |
| | 0.89 | 0.94 | 0.98 | 0.78 | 1.18 |
| | Cerium (Ce) (ppm) | | | | |
| | 15.95 | 17.30 | 20.5 | 25.1 | 24.4 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.38 | 0.51 | 0.41 | 0.37 | 0.49 |
| | Chromium (Cr) (ppm) | | | | |
| | 6 | 7 | 6 | 7 | 5 |
| | Cobalt (Co) (ppm) | | | | |
| | 7.4 | 7.1 | 6.6 | 5.7 | 6.0 |
| | Copper (Cu) (ppm) | | | | |
| | 2100 | 2280 | 2690 | 491 | 85.5 |
| | Gallium (Ga) (ppm) | | | | |
| | 8.30 | 7.57 | 6.13 | 5.40 | 5.34 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.11 | 0.12 | 0.10 | 0.10 | 0.11 |
| | Gold (Au) (ppm) | | | | |
| | 0.17 | 0.15 | 0.12 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.04 | 0.04 | 0.05 | 0.05 | 0.07 |
| | Indium (In) (ppm) | | | | |
| | 0.075 | 0.083 | 0.067 | 0.026 | 0.033 |
| | Iron (Fe) (%) | | | | |
| | 4.33 | 4.18 | 3.67 | 2.45 | 2.49 |
| | Lanthanum (La) (ppm) | | | | |
| | 8.4 | 9.2 | 10.8 | 12.7 | 12.5 |
| | Lead (Pb) (ppm) | | | | |
| | 3.4 | 3.4 | 3.3 | 1.8 | 2.7 |
| | Lithium (Li) (ppm) | | | | |
| | 6.1 | 5.1 | 4.4 | 5.6 | 6.4 |
| | Magnesium (Mg) (%) | | | | |
| | 0.63 | 0.60 | 0.55 | 0.60 | 0.68 |
| | Manganese (Mn) (ppm) | | | | |
| | 698 | 723 | 640 | 660 | 736 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1969816-6 Waste 01-AUG-17 129742 | L1969816-7 Waste 01-AUG-17 129743 | L1969816-8 Waste 01-AUG-17 129744 | L1969816-9 Waste 01-AUG-17 129745 | L1969816-10 Waste 01-AUG-17 129746 | |
|---|--|--|--|--|---|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.7 | 8.8 | 9.0 | 8.8 | 8.9 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.47 | 0.15 | 0.23 | 0.30 | 0.19 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 1.3 | 0.9 | 0.6 | 0.3 | 1.9 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 34 | 20 | 26 | 32 | 21 |
| | NNP (tCaCO3/1Kt) | 33 | 19 | 25 | 32 | 19 |
| | Ratio (NP/MPA) (Unity) | 27.20 | 21.33 | 41.60 | 102.40 | 11.20 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | 0.01 | 0.03 | <0.01 | 0.02 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.03 | 0.02 | <0.01 | 0.01 | 0.04 |
| | Total Sulfur (combustion) (%) | 0.04 | 0.03 | 0.02 | 0.01 | 0.06 |
| Total Metals | Aluminum (Al) (%) | 1.01 | 1.15 | 1.27 | 1.24 | 1.17 |
| | Antimony (Sb) (ppm) | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 1.2 | 0.6 | 0.8 | 0.9 | 0.7 |
| | Barium (Ba) (ppm) | 160 | 200 | 270 | 110 | 290 |
| | Beryllium (Be) (ppm) | 0.35 | 0.31 | 0.29 | 0.50 | 0.24 |
| | Bismuth (Bi) (ppm) | 0.09 | 0.05 | 0.06 | 0.03 | 0.10 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.08 | 0.04 | 0.04 | 0.04 | 0.19 |
| | Calcium (Ca) (%) | 1.30 | 0.94 | 1.19 | 1.53 | 0.81 |
| | Cerium (Ce) (ppm) | 29.7 | 20.3 | 19.15 | 16.60 | 21.2 |
| | Cesium (Cs) (ppm) | 0.44 | 0.33 | 0.38 | 0.44 | 0.48 |
| | Chromium (Cr) (ppm) | 8 | 5 | 8 | 5 | 7 |
| | Cobalt (Co) (ppm) | 6.0 | 5.6 | 5.1 | 5.0 | 5.9 |
| | Copper (Cu) (ppm) | 579 | 367 | 344 | 110.0 | 2260 |
| | Gallium (Ga) (ppm) | 5.33 | 5.42 | 5.30 | 5.82 | 5.53 |
| | Germanium (Ge) (ppm) | 0.11 | 0.12 | 0.11 | 0.09 | 0.11 |
| | Gold (Au) (ppm) | <0.02 | 0.02 | <0.02 | <0.02 | 0.03 |
| | Hafnium (Hf) (ppm) | 0.05 | 0.06 | 0.05 | 0.05 | 0.03 |
| | Indium (In) (ppm) | 0.036 | 0.022 | 0.021 | 0.018 | 0.039 |
| | Iron (Fe) (%) | 2.54 | 2.15 | 2.47 | 2.10 | 2.50 |
| | Lanthanum (La) (ppm) | 15.5 | 10.7 | 9.8 | 8.8 | 11.4 |
| | Lead (Pb) (ppm) | 3.1 | 2.3 | 2.7 | 4.2 | 2.4 |
| | Lithium (Li) (ppm) | 5.8 | 6.1 | 5.3 | 7.7 | 5.6 |
| | Magnesium (Mg) (%) | 0.71 | 0.67 | 0.69 | 0.71 | 0.66 |
| | Manganese (Mn) (ppm) | 594 | 528 | 602 | 550 | 555 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1969816-1 Tails 05-JUN-17 JUN TAL 2017 | L1969816-2 Tails 12-JUN-17 JUN TAL 2017 | L1969816-3 Tails 21-JUN-17 JUN TAL 2017 | L1969816-4 Waste 01-AUG-17 129740 | L1969816-5 Waste 01-AUG-17 129741 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | 1.45 | 2.08 | 2.12 | 0.68 | 0.89 |
| | Nickel (Ni) (ppm) | 2.9 | 3.5 | 3.7 | 2.9 | 2.5 |
| | Niobium (Nb) (ppm) | 0.12 | 0.18 | 0.15 | 0.10 | 0.10 |
| | Phosphorus (P) (ppm) | 710 | 650 | 710 | 650 | 700 |
| | Potassium (K) (%) | 0.45 | 0.58 | 0.44 | 0.63 | 0.37 |
| | Rhenium (Re) (ppm) | 0.001 | 0.002 | 0.001 | <0.001 | <0.001 |
| | Rubidium (Rb) (ppm) | 22.4 | 29.1 | 21.5 | 28.0 | 16.4 |
| | Scandium (Sc) (ppm) | 3.5 | 3.6 | 3.7 | 4.8 | 5.4 |
| | Selenium (Se) (ppm) | 2.2 | 2.5 | 2.2 | 0.2 | 0.4 |
| | Silver (Ag) (ppm) | 0.78 | 0.74 | 0.73 | 0.07 | 0.02 |
| | Sodium (Na) (%) | 0.06 | 0.06 | 0.06 | 0.08 | 0.10 |
| | Strontium (Sr) (ppm) | 58.5 | 75.6 | 72.3 | 51.7 | 71.6 |
| | Sulfur (S) (%) | 0.08 | 0.10 | 0.09 | <0.01 | <0.01 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.37 | 0.30 | 0.23 | 0.01 | <0.01 |
| | Thallium (Tl) (ppm) | 0.14 | 0.18 | 0.13 | 0.16 | 0.08 |
| | Thorium (Th) (ppm) | 3.2 | 3.1 | 3.4 | 2.8 | 2.3 |
| | Tin (Sn) (ppm) | 0.7 | 0.8 | 0.7 | 0.6 | 0.6 |
| | Titanium (Ti) (%) | 0.078 | 0.099 | 0.077 | 0.102 | 0.079 |
| | Tungsten (W) (ppm) | 0.05 | 0.07 | 0.06 | 0.26 | 0.25 |
| | Uranium (U) (ppm) | 0.29 | 0.32 | 0.34 | 0.15 | 0.23 |
| | Vanadium (V) (ppm) | 64 | 64 | 61 | 51 | 51 |
| | Yttrium (Y) (ppm) | 5.43 | 5.71 | 6.37 | 7.83 | 8.83 |
| | Zinc (Zn) (ppm) | 101 | 109 | 90 | 78 | 78 |
| | Zirconium (Zr) (ppm) | 0.9 | 1.1 | 1.1 | 0.7 | 1.5 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.7 | 0.9 | 0.9 | 0.5 | 1.0 |
| Miscellaneous | Carbon (C) (%) | 0.25 | 0.30 | 0.32 | 0.21 | 0.36 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

03-OCT-17 17:02 (MT)

Version: FINAL

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1969816-6 Waste 01-AUG-17 129742 | L1969816-7 Waste 01-AUG-17 129743 | L1969816-8 Waste 01-AUG-17 129744 | L1969816-9 Waste 01-AUG-17 129745 | L1969816-10 Waste 01-AUG-17 129746 |
|------------------------|--------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | 0.63 | 0.63 | 0.51 | 0.29 | 0.77 | |
| | Nickel (Ni) (ppm) | 5.8 | 2.5 | 3.3 | 2.4 | 3.1 | |
| | Niobium (Nb) (ppm) | 0.07 | 0.14 | 0.10 | 0.08 | 0.12 | |
| | Phosphorus (P) (ppm) | 700 | 650 | 620 | 610 | 630 | |
| | Potassium (K) (%) | 0.26 | 0.41 | 0.50 | 0.21 | 0.58 | |
| | Rhenium (Re) (ppm) | 0.001 | 0.002 | 0.001 | <0.001 | 0.001 | |
| | Rubidium (Rb) (ppm) | 12.1 | 18.5 | 20.2 | 9.1 | 26.9 | |
| | Scandium (Sc) (ppm) | 5.6 | 3.3 | 3.1 | 3.2 | 2.7 | |
| | Selenium (Se) (ppm) | 0.6 | 0.4 | 0.4 | 0.2 | 1.2 | |
| | Silver (Ag) (ppm) | 0.19 | 0.11 | 0.10 | 0.04 | 0.78 | |
| | Sodium (Na) (%) | 0.09 | 0.09 | 0.12 | 0.10 | 0.09 | |
| | Strontium (Sr) (ppm) | 97.9 | 62.8 | 80.2 | 89.8 | 64.6 | |
| | Sulfur (S) (%) | 0.02 | 0.02 | <0.01 | <0.01 | 0.05 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.05 | 0.03 | 0.02 | 0.01 | 0.15 | |
| | Thallium (Tl) (ppm) | 0.06 | 0.10 | 0.11 | 0.04 | 0.14 | |
| | Thorium (Th) (ppm) | 3.2 | 2.1 | 2.0 | 1.6 | 2.3 | |
| | Tin (Sn) (ppm) | 0.6 | 0.5 | 0.5 | 0.4 | 0.6 | |
| | Titanium (Ti) (%) | 0.038 | 0.088 | 0.092 | 0.039 | 0.098 | |
| | Tungsten (W) (ppm) | 0.37 | 0.49 | 0.79 | 0.35 | 0.50 | |
| | Uranium (U) (ppm) | 0.23 | 0.28 | 0.34 | 0.32 | 0.19 | |
| | Vanadium (V) (ppm) | 46 | 46 | 48 | 37 | 49 | |
| | Yttrium (Y) (ppm) | 8.16 | 6.92 | 8.36 | 8.24 | 5.55 | |
| | Zinc (Zn) (ppm) | 74 | 61 | 68 | 56 | 81 | |
| | Zirconium (Zr) (ppm) | 1.0 | 1.0 | 0.7 | 0.7 | 0.6 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.7 | 0.6 | 0.8 | 1.1 | 0.7 | |
| Miscellaneous | Carbon (C) (%) | 0.58 | 0.24 | 0.32 | 0.40 | 0.27 | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-25

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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CERTIFICATE VA17166068

Project: L1969816
 P.O. No.: ALSM-CW16-102-APN
 This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 8-AUG-2017.
 The following have access to data associated with this certificate:
 SHANE STACK

| SAMPLE PREPARATION | |
|---------------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|------------------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm |
|-------------------------|-----------------------------------|---------------------------|----------------------|--------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| L1969816-1-JUN-TAL 2017 | | 0.02 | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 |
| L1969816-2-JUN-TAL 2018 | | 0.54 | 0.78 | 1.14 | 1.0 | 0.17 | <10 | 170 | 0.26 | 0.68 | 0.89 | 0.25 | 15.95 | 7.4 | 6 | 0.38 |
| L1969816-3-JUN-TAL 2019 | | 0.54 | 0.74 | 1.14 | 1.3 | 0.15 | <10 | 210 | 0.25 | 0.52 | 0.94 | 0.40 | 17.30 | 7.1 | 7 | 0.51 |
| L1969816-4-129740 | | 0.54 | 0.73 | 1.02 | 1.7 | 0.12 | <10 | 190 | 0.25 | 0.42 | 0.98 | 0.28 | 20.5 | 6.6 | 6 | 0.41 |
| L1969816-5-129741 | | 1.10 | 0.07 | 1.18 | 0.8 | <0.02 | <10 | 340 | 0.22 | 0.04 | 0.78 | 0.12 | 25.1 | 5.7 | 7 | 0.37 |
| L1969816-6-129742 | | 1.08 | 0.02 | 1.14 | 1.0 | <0.02 | <10 | 210 | 0.39 | 0.01 | 1.18 | 0.13 | 24.4 | 6.0 | 5 | 0.49 |
| L1969816-7-129743 | | 1.10 | 0.19 | 1.01 | 1.2 | <0.02 | <10 | 160 | 0.35 | 0.09 | 1.30 | 0.08 | 29.7 | 6.0 | 8 | 0.44 |
| L1969816-8-129744 | | 1.04 | 0.11 | 1.15 | 0.6 | 0.02 | <10 | 200 | 0.31 | 0.05 | 0.94 | 0.04 | 20.3 | 5.6 | 5 | 0.33 |
| L1969816-9-129745 | | 1.06 | 0.10 | 1.27 | 0.8 | <0.02 | <10 | 270 | 0.29 | 0.06 | 1.19 | 0.04 | 19.15 | 5.1 | 8 | 0.38 |
| L1969816-10-129746 | | 0.94 | 0.04 | 1.24 | 0.9 | <0.02 | <10 | 110 | 0.50 | 0.03 | 1.53 | 0.04 | 16.60 | 5.0 | 5 | 0.44 |
| | | 1.08 | 0.78 | 1.17 | 0.7 | 0.03 | <10 | 290 | 0.24 | 0.10 | 0.81 | 0.19 | 21.2 | 5.9 | 7 | 0.48 |

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CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|-------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Cu | Fe | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb |
| Units | | ppm | % | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm |
| LOR | | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 |
| L1969816-1-JUN-TAL 2017 | | 2100 | 4.33 | 8.30 | 0.11 | 0.04 | 0.01 | 0.075 | 0.45 | 8.4 | 6.1 | 0.63 | 698 | 1.45 | 0.06 | 0.12 |
| L1969816-2-JUN-TAL 2018 | | 2280 | 4.18 | 7.57 | 0.12 | 0.04 | <0.01 | 0.083 | 0.58 | 9.2 | 5.1 | 0.60 | 723 | 2.08 | 0.06 | 0.18 |
| L1969816-3-JUN-TAL 2019 | | 2690 | 3.67 | 6.13 | 0.10 | 0.05 | <0.01 | 0.067 | 0.44 | 10.8 | 4.4 | 0.55 | 640 | 2.12 | 0.06 | 0.15 |
| L1969816-4-129740 | | 491 | 2.45 | 5.40 | 0.10 | 0.05 | <0.01 | 0.026 | 0.63 | 12.7 | 5.6 | 0.60 | 660 | 0.68 | 0.08 | 0.10 |
| L1969816-5-129741 | | 85.5 | 2.49 | 5.34 | 0.11 | 0.07 | <0.01 | 0.033 | 0.37 | 12.5 | 6.4 | 0.68 | 736 | 0.89 | 0.10 | 0.10 |
| L1969816-6-129742 | | 579 | 2.54 | 5.33 | 0.11 | 0.05 | <0.01 | 0.036 | 0.26 | 15.5 | 5.8 | 0.71 | 594 | 0.63 | 0.09 | 0.07 |
| L1969816-7-129743 | | 367 | 2.15 | 5.42 | 0.12 | 0.06 | <0.01 | 0.022 | 0.41 | 10.7 | 6.1 | 0.67 | 528 | 0.63 | 0.09 | 0.14 |
| L1969816-8-129744 | | 344 | 2.47 | 5.30 | 0.11 | 0.05 | <0.01 | 0.021 | 0.50 | 9.8 | 5.3 | 0.69 | 602 | 0.51 | 0.12 | 0.10 |
| L1969816-9-129745 | | 110.0 | 2.10 | 5.82 | 0.09 | 0.05 | <0.01 | 0.018 | 0.21 | 8.8 | 7.7 | 0.71 | 550 | 0.29 | 0.10 | 0.08 |
| L1969816-10-129746 | | 2260 | 2.50 | 5.53 | 0.11 | 0.03 | <0.01 | 0.039 | 0.58 | 11.4 | 5.6 | 0.66 | 555 | 0.77 | 0.09 | 0.12 |

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CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method Analyte Units LOR | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Tl % |
|-------------------------|--------------------------|----------------|---------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|
| L1969816-1-JUN-TAL 2017 | | 2.9 | 710 | 3.4 | 22.4 | 0.001 | 0.08 | 0.05 | 3.5 | 2.2 | 0.7 | 58.5 | <0.01 | 0.37 | 3.2 | 0.078 |
| L1969816-2-JUN-TAL 2018 | | 3.5 | 650 | 3.4 | 29.1 | 0.002 | 0.10 | 0.06 | 3.6 | 2.5 | 0.8 | 75.6 | <0.01 | 0.30 | 3.1 | 0.099 |
| L1969816-3-JUN-TAL 2019 | | 3.7 | 710 | 3.3 | 21.5 | 0.001 | 0.09 | <0.05 | 3.7 | 2.2 | 0.7 | 72.3 | <0.01 | 0.23 | 3.4 | 0.077 |
| L1969816-4-129740 | | 2.9 | 650 | 1.8 | 28.0 | <0.001 | <0.01 | <0.05 | 4.8 | 0.2 | 0.6 | 51.7 | <0.01 | 0.01 | 2.8 | 0.102 |
| L1969816-5-129741 | | 2.5 | 700 | 2.7 | 16.4 | <0.001 | <0.01 | <0.05 | 5.4 | 0.4 | 0.6 | 71.6 | <0.01 | <0.01 | 2.3 | 0.079 |
| L1969816-6-129742 | | 5.8 | 700 | 3.1 | 12.1 | 0.001 | 0.02 | 0.05 | 5.6 | 0.6 | 0.6 | 97.9 | <0.01 | 0.05 | 3.2 | 0.038 |
| L1969816-7-129743 | | 2.5 | 650 | 2.3 | 18.5 | 0.002 | 0.02 | <0.05 | 3.3 | 0.4 | 0.5 | 62.8 | <0.01 | 0.03 | 2.1 | 0.088 |
| L1969816-8-129744 | | 3.3 | 620 | 2.7 | 20.2 | 0.001 | <0.01 | <0.05 | 3.1 | 0.4 | 0.5 | 80.2 | <0.01 | 0.02 | 2.0 | 0.092 |
| L1969816-9-129745 | | 2.4 | 610 | 4.2 | 9.1 | <0.001 | <0.01 | <0.05 | 3.2 | 0.2 | 0.4 | 89.8 | <0.01 | 0.01 | 1.6 | 0.039 |
| L1969816-10-129746 | | 3.1 | 630 | 2.4 | 26.9 | 0.001 | 0.05 | <0.05 | 2.7 | 1.2 | 0.6 | 64.6 | <0.01 | 0.15 | 2.3 | 0.098 |

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Project: L1969816

CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | S-IR08 | S-CAL06a |
|-------------------------|--------------------------|---------|---------|---------|---------|---------|---------|---------|----------------|----------------|----------------|---------------|-----------------|----------|--------|----------|
| | | TI ppm | U ppm | V ppm | W ppm | Y ppm | Zn ppm | Zr ppm | FIZZ RAT Unity | MPA tCaCO3/1Kt | NNP tCaCO3/1Kt | NP tCaCO3/1Kt | Ratio (N) Unity | pH Unity | S % | S % |
| L1969816-1-JUN-TAL 2017 | | 0.14 | 0.29 | 64 | 0.05 | 5.43 | 101 | 0.9 | 2 | 2.8 | 18 | 21 | 7.47 | 7.8 | 0.09 | 0.05 |
| L1969816-2-JUN-TAL 2018 | | 0.18 | 0.32 | 64 | 0.07 | 5.71 | 109 | 1.1 | 2 | 3.8 | 19 | 23 | 6.13 | 7.9 | 0.12 | 0.06 |
| L1969816-3-JUN-TAL 2019 | | 0.13 | 0.34 | 61 | 0.06 | 6.37 | 90 | 1.1 | 2 | 3.4 | 20 | 23 | 6.69 | 7.8 | 0.11 | 0.06 |
| L1969816-4-129740 | | 0.16 | 0.15 | 51 | 0.26 | 7.83 | 78 | 0.7 | 2 | 0.3 | 19 | 19 | 60.80 | 8.7 | 0.01 | <0.01 |
| L1969816-5-129741 | | 0.08 | 0.23 | 51 | 0.25 | 8.83 | 78 | 1.5 | 2 | 0.3 | 27 | 27 | 86.40 | 8.7 | 0.01 | <0.01 |
| L1969816-6-129742 | | 0.06 | 0.23 | 46 | 0.37 | 8.16 | 74 | 1.0 | 2 | 1.3 | 33 | 34 | 27.20 | 8.7 | 0.04 | 0.03 |
| L1969816-7-129743 | | 0.10 | 0.28 | 46 | 0.49 | 6.92 | 61 | 1.0 | 2 | 0.9 | 19 | 20 | 21.33 | 8.8 | 0.03 | 0.02 |
| L1969816-8-129744 | | 0.11 | 0.34 | 48 | 0.79 | 8.36 | 68 | 0.7 | 2 | 0.6 | 25 | 26 | 41.60 | 9.0 | 0.02 | <0.01 |
| L1969816-9-129745 | | 0.04 | 0.32 | 37 | 0.35 | 8.24 | 56 | 0.7 | 2 | 0.3 | 32 | 32 | 102.40 | 8.8 | 0.01 | 0.01 |
| L1969816-10-129746 | | 0.14 | 0.19 | 49 | 0.50 | 5.55 | 81 | 0.6 | 2 | 1.9 | 19 | 21 | 11.20 | 8.9 | 0.06 | 0.04 |

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CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method Analyte Units LOR | C-GAS05 | C-GAS05 | S-GRA06a | C-IR07 | S-GRA06 |
|-------------------------|-----------------------------------|---------|----------|----------|--------|---------|
| | | C % | CO2 % | S % | C % | S % |
| | | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 |
| L1969816-1-JUN-TAL 2017 | | 0.20 | 0.7 | 0.04 | 0.25 | 0.04 |
| L1969816-2-JUN-TAL 2018 | | 0.25 | 0.9 | 0.06 | 0.30 | 0.04 |
| L1969816-3-JUN-TAL 2019 | | 0.25 | 0.9 | 0.05 | 0.32 | 0.04 |
| L1969816-4-129740 | | 0.15 | 0.5 | 0.01 | 0.21 | 0.01 |
| L1969816-5-129741 | | 0.28 | 1.0 | 0.01 | 0.36 | <0.01 |
| L1969816-6-129742 | | 0.47 | 1.7 | 0.01 | 0.58 | <0.01 |
| L1969816-7-129743 | | 0.15 | 0.6 | 0.01 | 0.24 | <0.01 |
| L1969816-8-129744 | | 0.23 | 0.8 | 0.03 | 0.32 | <0.01 |
| L1969816-9-129745 | | 0.30 | 1.1 | <0.01 | 0.40 | <0.01 |
| L1969816-10-129746 | | 0.19 | 0.7 | 0.02 | 0.27 | <0.01 |



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CERTIFICATE OF ANALYSIS VA17166068

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
 ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



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QC CERTIFICATE VA17166068

Project: L1969816
 P.O. No.: ALSM-CW16-102-APN
 This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 8-AUG-2017.
 The following have access to data associated with this certificate:
 SHANE STACK

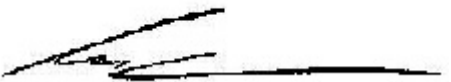
| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17166068

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Ag ppm | Al % | As ppm | Au ppm | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | |
| | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | 20.2 | 2.27 | 120.0 | 0.07 | <10 | 50 | 0.80 | 11.10 | 0.90 | 19.10 | 61.2 | 96.0 | 79 | 10.40 | 8170 | |
| Target Range - Lower Bound | 18.15 | 2.05 | 107.0 | 0.03 | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | |
| Upper Bound | 22.2 | 2.53 | 131.0 | 0.11 | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | |
| OREAS 920 | 0.11 | 2.38 | 4.4 | <0.02 | <10 | 70 | 0.69 | 0.59 | 0.33 | 0.05 | 74.4 | 14.1 | 41 | 1.95 | 109.0 | |
| Target Range - Lower Bound | 0.07 | 2.18 | 3.8 | <0.02 | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | |
| Upper Bound | 0.12 | 2.68 | 4.9 | 0.04 | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17166068

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | Fe % | Ga ppm | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm |
| | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OGGeo08 | 4.98 | 8.41 | 0.23 | 0.82 | 0.52 | 1.460 | 1.05 | 29.6 | 30.8 | 0.94 | 386 | 869 | 0.30 | 0.79 | 8680 |
| Target Range - Lower Bound | 4.51 | 8.05 | 0.21 | 0.72 | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 |
| Upper Bound | 5.53 | 9.95 | 0.45 | 0.92 | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 |
| OREAS 920 | 3.49 | 6.26 | 0.13 | 0.48 | <0.01 | 0.032 | 0.40 | 36.8 | 21.2 | 1.05 | 501 | 0.33 | 0.02 | 0.27 | 37.0 |
| Target Range - Lower Bound | 3.26 | 6.12 | <0.05 | 0.53 | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 |
| Upper Bound | 4.00 | 7.60 | 0.22 | 0.69 | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17166068

| Method Analyte Units LOR | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 | ME-MS41 Rb ppm 0.1 | ME-MS41 Re ppm 0.001 | ME-MS41 S % 0.01 | ME-MS41 Sb ppm 0.05 | ME-MS41 Sc ppm 0.1 | ME-MS41 Se ppm 0.2 | ME-MS41 Sn ppm 0.2 | ME-MS41 Sr ppm 0.2 | ME-MS41 Ta ppm 0.01 | ME-MS41 Te ppm 0.01 | ME-MS41 Th ppm 0.2 | ME-MS41 Ti % 0.005 | ME-MS41 Tl ppm 0.02 |
|----------------------------|------------------|--------------------|--------------------|----------------------|------------------|---------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|--------------------|--------------------|---------------------|
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OGGeo08 | 770 | 7040 | 122.5 | 1.450 | 2.69 | 19.35 | 6.1 | 12.1 | 13.2 | 65.8 | 0.01 | 0.16 | 16.7 | 0.302 | 1.35 |
| Target Range - Lower Bound | 700 | 6520 | 109.5 | 1.295 | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 |
| Upper Bound | 880 | 7970 | 134.5 | 1.585 | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 |
| OREAS 920 | 690 | 22.6 | 22.8 | <0.001 | 0.02 | 0.55 | 2.6 | 0.6 | 1.0 | 16.8 | 0.01 | 0.02 | 15.7 | 0.120 | 0.14 |
| Target Range - Lower Bound | | 19.2 | 22.2 | <0.001 | <0.01 | 0.45 | 2.5 | 0.4 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 |
| Upper Bound | | 23.9 | 27.4 | 0.002 | 0.05 | 0.77 | 3.3 | 1.3 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17166068

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | S-IR08 | S-CAL06a | C-GAS05 |
|----------------------------|---------|---------|---------|---------|---------|---------|-----------|------------|------------|------------|-----------|----------|--------|----------|---------|
| Sample Description | U | V | W | Y | Zn | Zr | FIZZ RAT | MPA | NNP | NP | Ratio (N | pH | S | S | C |
| | ppm | ppm | ppm | ppm | ppm | ppm | Unity | tCaCO3/1Kt | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % |
| | 0.05 | 1 | 0.05 | 0.05 | 2 | 0.5 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | 6.1 | | | |
| Buffer pH6 | | | | | | | | | | | | 6.1 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | 5.3 | | | |
| Upper Bound | | | | | | | | | | | | 6.7 | | | |
| CO-ASSAY | | | | | | | | | | | | | | | 0.50 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 0.42 |
| Upper Bound | | | | | | | | | | | | | | | 0.64 |
| DS-1 | | | | | | | | | | | | | 2.57 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 2.51 | | |
| Upper Bound | | | | | | | | | | | | | 2.71 | | |
| GS313-8 | | | | | | | | | | | | | 1.25 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 1.19 | | |
| Upper Bound | | | | | | | | | | | | | 1.29 | | |
| KZK-1 | | | | | | | 2 | 25.0 | 33 | 58 | 2.32 | | | | |
| KZK-1 | | | | | | | 2 | 25.0 | 31 | 56 | 2.24 | | | | |
| Target Range - Lower Bound | | | | | | | <1 | 22.9 | 30 | 54 | 2.18 | | | | |
| Upper Bound | | | | | | | >4 | 27.1 | 38 | 64 | 2.53 | | | | |
| MA-2c | | | | | | | | | | | | | | | 1.54 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 1.50 |
| Upper Bound | | | | | | | | | | | | | | | 1.84 |
| OGGeo08 | 5.29 | 78 | 3.01 | 16.80 | 7000 | 24.3 | | | | | | | | | |
| Target Range - Lower Bound | 4.45 | 70 | 2.58 | 15.35 | 6500 | 19.5 | | | | | | | | | |
| Upper Bound | 5.55 | 88 | 3.60 | 18.85 | 7950 | 27.5 | | | | | | | | | |
| OREAS 920 | 2.02 | 24 | 0.47 | 17.05 | 104 | 18.3 | | | | | | | | | |
| Target Range - Lower Bound | 1.89 | 23 | 0.31 | 16.85 | 93 | 17.6 | | | | | | | | | |
| Upper Bound | 2.42 | 30 | 0.61 | 20.7 | 119 | 25.0 | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method Analyte Units LOR | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % |
|----------------------------|--------------------------|---------------------|--------------------|------------------|-------------------|
| | | 0.2 | 0.01 | 0.01 | 0.01 |
| STANDARDS | | | | | |
| Buffer pH6 | | | | | |
| Buffer pH6 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| CO-ASSAY | | 1.8 | | | |
| Target Range - Lower Bound | | 1.5 | | | |
| Upper Bound | | 2.4 | | | |
| DS-1 | | | | 3.04 | |
| Target Range - Lower Bound | | | | 3.01 | |
| Upper Bound | | | | 3.25 | |
| GS313-8 | | | | 0.93 | |
| Target Range - Lower Bound | | | | 0.90 | |
| Upper Bound | | | | 0.98 | |
| KZK-1 | | | | | |
| KZK-1 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| MA-2c | | 5.6 | | | |
| Target Range - Lower Bound | | 5.5 | | | |
| Upper Bound | | 6.8 | | | |
| OGGeo08 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| OREAS 920 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| UTS-1 | | | | 0.89 | |
| Target Range - Lower Bound | | | | 0.83 | |
| Upper Bound | | | | 0.93 | |
| UTS-1 | | | 0.90 | | |
| UTS-1 | | | 0.88 | | |
| Target Range - Lower Bound | | | 0.81 | | |
| Upper Bound | | | 0.95 | | |
| UTS-4 | | | | 1.72 | |
| Target Range - Lower Bound | | | | 1.64 | |
| Upper Bound | | | | 1.84 | |
| UTS-4 | | | 1.75 | | |



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QC CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | |
|----------------------------|--------|---------|-------|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|------|-----|
| | | | | | Ag | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu |
| | | | | | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 |
| STANDARDS | | | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| BLANK | <0.01 | <0.01 | 0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | | | | |
| Target Range - Lower Bound | <0.01 | <0.01 | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | | | | |
| Upper Bound | 0.02 | 0.02 | 0.2 | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | | | | |
| BLANK | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| ORIGINAL | 0.42 | 0.35 | 104.5 | <0.02 | 10 | 90 | 0.26 | 0.03 | 14.20 | 2.37 | 17.85 | 1.9 | 37 | 1.67 | 6.9 | | | | |
| DUP | 0.48 | 0.39 | 108.5 | <0.02 | <10 | 90 | 0.36 | 0.03 | 14.60 | 2.52 | 18.95 | 2.0 | 39 | 1.84 | 7.4 | | | | |
| Target Range - Lower Bound | 0.42 | 0.34 | 101.0 | <0.02 | <10 | 70 | 0.24 | 0.02 | 13.65 | 2.31 | 17.45 | 1.8 | 35 | 1.62 | 6.7 | | | | |
| Upper Bound | 0.48 | 0.40 | 112.0 | 0.04 | 20 | 110 | 0.38 | 0.04 | 15.15 | 2.58 | 19.35 | 2.1 | 41 | 1.89 | 7.6 | | | | |

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Project: L1969816

QC CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method Analyte Units LOR | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | |
|----------------------------|--------------------------|--------------|----------------|----------------|----------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|--|
| | | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | | |
| BLANK | | <0.01 | <0.05 | 0.06 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | |
| Target Range - Lower Bound | | <0.01 | <0.05 | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | |
| Upper Bound | | 0.02 | 0.10 | 0.10 | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | | |
| ORIGINAL | | 0.87 | 1.09 | 0.10 | 0.17 | 0.56 | 0.010 | 0.09 | 16.7 | 4.6 | 5.61 | 135 | 14.30 | 0.05 | <0.05 | 14.5 | |
| DUP | | 0.91 | 1.25 | 0.10 | 0.17 | 0.61 | 0.010 | 0.09 | 17.8 | 5.5 | 5.77 | 140 | 15.15 | 0.05 | <0.05 | 15.6 | |
| Target Range - Lower Bound | | 0.84 | 1.06 | <0.05 | 0.14 | 0.53 | <0.005 | 0.08 | 16.2 | 4.7 | 5.40 | 126 | 13.95 | 0.04 | <0.05 | 14.1 | |
| Upper Bound | | 0.94 | 1.28 | 0.16 | 0.20 | 0.64 | 0.016 | 0.10 | 18.3 | 5.4 | 5.98 | 149 | 15.50 | 0.06 | 0.10 | 16.0 | |



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Project: L1969816

QC CERTIFICATE OF ANALYSIS VA17166068

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl |
| | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 |
| STANDARDS | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <10 | <0.2 | <0.1 | <0.001 | <0.01 | 0.09 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 |
| Target Range - Lower Bound | <10 | <0.2 | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 |
| Upper Bound | 20 | 0.4 | 0.2 | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | 2060 | 3.8 | 5.0 | 0.180 | 0.17 | 3.78 | 2.0 | 5.5 | 0.2 | 111.5 | <0.01 | 0.02 | 1.7 | <0.005 | 1.08 |
| DUP | 2140 | 4.1 | 5.5 | 0.188 | 0.18 | 3.86 | 2.2 | 5.6 | 0.2 | 117.0 | <0.01 | 0.01 | 1.9 | <0.005 | 1.14 |
| Target Range - Lower Bound | 1990 | 3.6 | 4.9 | 0.174 | 0.16 | 3.48 | 1.9 | 5.1 | <0.2 | 108.5 | <0.01 | <0.01 | 1.5 | <0.005 | 1.01 |
| Upper Bound | 2220 | 4.3 | 5.6 | 0.194 | 0.19 | 4.16 | 2.3 | 6.0 | 0.4 | 120.0 | 0.02 | 0.02 | 2.1 | 0.010 | 1.21 |

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QC CERTIFICATE OF ANALYSIS VA17166068

| Method Analyte Units LOR | ME-MS41 U ppm 0.05 | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | OA-VOL08m FIZZ RAT Unity 1 | OA-VOL08m MPA tCaCO3/1Kt 0.3 | OA-VOL08m NNP tCaCO3/1Kt 1 | OA-VOL08m NP tCaCO3/1Kt 1 | OA-VOL08m Ratio (N) Unity 0.01 | OA-ELE07 pH Unity 0.1 | S-IR08 S % 0.01 | S-CAL06a S % 0.01 | C-GAS05 C % 0.05 | |
|----------------------------|--------------------|-----------------|--------------------|--------------------|------------------|--------------------|----------------------------|------------------------------|----------------------------|---------------------------|--------------------------------|-----------------------|-----------------|-------------------|------------------|-------|
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <0.05 | <1 | <0.05 | <0.05 | <2 | <0.5 | | | | | | | | | | <0.05 |
| Target Range - Lower Bound | <0.05 | <1 | <0.05 | <0.05 | <2 | <0.5 | | | | | | | | | | <0.05 |
| Upper Bound | 0.10 | 2 | 0.10 | 0.10 | 4 | 1.0 | | | | | | | | | | 0.10 |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | 6.22 | 20 | 0.41 | 14.25 | 238 | 5.1 | | | | | | | | | | |
| DUP | 6.58 | 21 | 0.42 | 15.15 | 243 | 5.4 | | | | | | | | | | |
| Target Range - Lower Bound | 6.03 | 18 | 0.33 | 13.90 | 226 | 4.4 | | | | | | | | | | |
| Upper Bound | 6.77 | 23 | 0.50 | 15.50 | 255 | 6.1 | | | | | | | | | | |
| | | | | | | | | | | | | 6.1 | | | | |
| | | | | | | | | | | | | 5.5 | | | | |
| | | | | | | | | | | | | 6.9 | | | | |
| | | | | | | | | | | | | <0.01 | | | | |
| | | | | | | | | | | | | <0.01 | | | | |
| | | | | | | | | | | | | 0.02 | | | | |



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QC CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method Analyte Units | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % |
|----------------------------|----------------------|---------------------|--------------------|------------------|-------------------|
| | LOR | 0.2 | 0.01 | 0.01 | 0.01 |
| STANDARDS | | | | | |
| UTS-4 | | | 1.78 | | |
| Target Range - Lower Bound | | | 1.61 | | |
| Upper Bound | | | 1.87 | | |
| BLANKS | | | | | |
| BLANK | | <0.2 | | | |
| Target Range - Lower Bound | | <0.2 | | | |
| Upper Bound | | 0.4 | | | |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| BLANK | | | | <0.01 | |
| Target Range - Lower Bound | | | | <0.01 | |
| Upper Bound | | | | 0.02 | |
| BLANK | | | <0.01 | | |
| BLANK | | | <0.01 | | |
| Target Range - Lower Bound | | | <0.01 | | |
| Upper Bound | | | 0.02 | | |
| BLANK | | | | <0.01 | |
| Target Range - Lower Bound | | | | <0.01 | |
| Upper Bound | | | | 0.02 | |
| DUPLICATES | | | | | |
| ORIGINAL | | | | | |
| DUP | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |



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| QC CERTIFICATE OF ANALYSIS VA17166068 |
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| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | | |
|---|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|-----|------|-----|
| | | | | | Ag | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu |
| | | | | | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | 0.01 | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| L1968927-10-129732 775-46 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1969816-10-129746 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | |
|---|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|------|-----|
| | | | | | Fe | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni |
| | | | | | % | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm |
| | | | | | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| L1968927-10-129732 775-46 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1969816-10-129746 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

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Project: L1969816

| |
|--|
| QC CERTIFICATE OF ANALYSIS VA17166068 |
|--|

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | |
|----------------------------------|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|-------|------|
| | | | | | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl |
| | | | | | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm |
| | | | | | 10 | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| L1968927-10-129732 775-46 DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |
| L1969816-10-129746 DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method Analyte Units LOR | ME-MS41 U ppm 0.05 | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | OA-VOL08m FIZZ RAT Unity 1 | OA-VOL08m MPA tCaCO3/1Kt 0.3 | OA-VOL08m NNP tCaCO3/1Kt 1 | OA-VOL08m NP tCaCO3/1Kt 1 | OA-VOL08m Ratio (N) Unity 0.01 | OA-ELE07 pH Unity 0.1 | S-IR08 S % 0.01 | S-CAL06a S % 0.01 | C-GAS05 C % 0.05 | |
|----------------------------------|--------------------------|--------------------|-----------------|--------------------|--------------------|------------------|--------------------|----------------------------|------------------------------|----------------------------|---------------------------|--------------------------------|-----------------------|-----------------|-------------------|------------------|------|
| DUPLICATES | | | | | | | | | | | | | | | | | |
| L1968927-10-129732 775-46 DUP | | | | | | | | | | | | | | | | | 0.68 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | 0.68 |
| Upper Bound | | | | | | | | | | | | | | | | | 0.76 |
| L1969816-10-129746 DUP | | | | | | | | 2 | 1.9 | 19 | 21 | 11.20 | 8.9 | 0.06 | 0.04 | | |
| Target Range - Lower Bound | | | | | | | | 2 | 1.6 | 19 | 21 | 13.44 | 8.9 | 0.05 | 0.04 | | |
| Upper Bound | | | | | | | | <1 | 1.4 | 17 | 19 | 11.69 | 8.4 | 0.04 | 0.03 | | |
| | | | | | | | | 3 | 2.1 | 21 | 23 | 12.95 | 9.4 | 0.07 | 0.05 | | |

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 Account: APN

Project: L1969816

QC CERTIFICATE OF ANALYSIS VA17166068

| Sample Description | Method Analyte Units LOR | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % |
|----------------------------------|-----------------------------------|---------------------|--------------------|------------------|-------------------|
| | | 0.2 | 0.01 | 0.01 | 0.01 |
| DUPLICATES | | | | | |
| L1968927-10-129732 775-46 DUP | | 2.5 | | | |
| Target Range - Lower Bound | | 2.2 | | | |
| Upper Bound | | 2.8 | | | |
| L1969816-10-129746 DUP | | | 0.02 | 0.27 | <0.01 |
| Target Range - Lower Bound | | | 0.01 | 0.28 | <0.01 |
| Upper Bound | | | <0.01 | 0.26 | <0.01 |
| | | | 0.02 | 0.29 | 0.02 |



ALS Canada Ltd.
2103 Dollarton Hwy
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To: ALS ENVIRONMENTAL
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 8-SEP-2017
Account: APN

Project: L1969816

QC CERTIFICATE OF ANALYSIS VA17166068

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



Chain of Custody (COC) / Analytical Request Form

www.alslab.com

Canada Toll Free: 1 800 868 8878

L1969816-COFC

Page of



180-17-25

| | | | |
|---|--|---|--|
| Report To Contact and company name below will appear on the final report Company: Minto Explorations Ltd. Contact: Minto Environment - Coordinator Phone: 1-804-759-4659 Street: 2100-510 West Georgia St City/Province: Vancouver, British Columbia Postal Code: V6S 6M3 | | Report Format / Distribution Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input type="checkbox"/> ESD (DIGITAL) Quality Control (QC) Report with Report: <input type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: minto.environment@mintonline.com Email 2 Email 3 | |
| Invoice To Same as Report To: <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report: <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Company: Minto Explorations Ltd. Contact: Ruth Cayetano | | Invoice Distribution Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: ab@mintonline.com Email 2 Email 3 | |
| ALS Account # / Quote # Lab # PO / A/E: TBD LSD | | Oil and Gas Required Fields (client use) A/E/Cost Center: _____ PO# _____ Merchant Code: _____ Routing Code: _____ Requisitioner: _____ Location: _____ | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | |
| ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (this description will appear on the report) | |
| Drinking Water (DW) Samples (client use) Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | |
| Released by: _____ Date: _____ | | INITIAL SHIPMENT RECEPTION (lab use only) Time: _____ Received by: JMS Date: Aug 3 2017 | |
| REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the terms and conditions as specified on the back page of the white report copy. 1. If water samples are taken from Regulated Drinking Water (RDW) System please print using an authorized DW COC form | | FINAL SHIPMENT RECEPTION (lab use only) Time: _____ Received by: MS Date: Aug 5 2017 | |
| SHIPMENT RELEASE (client use) Date: _____ | | WHITE - LABORATORY COPY YELLOW - CLIENT COPY | |
| SHIPPING RELEASE (client use) Date: _____ | | INITIAL COOLER TEMPERATURES °C FINAL COOLER TEMPERATURES °C | |
| SAMPLE CONDITION AS RECEIVED (lab use only) Frozen <input type="checkbox"/> Ice Packs <input type="checkbox"/> Cooling Initiated <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact: Yes <input type="checkbox"/> No <input type="checkbox"/> | | ANALYSIS REQUEST Inactive Filtered (F), Preserved (P) or Filtered and Preserved (FP) pass: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | |
| Number of Containers | | Priority (Business Days) Regular (R) <input checked="" type="checkbox"/> Short-Turn (ST) if received by 1 pm - business days - no surcharges apply 4 day (P4) <input type="checkbox"/> 3 day (P3) <input type="checkbox"/> 2 day (P2) <input type="checkbox"/> EMERGENCY <input type="checkbox"/> 1 Business day (E1) <input type="checkbox"/> Same Day Weekend or Statutory holiday (E0) <input type="checkbox"/> | |
| Notes that can not be performed according to the method being attached, you will be contacted. | | DATE AND TIME REQUESTED FOR ALL EXP. DATE: dd-mm-yy hh mm | |



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 24-AUG-17
Report Date: 14-NOV-17 18:08 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1980572
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: 17-26, 17-27
Legal Site Desc:

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1980572-1 Waste 03-AUG-17 129747 769-42 | L1980572-2 Waste 05-AUG-17 129750 769-40 | L1980572-3 Waste 05-AUG-17 129751 769-40 | L1980572-4 Tail 08-AUG-17 JULY TAILS 2017 | L1980572-5 Waste 04-AUG-17 129748 | |
|---|---|---|---|--|--|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 9.2 | 8.9 | 8.9 | 8.1 | 8.9 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.52 | 0.19 | <0.05 | 0.19 | 0.38 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 1 | 1 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 1.6 | 0.6 | 0.6 | 4.7 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 39 | 22 | 11 | 18 | 30 |
| | NNP (tCaCO3/1Kt) | 37 | 21 | 10 | 13 | 29 |
| | Ratio (NP/MPA) (Unity) | 24.96 | 35.20 | 17.60 | 3.84 | 48.00 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | 0.05 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | <0.01 | 0.08 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.05 | 0.02 | 0.02 | 0.07 | 0.02 |
| | Total Sulfur (combustion) (%) | 0.05 | 0.02 | 0.02 | 0.15 | 0.02 |
| Total Metals | Aluminum (Al) (%) | 1.05 | 1.01 | 1.15 | 0.96 | 0.64 |
| | Antimony (Sb) (ppm) | 0.05 | 0.05 | <0.05 | 0.05 | <0.05 |
| | Arsenic (As) (ppm) | 0.8 | 2.1 | 0.8 | 1.3 | 2.1 |
| | Barium (Ba) (ppm) | 260 | 220 | 230 | 200 | 100 |
| | Beryllium (Be) (ppm) | 0.26 | 0.29 | 0.26 | 0.20 | 0.35 |
| | Bismuth (Bi) (ppm) | 0.09 | 0.13 | 0.03 | 0.58 | 0.04 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.07 | 0.18 | 0.13 | 0.57 | 0.10 |
| | Calcium (Ca) (%) | 1.38 | 0.81 | 0.52 | 0.74 | 1.04 |
| | Cerium (Ce) (ppm) | 28.2 | 24.3 | 22.7 | 18.20 | 36.6 |
| | Cesium (Cs) (ppm) | 0.52 | 0.39 | 0.35 | 0.41 | 0.59 |
| | Chromium (Cr) (ppm) | 5 | 5 | 7 | 6 | 4 |
| | Cobalt (Co) (ppm) | 5.5 | 5.7 | 6.0 | 8.1 | 6.0 |
| | Copper (Cu) (ppm) | 472 | 1245 | 432 | 4730 | 524 |
| | Gallium (Ga) (ppm) | 5.44 | 5.36 | 5.49 | 6.84 | 3.77 |
| | Germanium (Ge) (ppm) | 0.06 | 0.05 | 0.08 | 0.07 | 0.06 |
| | Gold (Au) (ppm) | <0.02 | 0.03 | <0.02 | 0.23 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.04 | 0.05 | 0.10 | 0.04 | 0.04 |
| | Indium (In) (ppm) | 0.038 | 0.038 | 0.021 | 0.110 | 0.050 |
| | Iron (Fe) (%) | 2.40 | 2.31 | 2.22 | 4.20 | 2.38 |
| | Lanthanum (La) (ppm) | 15.4 | 12.5 | 11.5 | 9.1 | 20.1 |
| | Lead (Pb) (ppm) | 3.0 | 2.6 | 1.7 | 9.3 | 3.2 |
| | Lithium (Li) (ppm) | 5.9 | 5.8 | 6.8 | 4.9 | 2.9 |
| | Magnesium (Mg) (%) | 0.74 | 0.57 | 0.64 | 0.54 | 0.36 |
| | Manganese (Mn) (ppm) | 525 | 670 | 623 | 659 | 619 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1980572-6 Waste 04-AUG-17 129749 | L1980572-7 Waste 06-AUG-17 128153 | L1980572-8 Waste 06-AUG-17 128152 | L1980572-9 Waste 10-AUG-17 128154 | L1980572-10 Waste 10-AUG-17 128155 763-35 | |
|---|--|--|--|--|--|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.9 | 9.1 | 8.7 | 8.8 | 9.1 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.35 | 0.06 | 0.25 | 0.34 | 0.24 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 1 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 1.6 | 1.3 | 0.9 | 2.2 | 0.9 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 28 | 10 | 25 | 33 | 26 |
| | NNP (tCaCO3/1Kt) | 26 | 9 | 24 | 31 | 25 |
| | Ratio (NP/MPA) (Unity) | 17.92 | 8.00 | 26.67 | 15.09 | 27.73 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.04 | 0.04 | 0.03 | 0.07 | 0.03 |
| | Total Sulfur (combustion) (%) | 0.05 | 0.04 | 0.03 | 0.07 | 0.03 |
| Total Metals | Aluminum (Al) (%) | 1.09 | 1.32 | 1.08 | 1.15 | 0.94 |
| | Antimony (Sb) (ppm) | 0.15 | <0.05 | <0.05 | <0.05 | 0.11 |
| | Arsenic (As) (ppm) | 1.7 | 1.5 | 0.7 | 1.0 | 2.0 |
| | Barium (Ba) (ppm) | 70 | 300 | 240 | 180 | 190 |
| | Beryllium (Be) (ppm) | 0.29 | 0.18 | 0.32 | 0.34 | 0.25 |
| | Bismuth (Bi) (ppm) | 0.16 | 0.36 | 0.67 | 0.11 | 0.13 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.05 | 0.09 | 0.26 | 0.11 | 0.08 |
| | Calcium (Ca) (%) | 1.06 | 0.34 | 0.92 | 1.36 | 0.99 |
| | Cerium (Ce) (ppm) | 41.5 | 37.1 | 32.2 | 24.2 | 19.70 |
| | Cesium (Cs) (ppm) | 0.23 | 0.64 | 0.52 | 0.45 | 0.34 |
| | Chromium (Cr) (ppm) | 3 | 5 | 4 | 6 | 5 |
| | Cobalt (Co) (ppm) | 5.4 | 6.8 | 6.7 | 6.0 | 5.1 |
| | Copper (Cu) (ppm) | 593 | 4760 | 4940 | 834 | 498 |
| | Gallium (Ga) (ppm) | 6.56 | 6.98 | 6.44 | 6.10 | 5.04 |
| | Germanium (Ge) (ppm) | 0.06 | 0.07 | 0.09 | 0.06 | 0.05 |
| | Gold (Au) (ppm) | <0.02 | 0.04 | 0.08 | 0.02 | 0.03 |
| | Hafnium (Hf) (ppm) | 0.06 | 0.03 | 0.08 | 0.05 | 0.03 |
| | Indium (In) (ppm) | 0.088 | 0.050 | 0.080 | 0.039 | 0.030 |
| | Iron (Fe) (%) | 2.74 | 2.82 | 3.14 | 2.44 | 2.11 |
| | Lanthanum (La) (ppm) | 22.8 | 19.7 | 17.2 | 12.7 | 9.4 |
| | Lead (Pb) (ppm) | 5.4 | 2.9 | 3.5 | 3.1 | 3.3 |
| | Lithium (Li) (ppm) | 9.1 | 6.6 | 5.6 | 7.6 | 5.4 |
| | Magnesium (Mg) (%) | 0.82 | 0.71 | 0.60 | 0.69 | 0.58 |
| | Manganese (Mn) (ppm) | 437 | 698 | 672 | 673 | 512 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1980572-11 Waste 10-AUG-17 128156 763-35 | L1980572-12 Waste 10-AUG-17 128157 763-35 | L1980572-13 Waste 11-AUG-17 128158 763-36B | L1980572-14 Waste 08-AUG-17 128161 763-34 | L1980572-15 Waste 08-AUG-17 128160 763-34 |
|---|--|--|--|---|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 9.1 | 8.7 | 9.1 | 8.8 | 8.9 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.28 | 0.36 | 0.33 | 0.40 | 1.29 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 3 |
| | MPA (tCaCO3/1Kt) | 1.9 | 2.5 | 3.4 | 2.2 | 1.9 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 29 | 34 | 28 | 37 | 96 |
| | NNP (tCaCO3/1Kt) | 27 | 32 | 25 | 35 | 94 |
| | Ratio (NP/MPA) (Unity) | 15.47 | 13.60 | 8.15 | 16.91 | 51.20 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | 0.02 | <0.01 | <0.01 | 0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.06 | 0.06 | 0.11 | 0.07 | 0.05 |
| | Total Sulfur (combustion) (%) | 0.06 | 0.08 | 0.11 | 0.07 | 0.06 |
| Total Metals | Aluminum (Al) (%) | 1.12 | 1.01 | 1.35 | 0.90 | 0.73 |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | <0.05 | 0.08 | 0.10 |
| | Arsenic (As) (ppm) | 0.9 | 0.9 | 0.6 | 1.2 | 1.7 |
| | Barium (Ba) (ppm) | 130 | 140 | 470 | 70 | 70 |
| | Beryllium (Be) (ppm) | 0.34 | 0.28 | 0.25 | 0.25 | 0.37 |
| | Bismuth (Bi) (ppm) | 0.16 | 0.09 | 0.19 | 0.10 | 0.11 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.16 | 0.09 | 0.12 | 0.08 | 0.10 |
| | Calcium (Ca) (%) | 1.16 | 1.29 | 1.17 | 1.48 | 2.89 |
| | Cerium (Ce) (ppm) | 23.2 | 29.2 | 21.4 | 26.5 | 22.6 |
| | Cesium (Cs) (ppm) | 0.39 | 0.29 | 0.62 | 0.34 | 0.36 |
| | Chromium (Cr) (ppm) | 5 | 11 | 6 | 4 | 4 |
| | Cobalt (Co) (ppm) | 6.0 | 5.8 | 7.6 | 4.7 | 5.3 |
| | Copper (Cu) (ppm) | 824 | 1245 | 3150 | 884 | 823 |
| | Gallium (Ga) (ppm) | 6.49 | 5.99 | 6.33 | 5.38 | 4.61 |
| | Germanium (Ge) (ppm) | 0.06 | 0.05 | 0.08 | <0.05 | 0.05 |
| | Gold (Au) (ppm) | 0.07 | 0.02 | 0.09 | 0.04 | 0.02 |
| | Hafnium (Hf) (ppm) | 0.03 | 0.03 | 0.08 | 0.02 | 0.03 |
| | Indium (In) (ppm) | 0.020 | 0.034 | 0.052 | 0.027 | 0.031 |
| | Iron (Fe) (%) | 2.58 | 2.64 | 3.02 | 1.97 | 2.18 |
| | Lanthanum (La) (ppm) | 11.8 | 15.5 | 10.5 | 13.7 | 11.6 |
| | Lead (Pb) (ppm) | 3.6 | 2.7 | 2.3 | 3.4 | 3.6 |
| | Lithium (Li) (ppm) | 8.3 | 6.9 | 5.5 | 6.3 | 3.9 |
| | Magnesium (Mg) (%) | 0.71 | 0.68 | 0.73 | 0.55 | 0.99 |
| | Manganese (Mn) (ppm) | 589 | 590 | 701 | 461 | 586 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1980572-16 Waste 14-AUG-17 128159 763-37 | L1980572-17 Waste 15-AUG-17 128162 763-39 | L1980572-18 Waste 17-AUG-17 128163 763-38 | L1980572-19 Waste 17-AUG-17 128164 763-38 | |
|---|--|--|--|--|-------|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | 9.0 | 9.0 | 8.7 | 9.0 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.51 | 0.23 | 0.84 | 0.33 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.9 | 0.6 | 4.4 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 37 | 23 | 50 | 31 |
| | NNP (tCaCO3/1Kt) | 36 | 22 | 46 | 31 |
| | Ratio (NP/MPA) (Unity) | 39.47 | 36.80 | 11.43 | 99.20 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | 0.01 | 0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.03 | 0.02 | 0.13 | <0.01 |
| | Total Sulfur (combustion) (%) | 0.03 | 0.02 | 0.14 | 0.01 |
| Total Metals | Aluminum (Al) (%) | 0.81 | 0.95 | 0.58 | 1.05 |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 0.9 | 0.9 | 1.8 | 0.9 |
| | Barium (Ba) (ppm) | 100 | 180 | 190 | 200 |
| | Beryllium (Be) (ppm) | 0.26 | 0.23 | 0.30 | 0.32 |
| | Bismuth (Bi) (ppm) | 0.07 | 0.07 | 1.13 | 0.02 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.06 | 0.09 | 0.28 | 0.07 |
| | Calcium (Ca) (%) | 1.31 | 0.82 | 1.39 | 1.16 |
| | Cerium (Ce) (ppm) | 31.7 | 32.5 | 25.7 | 24.6 |
| | Cesium (Cs) (ppm) | 0.37 | 0.58 | 0.29 | 0.38 |
| | Chromium (Cr) (ppm) | 4 | 5 | 4 | 5 |
| | Cobalt (Co) (ppm) | 5.6 | 6.2 | 7.0 | 5.8 |
| | Copper (Cu) (ppm) | 384 | 523 | 6470 | 178.5 |
| | Gallium (Ga) (ppm) | 4.83 | 5.05 | 3.72 | 5.65 |
| | Germanium (Ge) (ppm) | 0.05 | 0.07 | 0.06 | 0.05 |
| | Gold (Au) (ppm) | <0.02 | 0.05 | 0.21 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.04 | 0.08 | 0.05 | 0.04 |
| | Indium (In) (ppm) | 0.031 | 0.038 | 0.058 | 0.025 |
| | Iron (Fe) (%) | 2.20 | 2.54 | 3.26 | 2.34 |
| | Lanthanum (La) (ppm) | 17.4 | 17.4 | 13.7 | 13.1 |
| | Lead (Pb) (ppm) | 3.0 | 2.5 | 4.2 | 2.7 |
| | Lithium (Li) (ppm) | 4.8 | 4.3 | 2.4 | 6.1 |
| | Magnesium (Mg) (%) | 0.59 | 0.60 | 0.69 | 0.69 |
| | Manganese (Mn) (ppm) | 512 | 605 | 671 | 621 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1980572-1 | L1980572-2 | L1980572-3 | L1980572-4 | L1980572-5 |
|------------------------|--------------------------|--------------|---------------|---------------|---------------|-----------------|------------|
| | | Description | Waste | Waste | Waste | Tail | Waste |
| | | Sampled Date | 03-AUG-17 | 05-AUG-17 | 05-AUG-17 | 08-AUG-17 | 04-AUG-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 129747 769-42 | 129750 769-40 | 129751 769-40 | JULY TAILS 2017 | 129748 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | <0.01 | <0.01 | 0.02 | 0.01 |
| | Molybdenum (Mo) (ppm) | | 7.40 | 2.36 | 0.63 | 2.69 | 0.95 |
| | Nickel (Ni) (ppm) | | 2.6 | 2.3 | 5.0 | 3.4 | 2.1 |
| | Niobium (Nb) (ppm) | | 0.19 | 0.12 | 0.14 | 0.20 | 0.08 |
| | Phosphorus (P) (ppm) | | 720 | 670 | 730 | 700 | 710 |
| | Potassium (K) (%) | | 0.51 | 0.43 | 0.55 | 0.46 | 0.24 |
| | Rhenium (Re) (ppm) | | 0.021 | 0.003 | <0.001 | 0.002 | 0.001 |
| | Rubidium (Rb) (ppm) | | 27.3 | 22.2 | 27.3 | 25.3 | 13.2 |
| | Scandium (Sc) (ppm) | | 4.1 | 5.1 | 4.4 | 3.9 | 6.7 |
| | Selenium (Se) (ppm) | | 0.5 | 0.9 | 0.4 | 3.1 | 0.9 |
| | Silver (Ag) (ppm) | | 0.16 | 0.30 | 0.05 | 1.38 | 0.24 |
| | Sodium (Na) (%) | | 0.07 | 0.06 | 0.09 | 0.05 | 0.05 |
| | Strontium (Sr) (ppm) | | 119.5 | 61.5 | 40.8 | 65.8 | 78.3 |
| | Sulfur (S) (%) | | 0.05 | 0.03 | 0.01 | 0.16 | 0.01 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.03 | 0.07 | 0.01 | 0.39 | 0.02 |
| | Thallium (Tl) (ppm) | | 0.16 | 0.13 | 0.16 | 0.17 | 0.07 |
| | Thorium (Th) (ppm) | | 3.7 | 2.6 | 2.1 | 3.7 | 4.4 |
| | Tin (Sn) (ppm) | | 0.7 | 0.6 | 0.6 | 0.8 | 0.7 |
| | Titanium (Ti) (%) | | 0.083 | 0.069 | 0.099 | 0.085 | 0.031 |
| | Tungsten (W) (ppm) | | 0.40 | 0.36 | 0.47 | 0.09 | 0.17 |
| | Uranium (U) (ppm) | | 0.73 | 0.20 | 0.20 | 0.42 | 0.28 |
| | Vanadium (V) (ppm) | | 51 | 47 | 50 | 69 | 49 |
| | Yttrium (Y) (ppm) | | 6.79 | 9.05 | 8.92 | 5.28 | 8.78 |
| | Zinc (Zn) (ppm) | | 69 | 74 | 66 | 107 | 79 |
| | Zirconium (Zr) (ppm) | | 1.0 | 0.8 | 1.8 | 1.0 | 1.1 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 1.9 | 0.7 | <0.2 | 0.7 | 1.4 |
| Miscellaneous | Carbon (C) (%) | | 0.62 | 0.24 | 0.07 | 0.24 | 0.45 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L1980572-6 Waste 04-AUG-17 129749 | L1980572-7 Waste 06-AUG-17 128153 | L1980572-8 Waste 06-AUG-17 128152 | L1980572-9 Waste 10-AUG-17 128154 | L1980572-10 Waste 10-AUG-17 128155 763-35 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | 7.62 | 1.39 | 2.19 | 1.09 | 0.51 |
| | Nickel (Ni) (ppm) | 2.2 | 3.5 | 2.7 | 2.7 | 2.4 |
| | Niobium (Nb) (ppm) | <0.05 | 0.38 | 0.18 | 0.10 | 0.13 |
| | Phosphorus (P) (ppm) | 1020 | 780 | 860 | 710 | 600 |
| | Potassium (K) (%) | 0.11 | 0.86 | 0.52 | 0.31 | 0.40 |
| | Rhenium (Re) (ppm) | 0.027 | 0.001 | 0.002 | 0.002 | 0.001 |
| | Rubidium (Rb) (ppm) | 6.2 | 47.4 | 29.2 | 14.8 | 18.7 |
| | Scandium (Sc) (ppm) | 4.6 | 3.7 | 5.0 | 4.9 | 3.6 |
| | Selenium (Se) (ppm) | 0.8 | 2.1 | 3.1 | 1.0 | 1.0 |
| | Silver (Ag) (ppm) | 0.30 | 0.66 | 1.54 | 0.20 | 0.34 |
| | Sodium (Na) (%) | 0.04 | 0.07 | 0.04 | 0.07 | 0.05 |
| | Strontium (Sr) (ppm) | 65.1 | 27.7 | 52.0 | 84.1 | 64.6 |
| | Sulfur (S) (%) | 0.06 | 0.04 | 0.02 | 0.07 | 0.04 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.04 | 0.21 | 0.18 | 0.04 | 0.09 |
| | Thallium (Tl) (ppm) | 0.04 | 0.35 | 0.19 | 0.08 | 0.11 |
| | Thorium (Th) (ppm) | 8.2 | 5.7 | 6.1 | 2.7 | 2.2 |
| | Tin (Sn) (ppm) | 1.0 | 0.7 | 0.7 | 0.6 | 0.5 |
| | Titanium (Ti) (%) | 0.006 | 0.144 | 0.084 | 0.048 | 0.066 |
| | Tungsten (W) (ppm) | 0.30 | 0.98 | 0.50 | 0.69 | 0.68 |
| | Uranium (U) (ppm) | 1.05 | 0.22 | 0.50 | 0.31 | 0.28 |
| | Vanadium (V) (ppm) | 55 | 59 | 59 | 47 | 42 |
| | Yttrium (Y) (ppm) | 11.90 | 4.65 | 9.23 | 9.05 | 7.29 |
| | Zinc (Zn) (ppm) | 52 | 88 | 84 | 71 | 69 |
| | Zirconium (Zr) (ppm) | 1.4 | 0.6 | 1.5 | 0.8 | 0.6 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.3 | 0.2 | 0.9 | 1.2 | 0.9 |
| Miscellaneous | Carbon (C) (%) | 0.47 | 0.10 | 0.30 | 0.43 | 0.31 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1980572-11 | L1980572-12 | L1980572-13 | L1980572-14 | L1980572-15 |
|------------------------|--------------------------|--------------|---------------|---------------|----------------|---------------|---------------|
| | | Description | Waste | Waste | Waste | Waste | Waste |
| | | Sampled Date | 10-AUG-17 | 10-AUG-17 | 11-AUG-17 | 08-AUG-17 | 08-AUG-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 128156 763-35 | 128157 763-35 | 128158 763-36B | 128161 763-34 | 128160 763-34 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | <0.01 | 0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | | 0.30 | 5.66 | 0.61 | 0.65 | 0.57 |
| | Nickel (Ni) (ppm) | | 2.4 | 3.1 | 2.6 | 2.0 | 2.7 |
| | Niobium (Nb) (ppm) | | 0.09 | 0.05 | 0.22 | <0.05 | <0.05 |
| | Phosphorus (P) (ppm) | | 580 | 670 | 860 | 550 | 610 |
| | Potassium (K) (%) | | 0.26 | 0.25 | 0.92 | 0.13 | 0.14 |
| | Rhenium (Re) (ppm) | | <0.001 | 0.002 | <0.001 | 0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | | 13.3 | 12.0 | 46.2 | 7.3 | 7.4 |
| | Scandium (Sc) (ppm) | | 2.7 | 3.8 | 4.1 | 3.0 | 2.6 |
| | Selenium (Se) (ppm) | | 1.2 | 1.3 | 2.2 | 1.1 | 1.1 |
| | Silver (Ag) (ppm) | | 0.53 | 0.40 | 0.87 | 0.30 | 0.87 |
| | Sodium (Na) (%) | | 0.06 | 0.04 | 0.08 | 0.03 | 0.05 |
| | Strontium (Sr) (ppm) | | 63.6 | 83.0 | 73.2 | 61.0 | 307 |
| | Sulfur (S) (%) | | 0.06 | 0.09 | 0.11 | 0.07 | 0.05 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.14 | 0.09 | 0.12 | 0.06 | 0.33 |
| | Thallium (Tl) (ppm) | | 0.07 | 0.07 | 0.27 | 0.04 | 0.04 |
| | Thorium (Th) (ppm) | | 2.8 | 3.4 | 2.3 | 2.9 | 2.5 |
| | Tin (Sn) (ppm) | | 0.4 | 0.6 | 0.7 | 0.4 | 0.4 |
| | Titanium (Ti) (%) | | 0.044 | 0.033 | 0.176 | 0.006 | 0.009 |
| | Tungsten (W) (ppm) | | 0.67 | 0.41 | 0.34 | 0.25 | 0.36 |
| | Uranium (U) (ppm) | | 0.37 | 0.24 | 0.17 | 0.24 | 0.43 |
| | Vanadium (V) (ppm) | | 43 | 44 | 67 | 31 | 33 |
| | Yttrium (Y) (ppm) | | 5.61 | 6.10 | 5.96 | 5.24 | 6.21 |
| | Zinc (Zn) (ppm) | | 82 | 81 | 90 | 62 | 74 |
| | Zirconium (Zr) (ppm) | | 0.5 | 0.6 | 2.4 | 0.5 | 1.0 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 1.0 | 1.3 | 1.2 | 1.5 | 4.7 |
| Miscellaneous | Carbon (C) (%) | | 0.33 | 0.46 | 0.43 | 0.50 | 1.44 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1980572-16 | L1980572-17 | L1980572-18 | L1980572-19 |
|------------------------|--------------------------|--------------|---------------|---------------|---------------|---------------|
| | | Description | Waste | Waste | Waste | Waste |
| | | Sampled Date | 14-AUG-17 | 15-AUG-17 | 17-AUG-17 | 17-AUG-17 |
| | | Sampled Time | | | | |
| | | Client ID | 128159 763-37 | 128162 763-39 | 128163 763-38 | 128164 763-38 |
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | | 2.96 | 0.96 | 2.14 | 0.64 |
| | Nickel (Ni) (ppm) | | 2.4 | 2.1 | 2.2 | 2.5 |
| | Niobium (Nb) (ppm) | | 0.06 | 0.12 | 0.08 | 0.08 |
| | Phosphorus (P) (ppm) | | 700 | 860 | 820 | 640 |
| | Potassium (K) (%) | | 0.23 | 0.63 | 0.25 | 0.39 |
| | Rhenium (Re) (ppm) | | 0.009 | 0.001 | 0.003 | <0.001 |
| | Rubidium (Rb) (ppm) | | 12.7 | 40.4 | 12.2 | 19.0 |
| | Scandium (Sc) (ppm) | | 3.7 | 4.8 | 3.5 | 4.1 |
| | Selenium (Se) (ppm) | | 0.5 | 0.9 | 5.8 | 0.4 |
| | Silver (Ag) (ppm) | | 0.19 | 0.22 | 4.10 | 0.04 |
| | Sodium (Na) (%) | | 0.05 | 0.05 | 0.03 | 0.08 |
| | Strontium (Sr) (ppm) | | 92.0 | 62.5 | 116.0 | 100.5 |
| | Sulfur (S) (%) | | 0.03 | 0.01 | 0.20 | <0.01 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.02 | 0.03 | 0.74 | 0.02 |
| | Thallium (Tl) (ppm) | | 0.08 | 0.29 | 0.07 | 0.10 |
| | Thorium (Th) (ppm) | | 4.7 | 5.6 | 3.4 | 2.5 |
| | Tin (Sn) (ppm) | | 0.5 | 0.6 | 0.5 | 0.5 |
| | Titanium (Ti) (%) | | 0.028 | 0.096 | 0.033 | 0.063 |
| | Tungsten (W) (ppm) | | 0.35 | 0.41 | 0.30 | 0.52 |
| | Uranium (U) (ppm) | | 0.57 | 0.56 | 0.39 | 0.17 |
| | Vanadium (V) (ppm) | | 40 | 58 | 52 | 47 |
| | Yttrium (Y) (ppm) | | 8.02 | 9.93 | 6.39 | 7.59 |
| | Zinc (Zn) (ppm) | | 62 | 90 | 97 | 71 |
| | Zirconium (Zr) (ppm) | | 1.0 | 1.6 | 1.7 | 0.7 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 1.9 | 0.9 | 3.1 | 1.2 |
| Miscellaneous | Carbon (C) (%) | | 0.59 | 0.31 | 1.01 | 0.41 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-26 17-27

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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 Account: APN

CERTIFICATE VA17186398

Project: L1980572

This report is for 19 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 1-SEP-2017.

The following have access to data associated with this certificate:

| | | |
|------------------|-------------|--|
| ALSEV DATASUBLET | SHANE STACK | |
|------------------|-------------|--|

| SAMPLE PREPARATION | |
|---------------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|------------------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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Project: L1980572

CERTIFICATE OF ANALYSIS VA17186398

| Sample Description | Method | WEI-21 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | S-IR08 | S-CAL06a | C-GAS05 | C-GAS05 | S-GRA06a | C-IR07 | S-GRA06 | ME-MS41 |
|----------------------------|---------|-----------|------------|------------|------------|-----------|-----------|----------|--------|----------|---------|---------|----------|--------|---------|---------|
| | Analyte | Recvd Wt. | FIZZ RAT | MPA | NNP | NP | Ratio (N | pH | S | S | C | CO2 | S | C | S | Ag |
| LOR | kg | Unity | tCaCO3/1Kt | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | Unity | % | % | % | % | % | % | % | ppm |
| L1980572-1 129747 769-42 | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 |
| L1980572-2 129750 769-40 | | 1.08 | 2 | 1.6 | 37 | 39 | 24.96 | 9.2 | 0.05 | 0.05 | 0.52 | 1.9 | <0.01 | 0.62 | <0.01 | 0.16 |
| L1980572-3 129751 769-40 | | 1.10 | 1 | 0.6 | 21 | 22 | 35.20 | 8.9 | 0.02 | 0.02 | 0.19 | 0.7 | <0.01 | 0.24 | <0.01 | 0.30 |
| L1980572-4 JULY TAILS 2017 | | 1.10 | 1 | 0.6 | 10 | 11 | 17.60 | 8.9 | 0.02 | 0.02 | <0.05 | <0.2 | <0.01 | 0.07 | <0.01 | 0.05 |
| L1980572-5 129748 | | 1.12 | 2 | 4.7 | 13 | 18 | 3.84 | 8.1 | 0.15 | 0.07 | 0.19 | 0.7 | 0.08 | 0.24 | 0.05 | 1.38 |
| L1980572-6 129749 | | 1.10 | 2 | 0.6 | 29 | 30 | 48.00 | 8.9 | 0.02 | 0.02 | 0.38 | 1.4 | <0.01 | 0.45 | <0.01 | 0.24 |
| L1980572-7 128153 | | 1.06 | 2 | 1.6 | 26 | 28 | 17.92 | 8.9 | 0.05 | 0.04 | 0.35 | 1.3 | 0.01 | 0.47 | <0.01 | 0.30 |
| L1980572-8 128152 | | 1.14 | 1 | 1.3 | 9 | 10 | 8.00 | 9.1 | 0.04 | 0.04 | 0.06 | 0.2 | <0.01 | 0.10 | <0.01 | 0.66 |
| L1980572-9 128154 | | 1.14 | 2 | 0.9 | 24 | 25 | 26.67 | 8.7 | 0.03 | 0.03 | 0.25 | 0.9 | <0.01 | 0.30 | <0.01 | 1.54 |
| L1980572-10 128155 763-35 | | 1.10 | 2 | 2.2 | 31 | 33 | 15.09 | 8.8 | 0.07 | 0.07 | 0.34 | 1.2 | <0.01 | 0.43 | 0.01 | 0.20 |
| L1980572-11 128156 763-35 | | 1.10 | 2 | 0.9 | 25 | 26 | 27.73 | 9.1 | 0.03 | 0.03 | 0.24 | 0.9 | <0.01 | 0.31 | <0.01 | 0.34 |
| L1980572-12 128157 763-35 | | 1.08 | 2 | 1.9 | 27 | 29 | 15.47 | 9.1 | 0.06 | 0.06 | 0.28 | 1.0 | <0.01 | 0.33 | 0.01 | 0.53 |
| L1980572-13 128158 763-36B | | 1.08 | 2 | 2.5 | 32 | 34 | 13.60 | 8.7 | 0.08 | 0.06 | 0.36 | 1.3 | 0.02 | 0.46 | <0.01 | 0.40 |
| L1980572-14 128161 763-34 | | 1.08 | 2 | 3.4 | 25 | 28 | 8.15 | 9.1 | 0.11 | 0.11 | 0.33 | 1.2 | <0.01 | 0.43 | <0.01 | 0.87 |
| L1980572-15 128160 763-34 | | 1.06 | 2 | 2.2 | 35 | 37 | 16.91 | 8.8 | 0.07 | 0.07 | 0.40 | 1.5 | <0.01 | 0.50 | <0.01 | 0.30 |
| L1980572-16 128159 763-37 | | 1.06 | 3 | 1.9 | 94 | 96 | 51.20 | 8.9 | 0.06 | 0.05 | 1.29 | 4.7 | 0.01 | 1.44 | <0.01 | 0.87 |
| L1980572-17 128162 763-39 | | 1.08 | 2 | 0.9 | 36 | 37 | 39.47 | 9.0 | 0.03 | 0.03 | 0.51 | 1.9 | <0.01 | 0.59 | <0.01 | 0.19 |
| L1980572-18 128163 763-38 | | 1.06 | 2 | 0.6 | 22 | 23 | 36.80 | 9.0 | 0.02 | 0.02 | 0.23 | 0.9 | <0.01 | 0.31 | <0.01 | 0.22 |
| L1980572-19 128164 763-38 | | 1.08 | 2 | 4.4 | 46 | 50 | 11.43 | 8.7 | 0.14 | 0.13 | 0.84 | 3.1 | 0.01 | 1.01 | <0.01 | 4.10 |
| L1980572-19 128164 763-38 | | 1.00 | 2 | 0.3 | 31 | 31 | 99.20 | 9.0 | 0.01 | <0.01 | 0.33 | 1.2 | 0.01 | 0.41 | <0.01 | 0.04 |



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CERTIFICATE OF ANALYSIS VA17186398

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|-------------------------|---------|-----------|-----------|----------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|---------|
| | Analyte Units LOR | Al % | As ppm | Au ppm | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % |
| L1980572-1 129747 769-42 | | 1.05 | 0.8 | <0.02 | <10 | 260 | 0.26 | 0.09 | 1.38 | 0.07 | 28.2 | 5.5 | 5 | 0.52 | 472 | 2.40 |
| L1980572-2 129750 769-40 | | 1.01 | 2.1 | 0.03 | <10 | 220 | 0.29 | 0.13 | 0.81 | 0.18 | 24.3 | 5.7 | 5 | 0.39 | 1245 | 2.31 |
| L1980572-3 129751 769-40 | | 1.15 | 0.8 | <0.02 | <10 | 230 | 0.26 | 0.03 | 0.52 | 0.13 | 22.7 | 6.0 | 7 | 0.35 | 432 | 2.22 |
| L1980572-4 JULY TAILS 2017 | | 0.96 | 1.3 | 0.23 | <10 | 200 | 0.20 | 0.58 | 0.74 | 0.57 | 18.20 | 8.1 | 6 | 0.41 | 4730 | 4.20 |
| L1980572-5 129748 | | 0.64 | 2.1 | <0.02 | <10 | 100 | 0.35 | 0.04 | 1.04 | 0.10 | 36.6 | 6.0 | 4 | 0.59 | 524 | 2.38 |
| L1980572-6 129749 | | 1.09 | 1.7 | <0.02 | <10 | 70 | 0.29 | 0.16 | 1.06 | 0.05 | 41.5 | 5.4 | 3 | 0.23 | 593 | 2.74 |
| L1980572-7 128153 | | 1.32 | 1.5 | 0.04 | <10 | 300 | 0.18 | 0.36 | 0.34 | 0.09 | 37.1 | 6.8 | 5 | 0.64 | 4760 | 2.82 |
| L1980572-8 128152 | | 1.08 | 0.7 | 0.08 | <10 | 240 | 0.32 | 0.67 | 0.92 | 0.26 | 32.2 | 6.7 | 4 | 0.52 | 4940 | 3.14 |
| L1980572-9 128154 | | 1.15 | 1.0 | 0.02 | <10 | 180 | 0.34 | 0.11 | 1.36 | 0.11 | 24.2 | 6.0 | 6 | 0.45 | 834 | 2.44 |
| L1980572-10 128155 763-35 | | 0.94 | 2.0 | 0.03 | <10 | 190 | 0.25 | 0.13 | 0.99 | 0.08 | 19.70 | 5.1 | 5 | 0.34 | 498 | 2.11 |
| L1980572-11 128156 763-35 | | 1.12 | 0.9 | 0.07 | <10 | 130 | 0.34 | 0.16 | 1.16 | 0.16 | 23.2 | 6.0 | 5 | 0.39 | 824 | 2.58 |
| L1980572-12 128157 763-35 | | 1.01 | 0.9 | 0.02 | <10 | 140 | 0.28 | 0.09 | 1.29 | 0.09 | 29.2 | 5.8 | 11 | 0.29 | 1245 | 2.64 |
| L1980572-13 128158 763-36B | | 1.35 | 0.6 | 0.09 | <10 | 470 | 0.25 | 0.19 | 1.17 | 0.12 | 21.4 | 7.6 | 6 | 0.62 | 3150 | 3.02 |
| L1980572-14 128161 763-34 | | 0.90 | 1.2 | 0.04 | <10 | 70 | 0.25 | 0.10 | 1.48 | 0.08 | 26.5 | 4.7 | 4 | 0.34 | 884 | 1.97 |
| L1980572-15 128160 763-34 | | 0.73 | 1.7 | 0.02 | <10 | 70 | 0.37 | 0.11 | 2.89 | 0.10 | 22.6 | 5.3 | 4 | 0.36 | 823 | 2.18 |
| L1980572-16 128159 763-37 | | 0.81 | 0.9 | <0.02 | <10 | 100 | 0.26 | 0.07 | 1.31 | 0.06 | 31.7 | 5.6 | 4 | 0.37 | 384 | 2.20 |
| L1980572-17 128162 763-39 | | 0.95 | 0.9 | 0.05 | <10 | 180 | 0.23 | 0.07 | 0.82 | 0.09 | 32.5 | 6.2 | 5 | 0.58 | 523 | 2.54 |
| L1980572-18 128163 763-38 | | 0.58 | 1.8 | 0.21 | <10 | 190 | 0.30 | 1.13 | 1.39 | 0.28 | 25.7 | 7.0 | 4 | 0.29 | 6470 | 3.26 |
| L1980572-19 128164 763-38 | | 1.05 | 0.9 | <0.02 | <10 | 200 | 0.32 | 0.02 | 1.16 | 0.07 | 24.6 | 5.8 | 5 | 0.38 | 178.5 | 2.34 |



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 100 - 8081 LOUGHEED HWY.
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Project: L1980572

CERTIFICATE OF ANALYSIS VA17186398

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|-------------------------|-----------|-----------|-----------|-----------|-----------|---------|-----------|-----------|---------|-----------|-----------|---------|-----------|-----------|----------|
| | Analyte Units LOR | Ga ppm | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm |
| L1980572-1 129747 769-42 | | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 |
| L1980572-2 129750 769-40 | | 5.44 | 0.06 | 0.04 | <0.01 | 0.038 | 0.51 | 15.4 | 5.9 | 0.74 | 525 | 7.40 | 0.07 | 0.19 | 2.6 | 720 |
| L1980572-3 129751 769-40 | | 5.36 | 0.05 | 0.05 | <0.01 | 0.038 | 0.43 | 12.5 | 5.8 | 0.57 | 670 | 2.36 | 0.06 | 0.12 | 2.3 | 670 |
| L1980572-4 JULY TAILS 2017 | | 5.49 | 0.08 | 0.10 | <0.01 | 0.021 | 0.55 | 11.5 | 6.8 | 0.64 | 623 | 0.63 | 0.09 | 0.14 | 5.0 | 730 |
| L1980572-5 129748 | | 6.84 | 0.07 | 0.04 | 0.02 | 0.110 | 0.46 | 9.1 | 4.9 | 0.54 | 659 | 2.69 | 0.05 | 0.20 | 3.4 | 700 |
| L1980572-6 129749 | | 3.77 | 0.06 | 0.04 | 0.01 | 0.050 | 0.24 | 20.1 | 2.9 | 0.36 | 619 | 0.95 | 0.05 | 0.08 | 2.1 | 710 |
| L1980572-7 128153 | | 6.56 | 0.06 | 0.06 | <0.01 | 0.088 | 0.11 | 22.8 | 9.1 | 0.82 | 437 | 7.62 | 0.04 | <0.05 | 2.2 | 1020 |
| L1980572-8 128152 | | 6.98 | 0.07 | 0.03 | 0.01 | 0.050 | 0.86 | 19.7 | 6.6 | 0.71 | 698 | 1.39 | 0.07 | 0.38 | 3.5 | 780 |
| L1980572-9 128154 | | 6.44 | 0.09 | 0.08 | <0.01 | 0.080 | 0.52 | 17.2 | 5.6 | 0.60 | 672 | 2.19 | 0.04 | 0.18 | 2.7 | 860 |
| L1980572-10 128155 763-35 | | 6.10 | 0.06 | 0.05 | <0.01 | 0.039 | 0.31 | 12.7 | 7.6 | 0.69 | 673 | 1.09 | 0.07 | 0.10 | 2.7 | 710 |
| L1980572-11 128156 763-35 | | 5.04 | 0.05 | 0.03 | <0.01 | 0.030 | 0.40 | 9.4 | 5.4 | 0.58 | 512 | 0.51 | 0.05 | 0.13 | 2.4 | 600 |
| L1980572-12 128157 763-35 | | 6.49 | 0.06 | 0.03 | <0.01 | 0.020 | 0.26 | 11.8 | 8.3 | 0.71 | 589 | 0.30 | 0.06 | 0.09 | 2.4 | 580 |
| L1980572-13 128158 763-36B | | 5.99 | 0.05 | 0.03 | <0.01 | 0.034 | 0.25 | 15.5 | 6.9 | 0.68 | 590 | 5.66 | 0.04 | 0.05 | 3.1 | 670 |
| L1980572-14 128161 763-34 | | 6.33 | 0.08 | 0.08 | 0.01 | 0.052 | 0.92 | 10.5 | 5.5 | 0.73 | 701 | 0.61 | 0.08 | 0.22 | 2.6 | 860 |
| L1980572-15 128160 763-34 | | 5.38 | <0.05 | 0.02 | <0.01 | 0.027 | 0.13 | 13.7 | 6.3 | 0.55 | 461 | 0.65 | 0.03 | <0.05 | 2.0 | 550 |
| L1980572-16 128159 763-37 | | 4.61 | 0.05 | 0.03 | <0.01 | 0.031 | 0.14 | 11.6 | 3.9 | 0.99 | 586 | 0.57 | 0.05 | <0.05 | 2.7 | 610 |
| L1980572-17 128162 763-39 | | 4.83 | 0.05 | 0.04 | <0.01 | 0.031 | 0.23 | 17.4 | 4.8 | 0.59 | 512 | 2.96 | 0.05 | 0.06 | 2.4 | 700 |
| L1980572-18 128163 763-38 | | 5.05 | 0.07 | 0.08 | <0.01 | 0.038 | 0.63 | 17.4 | 4.3 | 0.60 | 605 | 0.96 | 0.05 | 0.12 | 2.1 | 860 |
| L1980572-19 128164 763-38 | | 3.72 | 0.06 | 0.05 | <0.01 | 0.058 | 0.25 | 13.7 | 2.4 | 0.69 | 671 | 2.14 | 0.03 | 0.08 | 2.2 | 820 |
| | | 5.65 | 0.05 | 0.04 | <0.01 | 0.025 | 0.39 | 13.1 | 6.1 | 0.69 | 621 | 0.64 | 0.08 | 0.08 | 2.5 | 640 |



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CERTIFICATE OF ANALYSIS VA17186398

| Sample Description | Method Analyte Units LOR | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Tl % | ME-MS41 Tl ppm | ME-MS41 U ppm |
|----------------------------|--------------------------|----------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|
| L1980572-1 129747 769-42 | | 3.0 | 27.3 | 0.021 | 0.05 | 0.05 | 4.1 | 0.5 | 0.7 | 119.5 | <0.01 | 0.03 | 3.7 | 0.083 | 0.16 | 0.73 |
| L1980572-2 129750 769-40 | | 2.6 | 22.2 | 0.003 | 0.03 | 0.05 | 5.1 | 0.9 | 0.6 | 61.5 | <0.01 | 0.07 | 2.6 | 0.069 | 0.13 | 0.20 |
| L1980572-3 129751 769-40 | | 1.7 | 27.3 | <0.001 | 0.01 | <0.05 | 4.4 | 0.4 | 0.6 | 40.8 | <0.01 | 0.01 | 2.1 | 0.099 | 0.16 | 0.20 |
| L1980572-4 JULY TAILS 2017 | | 9.3 | 25.3 | 0.002 | 0.16 | 0.05 | 3.9 | 3.1 | 0.8 | 65.8 | <0.01 | 0.39 | 3.7 | 0.085 | 0.17 | 0.42 |
| L1980572-5 129748 | | 3.2 | 13.2 | 0.001 | 0.01 | <0.05 | 6.7 | 0.9 | 0.7 | 78.3 | <0.01 | 0.02 | 4.4 | 0.031 | 0.07 | 0.28 |
| L1980572-6 129749 | | 5.4 | 6.2 | 0.027 | 0.06 | 0.15 | 4.6 | 0.8 | 1.0 | 65.1 | <0.01 | 0.04 | 8.2 | 0.006 | 0.04 | 1.05 |
| L1980572-7 128153 | | 2.9 | 47.4 | 0.001 | 0.04 | <0.05 | 3.7 | 2.1 | 0.7 | 27.7 | <0.01 | 0.21 | 5.7 | 0.144 | 0.35 | 0.22 |
| L1980572-8 128152 | | 3.5 | 29.2 | 0.002 | 0.02 | <0.05 | 5.0 | 3.1 | 0.7 | 52.0 | <0.01 | 0.18 | 6.1 | 0.084 | 0.19 | 0.50 |
| L1980572-9 128154 | | 3.1 | 14.8 | 0.002 | 0.07 | <0.05 | 4.9 | 1.0 | 0.6 | 84.1 | <0.01 | 0.04 | 2.7 | 0.048 | 0.08 | 0.31 |
| L1980572-10 128155 763-35 | | 3.3 | 18.7 | 0.001 | 0.04 | 0.11 | 3.6 | 1.0 | 0.5 | 64.6 | <0.01 | 0.09 | 2.2 | 0.066 | 0.11 | 0.28 |
| L1980572-11 128156 763-35 | | 3.6 | 13.3 | <0.001 | 0.06 | <0.05 | 2.7 | 1.2 | 0.4 | 63.6 | <0.01 | 0.14 | 2.8 | 0.044 | 0.07 | 0.37 |
| L1980572-12 128157 763-35 | | 2.7 | 12.0 | 0.002 | 0.09 | <0.05 | 3.8 | 1.3 | 0.6 | 83.0 | <0.01 | 0.09 | 3.4 | 0.033 | 0.07 | 0.24 |
| L1980572-13 128158 763-36B | | 2.3 | 46.2 | <0.001 | 0.11 | <0.05 | 4.1 | 2.2 | 0.7 | 73.2 | <0.01 | 0.12 | 2.3 | 0.176 | 0.27 | 0.17 |
| L1980572-14 128161 763-34 | | 3.4 | 7.3 | 0.001 | 0.07 | 0.08 | 3.0 | 1.1 | 0.4 | 61.0 | <0.01 | 0.06 | 2.9 | 0.006 | 0.04 | 0.24 |
| L1980572-15 128160 763-34 | | 3.6 | 7.4 | 0.001 | 0.05 | 0.10 | 2.6 | 1.1 | 0.4 | 307 | <0.01 | 0.33 | 2.5 | 0.009 | 0.04 | 0.43 |
| L1980572-16 128159 763-37 | | 3.0 | 12.7 | 0.009 | 0.03 | <0.05 | 3.7 | 0.5 | 0.5 | 92.0 | <0.01 | 0.02 | 4.7 | 0.028 | 0.08 | 0.57 |
| L1980572-17 128162 763-39 | | 2.5 | 40.4 | 0.001 | 0.01 | <0.05 | 4.8 | 0.9 | 0.6 | 62.5 | <0.01 | 0.03 | 5.6 | 0.096 | 0.29 | 0.56 |
| L1980572-18 128163 763-38 | | 4.2 | 12.2 | 0.003 | 0.20 | <0.05 | 3.5 | 5.8 | 0.5 | 116.0 | <0.01 | 0.74 | 3.4 | 0.033 | 0.07 | 0.39 |
| L1980572-19 128164 763-38 | | 2.7 | 19.0 | <0.001 | <0.01 | <0.05 | 4.1 | 0.4 | 0.5 | 100.5 | <0.01 | 0.02 | 2.5 | 0.063 | 0.10 | 0.17 |



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CERTIFICATE OF ANALYSIS VA17186398

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|----------------------------|---------|---------|---------|---------|---------|---------|
| | Analyte | V | W | Y | Zn | Zr |
| Units | | ppm | ppm | ppm | ppm | ppm |
| LOR | | 1 | 0.05 | 0.05 | 2 | 0.5 |
| L1980572-1 129747 769-42 | | 51 | 0.40 | 6.79 | 69 | 1.0 |
| L1980572-2 129750 769-40 | | 47 | 0.36 | 9.05 | 74 | 0.8 |
| L1980572-3 129751 769-40 | | 50 | 0.47 | 8.92 | 66 | 1.8 |
| L1980572-4 JULY TAILS 2017 | | 69 | 0.09 | 5.28 | 107 | 1.0 |
| L1980572-5 129748 | | 49 | 0.17 | 8.78 | 79 | 1.1 |
| L1980572-6 129749 | | 55 | 0.30 | 11.90 | 52 | 1.4 |
| L1980572-7 128153 | | 59 | 0.98 | 4.65 | 88 | 0.6 |
| L1980572-8 128152 | | 59 | 0.50 | 9.23 | 84 | 1.5 |
| L1980572-9 128154 | | 47 | 0.69 | 9.05 | 71 | 0.8 |
| L1980572-10 128155 763-35 | | 42 | 0.68 | 7.29 | 69 | 0.6 |
| L1980572-11 128156 763-35 | | 43 | 0.67 | 5.61 | 82 | 0.5 |
| L1980572-12 128157 763-35 | | 44 | 0.41 | 6.10 | 81 | 0.6 |
| L1980572-13 128158 763-36B | | 67 | 0.34 | 5.96 | 90 | 2.4 |
| L1980572-14 128161 763-34 | | 31 | 0.25 | 5.24 | 62 | 0.5 |
| L1980572-15 128160 763-34 | | 33 | 0.36 | 6.21 | 74 | 1.0 |
| L1980572-16 128159 763-37 | | 40 | 0.35 | 8.02 | 62 | 1.0 |
| L1980572-17 128162 763-39 | | 58 | 0.41 | 9.93 | 90 | 1.6 |
| L1980572-18 128163 763-38 | | 52 | 0.30 | 6.39 | 97 | 1.7 |
| L1980572-19 128164 763-38 | | 47 | 0.52 | 7.59 | 71 | 0.7 |



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CERTIFICATE OF ANALYSIS VA17186398

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



Chain of Custody (COC) / Analytical Request Form



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|--|---|--|--------------|--|---|--|-----------------------|--|--|--|----------------------|--|--|--|--|--|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | Analysis Request | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | |
| PO / AFE: | TBD | Requisitioner: | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | |
| | | | | | | Composite | R | R | R | R | | | | | | | | |
| | 129747 | 769-42 | | 03-AUG-17 | | WASTE | X | X | X | X | X | | | | | | | |
| | 129750 | 769-40 | | 05/08/17 | | WASTE | X | X | X | X | X | | | | | | | |
| | 129751 | 769-40 | | 05/08/17 | | WASTE | X | X | X | X | X | | | | | | | |
| | JULY FAILS 2017 | | | 8/8/17 | | TAIL | X | X | X | X | X | | | | | | | |
| | 129748 | | | 04/AUG-17 | | WASTE | X | X | X | X | X | | | | | | | |
| | 129749 | | | 04-AUG-17 | | WASTE | X | X | X | X | X | | | | | | | |
| | 128153 | | | 06-AUG-17 | | WASTE | X | X | X | X | X | | | | | | | |
| | 128152 | | | 06-AUG-17 | | WASTE | X | X | X | X | X | | | | | | | |
| | 128154 | | | 10-AUG-17 | | WASTIG | X | X | X | X | X | | | | | | | |
| | # 128155 | 763-35 | | 10/8/17 | | WASTE | X | X | X | X | X | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | | INITIAL COOLER TEMPERATURES °C | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | |
| | | | | | | 15.0 | | | 3.4 4.2 | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | |
| Released by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | | | | | | | |
| Thomas Set | Aug. 18 17 | 9:50A | E14F | 24 Aug 2017 | 11:20 | MS | Aug 25 17 | 11:50 | | | | | | | | | | |

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OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DIV COC form



Chain of Custody (COC) / Analytical Request Form

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|--|---|---|----------|--------------------|--------------|--|--|--|-----------------------|-----------------------------|--|----------------------------|---|------------------------|--|--------------------|----------------------|
| Contact and company name below will appear on the final report | | Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | | <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | | Priority (Business Days) | | Regular [R] | | | EMERGENCY | | Standard TAT | | | | |
| Contact: Minto Environment - Coordinator | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 4 day [P4] | | 1 Business day [E1] | | | 3 day [P3] | | Same Day, Weekend or Statutory holiday [E0] | | | | |
| Phone: 1-604-759-4659 | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] | | Date and Time Required for all E&P TATs: | | | dd-mmm-yy hh:mm | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | | Analysis Request | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: TBD | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals-Aqua regia digestion (CP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MIEND 1991) | | | | | Number of Containers |
| | | | | | | Composite | R | R | R | R | R | R | | | | | |
| | 128156 | 763-35 | 10/08/17 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 128157 | 763-35 | 10/08/17 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 128158 | 763-36B | 11/08/17 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 128161 | 763-34 | 08/08/17 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 128160 | 763-34 | 08/08/17 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 128159 | 763-37 | 14/08/17 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 128162 | 763-39 | 15/08/17 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 128163 | 763-38 | 17/08/17 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 128164 | 763-38 | 17/08/17 | | | WASTE | X | X | X | X | X | X | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | |
| | | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | |
| | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | | | | | | |
| | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | |
| | | | | | | 15.0 | | | | | | | | | | | |
| | | | | | | 3.4 4.2 | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | |
| Released by: <i>Thom Sar</i> | | Date: <i>Aug. 18/17</i> | | Time: <i>9:50A</i> | | Received by: <i>EHF</i> | | Date: <i>24 Aug 2017</i> | | Time: <i>11:20</i> | | Received by: <i>MS</i> | | Date: <i>Aug 25/17</i> | | Time: <i>11:50</i> | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 01-SEP-17
Report Date: 22-NOV-17 16:33 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1985339
Project P.O. #: 227382
Job Reference:
C of C Numbers: 17 28
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1985339-1 Waste 12-AUG-17 128560 | L1985339-2 Waste 12-AUG-17 128561 | L1985339-3 Waste 12-AUG-17 128562 | L1985339-4 Waste 12-AUG-17 128563 | L1985339-5 Waste 12-AUG-17 128564 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 9.1 | 9.1 | 8.8 | 8.7 | 9.1 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.21 | 0.16 | 0.20 | 0.20 | 0.20 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 10.3 | 6.3 | 8.1 | 9.1 | 7.2 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 19 | 17 | 20 | 19 | 19 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 9 | 11 | 12 | 10 | 12 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 1.84 | 2.72 | 2.46 | 2.10 | 2.64 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | <0.01 | <0.01 | 0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | 0.03 | 0.03 | 0.05 | 0.03 | 0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | | | | |
| | 0.30 | 0.17 | 0.21 | 0.26 | 0.22 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.33 | 0.20 | 0.26 | 0.29 | 0.23 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.05 | 1.12 | 1.15 | 1.19 | 1.08 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.06 | 0.08 | 0.07 | 0.05 | 0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 0.6 | 0.9 | 0.8 | 0.8 | 0.8 |
| | Barium (Ba) (ppm) | | | | |
| | 240 | 250 | 270 | 260 | 240 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.19 | 0.21 | 0.22 | 0.20 | 0.19 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.77 | 0.54 | 0.40 | 0.68 | 0.51 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.46 | 0.17 | 0.24 | 0.22 | 0.19 |
| | Calcium (Ca) (%) | | | | |
| | 0.76 | 0.69 | 0.81 | 0.76 | 0.77 |
| | Cerium (Ce) (ppm) | | | | |
| | 20.7 | 21.6 | 24.5 | 23.9 | 21.9 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.31 | 0.33 | 0.32 | 0.32 | 0.31 |
| | Chromium (Cr) (ppm) | | | | |
| | 6 | 7 | 6 | 7 | 7 |
| | Cobalt (Co) (ppm) | | | | |
| | 5.5 | 5.3 | 5.7 | 5.6 | 5.2 |
| | Copper (Cu) (ppm) | | | | |
| | 5310 | 3120 | 3400 | 3850 | 3170 |
| | Gallium (Ga) (ppm) | | | | |
| | 5.81 | 5.59 | 5.73 | 6.00 | 5.56 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.07 | 0.07 | 0.08 | 0.08 | 0.08 |
| | Gold (Au) (ppm) | | | | |
| | 0.24 | 0.07 | 0.12 | 0.12 | 0.27 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 |
| | Indium (In) (ppm) | | | | |
| | 0.049 | 0.035 | 0.044 | 0.048 | 0.037 |
| | Iron (Fe) (%) | | | | |
| | 3.25 | 3.03 | 2.98 | 3.03 | 2.88 |
| | Lanthanum (La) (ppm) | | | | |
| | 11.2 | 11.5 | 13.0 | 12.7 | 11.6 |
| | Lead (Pb) (ppm) | | | | |
| | 2.3 | 2.1 | 2.3 | 2.1 | 2.1 |
| | Lithium (Li) (ppm) | | | | |
| | 5.0 | 5.0 | 5.3 | 5.6 | 5.0 |
| | Magnesium (Mg) (%) | | | | |
| | 0.58 | 0.56 | 0.62 | 0.63 | 0.57 |
| | Manganese (Mn) (ppm) | | | | |
| | 547 | 522 | 569 | 559 | 531 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L1985339-6 Waste 12-AUG-17 128565 | L1985339-7 Waste 12-AUG-17 128566 | L1985339-8 Waste 12-AUG-17 128567 | L1985339-9 Waste 12-AUG-17 128568 | L1985339-10 Waste 12-AUG-17 128569 |
|-------------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 9.1 | 9.0 | 9.0 | 9.1 | 9.1 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.21 | 0.20 | 0.23 | 0.18 | 0.18 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 7.5 | 9.1 | 8.4 | 7.5 | 8.1 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 19 | 20 | 22 | 19 | 19 |
| | NNP (tCaCO3/1Kt) | 12 | 11 | 14 | 12 | 11 |
| | Ratio (NP/MPA) (Unity) | 2.53 | 2.21 | 2.61 | 2.53 | 2.34 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | 0.01 | <0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.01 | 0.03 | 0.02 | 0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.23 | 0.26 | 0.25 | 0.23 | 0.26 |
| | Total Sulfur (combustion) (%) | 0.24 | 0.29 | 0.27 | 0.24 | 0.26 |
| Total Metals | Aluminum (Al) (%) | 1.15 | 1.11 | 1.15 | 1.09 | 1.13 |
| | Antimony (Sb) (ppm) | 0.07 | 0.14 | 0.08 | 0.11 | 0.05 |
| | Arsenic (As) (ppm) | 0.8 | 1.0 | 0.7 | 0.7 | 0.9 |
| | Barium (Ba) (ppm) | 240 | 250 | 250 | 240 | 240 |
| | Beryllium (Be) (ppm) | 0.23 | 0.22 | 0.21 | 0.20 | 0.21 |
| | Bismuth (Bi) (ppm) | 0.52 | 0.53 | 0.64 | 0.44 | 0.53 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.19 | 0.21 | 0.26 | 0.23 | 0.20 |
| | Calcium (Ca) (%) | 0.77 | 0.78 | 0.89 | 0.75 | 0.74 |
| | Cerium (Ce) (ppm) | 21.3 | 21.7 | 22.8 | 22.6 | 21.4 |
| | Cesium (Cs) (ppm) | 0.33 | 0.32 | 0.33 | 0.31 | 0.32 |
| | Chromium (Cr) (ppm) | 7 | 6 | 7 | 7 | 7 |
| | Cobalt (Co) (ppm) | 5.4 | 5.4 | 5.6 | 5.2 | 5.8 |
| | Copper (Cu) (ppm) | 3780 | 4280 | 3970 | 3490 | 3610 |
| | Gallium (Ga) (ppm) | 5.91 | 5.74 | 5.90 | 5.71 | 6.24 |
| | Germanium (Ge) (ppm) | 0.07 | 0.07 | 0.07 | 0.06 | 0.08 |
| | Gold (Au) (ppm) | 0.12 | 0.16 | 0.11 | 0.54 | 0.16 |
| | Hafnium (Hf) (ppm) | 0.04 | 0.03 | 0.04 | 0.04 | 0.04 |
| | Indium (In) (ppm) | 0.047 | 0.056 | 0.044 | 0.044 | 0.046 |
| | Iron (Fe) (%) | 3.09 | 3.03 | 3.09 | 2.91 | 2.97 |
| | Lanthanum (La) (ppm) | 11.3 | 11.9 | 12.0 | 12.2 | 11.6 |
| | Lead (Pb) (ppm) | 2.5 | 2.4 | 2.2 | 2.2 | 2.5 |
| | Lithium (Li) (ppm) | 5.2 | 5.2 | 5.2 | 5.1 | 5.3 |
| | Magnesium (Mg) (%) | 0.60 | 0.59 | 0.59 | 0.58 | 0.59 |
| | Manganese (Mn) (ppm) | 563 | 552 | 550 | 524 | 535 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1985339-1 Waste 12-AUG-17 128560 | L1985339-2 Waste 12-AUG-17 128561 | L1985339-3 Waste 12-AUG-17 128562 | L1985339-4 Waste 12-AUG-17 128563 | L1985339-5 Waste 12-AUG-17 128564 |
|------------------------|--------------------------|---|--|--|--|--|--|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | <0.01 | 0.01 | <0.01 | <0.01 | |
| | Molybdenum (Mo) (ppm) | 0.68 | 0.79 | 1.05 | 1.00 | 1.37 | |
| | Nickel (Ni) (ppm) | 1.7 | 1.9 | 1.8 | 1.8 | 1.7 | |
| | Niobium (Nb) (ppm) | 0.24 | 0.22 | 0.23 | 0.23 | 0.21 | |
| | Phosphorus (P) (ppm) | 540 | 570 | 620 | 620 | 570 | |
| | Potassium (K) (%) | 0.59 | 0.61 | 0.65 | 0.64 | 0.59 | |
| | Rhenium (Re) (ppm) | 0.002 | 0.001 | 0.001 | 0.002 | 0.003 | |
| | Rubidium (Rb) (ppm) | 27.8 | 28.1 | 29.7 | 29.6 | 28.2 | |
| | Scandium (Sc) (ppm) | 2.9 | 3.2 | 3.3 | 3.3 | 3.1 | |
| | Selenium (Se) (ppm) | 4.8 | 2.8 | 3.4 | 3.6 | 3.2 | |
| | Silver (Ag) (ppm) | 2.04 | 1.04 | 1.00 | 1.31 | 1.04 | |
| | Sodium (Na) (%) | 0.08 | 0.09 | 0.09 | 0.10 | 0.09 | |
| | Strontium (Sr) (ppm) | 64.0 | 62.5 | 74.6 | 71.9 | 63.4 | |
| | Sulfur (S) (%) | 0.36 | 0.21 | 0.27 | 0.29 | 0.24 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.34 | 0.17 | 0.20 | 0.24 | 0.22 | |
| | Thallium (Tl) (ppm) | 0.16 | 0.18 | 0.19 | 0.18 | 0.19 | |
| | Thorium (Th) (ppm) | 2.7 | 2.8 | 3.1 | 3.2 | 3.0 | |
| | Tin (Sn) (ppm) | 0.6 | 0.6 | 0.6 | 0.6 | 0.5 | |
| | Titanium (Ti) (%) | 0.113 | 0.113 | 0.121 | 0.120 | 0.108 | |
| | Tungsten (W) (ppm) | <0.05 | 0.05 | 0.05 | 0.18 | 0.07 | |
| | Uranium (U) (ppm) | 0.27 | 0.24 | 0.27 | 0.26 | 0.31 | |
| | Vanadium (V) (ppm) | 52 | 53 | 54 | 55 | 50 | |
| | Yttrium (Y) (ppm) | 3.97 | 4.26 | 5.18 | 4.61 | 4.33 | |
| | Zinc (Zn) (ppm) | 83 | 70 | 76 | 78 | 70 | |
| | Zirconium (Zr) (ppm) | 0.7 | 0.8 | 0.8 | 0.8 | 0.7 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.8 | 0.6 | 0.7 | 0.7 | 0.7 | |
| Miscellaneous | Carbon (C) (%) | 0.25 | 0.21 | 0.22 | 0.19 | 0.22 | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1985339-6 Waste 12-AUG-17 128565 | L1985339-7 Waste 12-AUG-17 128566 | L1985339-8 Waste 12-AUG-17 128567 | L1985339-9 Waste 12-AUG-17 128568 | L1985339-10 Waste 12-AUG-17 128569 |
|------------------------|--------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | 0.01 | <0.01 | <0.01 | 0.01 | |
| | Molybdenum (Mo) (ppm) | 0.56 | 0.75 | 1.25 | 1.24 | 0.95 | |
| | Nickel (Ni) (ppm) | 1.8 | 1.7 | 1.8 | 1.7 | 2.0 | |
| | Niobium (Nb) (ppm) | 0.22 | 0.27 | 0.25 | 0.21 | 0.26 | |
| | Phosphorus (P) (ppm) | 580 | 600 | 570 | 570 | 560 | |
| | Potassium (K) (%) | 0.61 | 0.61 | 0.63 | 0.59 | 0.61 | |
| | Rhenium (Re) (ppm) | <0.001 | 0.002 | 0.003 | 0.003 | 0.002 | |
| | Rubidium (Rb) (ppm) | 28.1 | 28.7 | 29.3 | 27.1 | 29.7 | |
| | Scandium (Sc) (ppm) | 3.4 | 3.4 | 3.3 | 3.2 | 3.5 | |
| | Selenium (Se) (ppm) | 3.2 | 3.7 | 3.7 | 2.9 | 3.7 | |
| | Silver (Ag) (ppm) | 1.20 | 1.34 | 1.30 | 1.19 | 1.14 | |
| | Sodium (Na) (%) | 0.11 | 0.09 | 0.10 | 0.08 | 0.09 | |
| | Strontium (Sr) (ppm) | 69.3 | 66.0 | 68.9 | 61.2 | 65.4 | |
| | Sulfur (S) (%) | 0.27 | 0.32 | 0.28 | 0.25 | 0.28 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.21 | 0.27 | 0.27 | 0.22 | 0.23 | |
| | Thallium (Tl) (ppm) | 0.19 | 0.19 | 0.19 | 0.17 | 0.18 | |
| | Thorium (Th) (ppm) | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | |
| | Tin (Sn) (ppm) | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | |
| | Titanium (Ti) (%) | 0.112 | 0.113 | 0.117 | 0.109 | 0.113 | |
| | Tungsten (W) (ppm) | 0.07 | 0.09 | <0.05 | 0.05 | <0.05 | |
| | Uranium (U) (ppm) | 0.25 | 0.22 | 0.28 | 0.27 | 0.32 | |
| | Vanadium (V) (ppm) | 52 | 52 | 54 | 51 | 51 | |
| | Yttrium (Y) (ppm) | 4.38 | 4.51 | 4.67 | 4.55 | 4.68 | |
| | Zinc (Zn) (ppm) | 74 | 75 | 76 | 71 | 75 | |
| | Zirconium (Zr) (ppm) | 0.8 | 0.8 | 0.8 | 0.7 | 0.8 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.8 | 0.8 | 0.9 | 0.7 | 0.7 | |
| Miscellaneous | Carbon (C) (%) | 0.23 | 0.24 | 0.28 | 0.21 | 0.21 | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17 28

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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 21-NOV-2017
 Account: APN

CERTIFICATE VA17194473

Project: L1985339
 P.O. No.: ALSM-CW16-102-APN
 This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 11-SEP-2017.
 The following have access to data associated with this certificate:

| | | |
|------------------|-------------|-------------|
| ALSEV DATASUBLET | SHANE RAMOS | SHANE STACK |
|------------------|-------------|-------------|

| SAMPLE PREPARATION | |
|---------------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|------------------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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Project: L1985339

CERTIFICATE OF ANALYSIS VA17194473

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm |
|--------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|
| L1985339-1 128560 | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 |
| L1985339-2 128561 | | 1.08 | 2 | 10.3 | 9 | 19 | 1.84 | 9.1 | 0.33 | 0.30 | 0.21 | 0.8 | 0.03 | 0.25 | <0.01 | 2.04 |
| L1985339-3 128562 | | 1.24 | 2 | 6.3 | 11 | 17 | 2.72 | 9.1 | 0.20 | 0.17 | 0.16 | 0.6 | 0.03 | 0.21 | <0.01 | 1.04 |
| L1985339-4 128563 | | 1.06 | 2 | 8.1 | 12 | 20 | 2.46 | 8.8 | 0.26 | 0.21 | 0.20 | 0.7 | 0.05 | 0.22 | 0.01 | 1.00 |
| L1985339-5 128564 | | 1.28 | 2 | 9.1 | 10 | 19 | 2.10 | 8.7 | 0.29 | 0.26 | 0.20 | 0.7 | 0.03 | 0.19 | 0.01 | 1.31 |
| L1985339-6 128565 | | 1.08 | 2 | 7.2 | 12 | 19 | 2.64 | 9.1 | 0.23 | 0.22 | 0.20 | 0.7 | 0.01 | 0.22 | <0.01 | 1.04 |
| L1985339-7 128566 | | 1.24 | 2 | 7.5 | 12 | 19 | 2.53 | 9.1 | 0.24 | 0.23 | 0.21 | 0.8 | 0.01 | 0.23 | 0.01 | 1.20 |
| L1985339-8 128567 | | 1.30 | 2 | 9.1 | 11 | 20 | 2.21 | 9.0 | 0.29 | 0.26 | 0.20 | 0.8 | 0.03 | 0.24 | 0.01 | 1.34 |
| L1985339-9 128568 | | 1.08 | 2 | 8.4 | 14 | 22 | 2.61 | 9.0 | 0.27 | 0.25 | 0.23 | 0.9 | 0.02 | 0.28 | <0.01 | 1.30 |
| L1985339-10 128569 | | 1.14 | 2 | 7.5 | 12 | 19 | 2.53 | 9.1 | 0.24 | 0.23 | 0.18 | 0.7 | 0.01 | 0.21 | 0.01 | 1.19 |
| | | 1.42 | 2 | 8.1 | 11 | 19 | 2.34 | 9.1 | 0.26 | 0.26 | 0.18 | 0.7 | <0.01 | 0.21 | <0.01 | 1.14 |

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Project: L1985339

CERTIFICATE OF ANALYSIS VA17194473

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe |
| Units | | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % |
| LOR | | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 |
| L1985339-1 128560 | | 1.05 | 0.6 | 0.24 | <10 | 240 | 0.19 | 0.77 | 0.76 | 0.46 | 20.7 | 5.5 | 6 | 0.31 | 5310 | 3.25 |
| L1985339-2 128561 | | 1.12 | 0.9 | 0.07 | <10 | 250 | 0.21 | 0.54 | 0.69 | 0.17 | 21.6 | 5.3 | 7 | 0.33 | 3120 | 3.03 |
| L1985339-3 128562 | | 1.15 | 0.8 | 0.12 | <10 | 270 | 0.22 | 0.40 | 0.81 | 0.24 | 24.5 | 5.7 | 6 | 0.32 | 3400 | 2.98 |
| L1985339-4 128563 | | 1.19 | 0.8 | 0.12 | <10 | 260 | 0.20 | 0.68 | 0.76 | 0.22 | 23.9 | 5.6 | 7 | 0.32 | 3850 | 3.03 |
| L1985339-5 128564 | | 1.08 | 0.8 | 0.27 | <10 | 240 | 0.19 | 0.51 | 0.77 | 0.19 | 21.9 | 5.2 | 7 | 0.31 | 3170 | 2.88 |
| L1985339-6 128565 | | 1.15 | 0.8 | 0.12 | <10 | 240 | 0.23 | 0.52 | 0.77 | 0.19 | 21.3 | 5.4 | 7 | 0.33 | 3780 | 3.09 |
| L1985339-7 128566 | | 1.11 | 1.0 | 0.16 | <10 | 250 | 0.22 | 0.53 | 0.78 | 0.21 | 21.7 | 5.4 | 6 | 0.32 | 4280 | 3.03 |
| L1985339-8 128567 | | 1.15 | 0.7 | 0.11 | <10 | 250 | 0.21 | 0.64 | 0.89 | 0.26 | 22.8 | 5.6 | 7 | 0.33 | 3970 | 3.09 |
| L1985339-9 128568 | | 1.09 | 0.7 | 0.54 | <10 | 240 | 0.20 | 0.44 | 0.75 | 0.23 | 22.6 | 5.2 | 7 | 0.31 | 3490 | 2.91 |
| L1985339-10 128569 | | 1.13 | 0.9 | 0.16 | <10 | 240 | 0.21 | 0.53 | 0.74 | 0.20 | 21.4 | 5.8 | 7 | 0.32 | 3610 | 2.97 |

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Project: L1985339

CERTIFICATE OF ANALYSIS VA17194473

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P |
| | Units | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm |
| | LOR | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 |
| L1985339-1 128560 | | 5.81 | 0.07 | 0.03 | 0.01 | 0.049 | 0.59 | 11.2 | 5.0 | 0.58 | 547 | 0.68 | 0.08 | 0.24 | 1.7 | 540 |
| L1985339-2 128561 | | 5.59 | 0.07 | 0.03 | <0.01 | 0.035 | 0.61 | 11.5 | 5.0 | 0.56 | 522 | 0.79 | 0.09 | 0.22 | 1.9 | 570 |
| L1985339-3 128562 | | 5.73 | 0.08 | 0.03 | 0.01 | 0.044 | 0.65 | 13.0 | 5.3 | 0.62 | 569 | 1.05 | 0.09 | 0.23 | 1.8 | 620 |
| L1985339-4 128563 | | 6.00 | 0.08 | 0.04 | <0.01 | 0.048 | 0.64 | 12.7 | 5.6 | 0.63 | 559 | 1.00 | 0.10 | 0.23 | 1.8 | 620 |
| L1985339-5 128564 | | 5.56 | 0.08 | 0.04 | <0.01 | 0.037 | 0.59 | 11.6 | 5.0 | 0.57 | 531 | 1.37 | 0.09 | 0.21 | 1.7 | 570 |
| L1985339-6 128565 | | 5.91 | 0.07 | 0.04 | 0.01 | 0.047 | 0.61 | 11.3 | 5.2 | 0.60 | 563 | 0.56 | 0.11 | 0.22 | 1.8 | 580 |
| L1985339-7 128566 | | 5.74 | 0.07 | 0.03 | 0.01 | 0.056 | 0.61 | 11.9 | 5.2 | 0.59 | 552 | 0.75 | 0.09 | 0.27 | 1.7 | 600 |
| L1985339-8 128567 | | 5.90 | 0.07 | 0.04 | <0.01 | 0.044 | 0.63 | 12.0 | 5.2 | 0.59 | 550 | 1.25 | 0.10 | 0.25 | 1.8 | 570 |
| L1985339-9 128568 | | 5.71 | 0.06 | 0.04 | <0.01 | 0.044 | 0.59 | 12.2 | 5.1 | 0.58 | 524 | 1.24 | 0.08 | 0.21 | 1.7 | 570 |
| L1985339-10 128569 | | 6.24 | 0.08 | 0.04 | 0.01 | 0.046 | 0.61 | 11.6 | 5.3 | 0.59 | 535 | 0.95 | 0.09 | 0.26 | 2.0 | 560 |

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Project: L1985339

CERTIFICATE OF ANALYSIS VA17194473

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|-----------------------------------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-----------|----------|
| | | Pb ppm | Rb ppm | Re ppm | S % | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm |
| L1985339-1 128560 | | 2.3 | 27.8 | 0.002 | 0.36 | 0.06 | 2.9 | 4.8 | 0.6 | 64.0 | <0.01 | 0.34 | 2.7 | 0.113 | 0.16 | 0.27 |
| L1985339-2 128561 | | 2.1 | 28.1 | 0.001 | 0.21 | 0.08 | 3.2 | 2.8 | 0.6 | 62.5 | <0.01 | 0.17 | 2.8 | 0.113 | 0.18 | 0.24 |
| L1985339-3 128562 | | 2.3 | 29.7 | 0.001 | 0.27 | 0.07 | 3.3 | 3.4 | 0.6 | 74.6 | <0.01 | 0.20 | 3.1 | 0.121 | 0.19 | 0.27 |
| L1985339-4 128563 | | 2.1 | 29.6 | 0.002 | 0.29 | 0.05 | 3.3 | 3.6 | 0.6 | 71.9 | <0.01 | 0.24 | 3.2 | 0.120 | 0.18 | 0.26 |
| L1985339-5 128564 | | 2.1 | 28.2 | 0.003 | 0.24 | 0.05 | 3.1 | 3.2 | 0.5 | 63.4 | <0.01 | 0.22 | 3.0 | 0.108 | 0.19 | 0.31 |
| L1985339-6 128565 | | 2.5 | 28.1 | <0.001 | 0.27 | 0.07 | 3.4 | 3.2 | 0.6 | 69.3 | <0.01 | 0.21 | 2.9 | 0.112 | 0.19 | 0.25 |
| L1985339-7 128566 | | 2.4 | 28.7 | 0.002 | 0.32 | 0.14 | 3.4 | 3.7 | 0.6 | 66.0 | <0.01 | 0.27 | 2.9 | 0.113 | 0.19 | 0.22 |
| L1985339-8 128567 | | 2.2 | 29.3 | 0.003 | 0.28 | 0.08 | 3.3 | 3.7 | 0.6 | 68.9 | <0.01 | 0.27 | 2.9 | 0.117 | 0.19 | 0.28 |
| L1985339-9 128568 | | 2.2 | 27.1 | 0.003 | 0.25 | 0.11 | 3.2 | 2.9 | 0.6 | 61.2 | <0.01 | 0.22 | 2.9 | 0.109 | 0.17 | 0.27 |
| L1985339-10 128569 | | 2.5 | 29.7 | 0.002 | 0.28 | 0.05 | 3.5 | 3.7 | 0.6 | 65.4 | <0.01 | 0.23 | 2.9 | 0.113 | 0.18 | 0.32 |

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| |
|---|
| CERTIFICATE OF ANALYSIS VA17194473 |
|---|

| Sample Description | Method Analyte Units LOR | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|--------------------|-----------------------------------|--------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| L1985339-1 128560 | | 52 | <0.05 | 3.97 | 83 | 0.7 |
| L1985339-2 128561 | | 53 | 0.05 | 4.26 | 70 | 0.8 |
| L1985339-3 128562 | | 54 | 0.05 | 5.18 | 76 | 0.8 |
| L1985339-4 128563 | | 55 | 0.18 | 4.61 | 78 | 0.8 |
| L1985339-5 128564 | | 50 | 0.07 | 4.33 | 70 | 0.7 |
| L1985339-6 128565 | | 52 | 0.07 | 4.38 | 74 | 0.8 |
| L1985339-7 128566 | | 52 | 0.09 | 4.51 | 75 | 0.8 |
| L1985339-8 128567 | | 54 | <0.05 | 4.67 | 76 | 0.8 |
| L1985339-9 128568 | | 51 | 0.05 | 4.55 | 71 | 0.7 |
| L1985339-10 128569 | | 51 | <0.05 | 4.68 | 75 | 0.8 |
| | | | | | | |



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CERTIFICATE OF ANALYSIS VA17194473

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



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QC CERTIFICATE VA17194473

Project: L1985339
 P.O. No.: ALSM-CW16-102-APN
 This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 11-SEP-2017.
 The following have access to data associated with this certificate:

| | | |
|------------------|-------------|-------------|
| ALSEV DATASUBLET | SHANE RAMOS | SHANE STACK |
|------------------|-------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17194473

| Method Analyte Units LOR | OA-VOL08m FIZZ RAT | OA-VOL08m MPA | OA-VOL08m NNP | OA-VOL08m NP | OA-VOL08m Ratio (N) | OA-ELE07 pH | S-IR08 S | C-GAS05 C | C-GAS05 CO2 | S-GRA06a S | C-IR07 C | S-GRA06 S | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As |
|----------------------------|--------------------|---------------|---------------|--------------|---------------------|-------------|----------|-----------|-------------|------------|----------|-----------|------------|------------|------------|
| Sample Description | Unity | tCaCO3/1Kt | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | % | ppm | % | ppm |
| | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.3 | | | | | | | | | |
| Upper Bound | | | | | | 6.7 | | | | | | | | | |
| DS-1 | | | | | | | | | | | 3.10 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | 3.01 | | | | |
| Upper Bound | | | | | | | | | | | 3.25 | | | | |
| GS313-8 | | | | | | | 1.21 | | | | 0.92 | | | | |
| Target Range - Lower Bound | | | | | | | 1.19 | | | | 0.90 | | | | |
| Upper Bound | | | | | | | 1.29 | | | | 0.98 | | | | |
| KZK-1 | 2 | 25.0 | 33 | 58 | 2.32 | | | | | | | | | | |
| Target Range - Lower Bound | <1 | 22.9 | 30 | 54 | 2.18 | | | | | | | | | | |
| Upper Bound | >4 | 27.1 | 38 | 64 | 2.53 | | | | | | | | | | |
| MA-3a | | | | | | | | 2.43 | 8.9 | | | | | | |
| Target Range - Lower Bound | | | | | | | | 2.31 | 8.4 | | | | | | |
| Upper Bound | | | | | | | | 2.77 | 10.2 | | | | | | |
| MRGeo08 | | | | | | | | | | | | | 4.23 | 2.52 | 34.5 |
| Target Range - Lower Bound | | | | | | | | | | | | | 4.00 | 2.44 | 29.6 |
| Upper Bound | | | | | | | | | | | | | 4.92 | 3.00 | 36.4 |
| OGGeo08 | | | | | | | | | | | | | 20.4 | 2.13 | 121.5 |
| Target Range - Lower Bound | | | | | | | | | | | | | 18.15 | 2.05 | 107.0 |
| Upper Bound | | | | | | | | | | | | | 22.2 | 2.53 | 131.0 |
| OREAS 905 | | | | | | | | | | | | | 0.51 | 0.81 | 33.5 |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.45 | 0.73 | 28.4 |
| Upper Bound | | | | | | | | | | | | | 0.58 | 0.91 | 35.0 |
| OREAS 920 | | | | | | | | | | | | | 0.09 | 2.28 | 4.8 |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.07 | 2.18 | 3.8 |
| Upper Bound | | | | | | | | | | | | | 0.12 | 2.68 | 4.9 |
| SY-4 | | | | | | | | 0.89 | 3.3 | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.84 | 3.0 | | | | | | |
| Upper Bound | | | | | | | | 1.08 | 4.0 | | | | | | |
| UTS-1 | | | | | | | | | | | | 0.87 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | 0.83 | | | |
| Upper Bound | | | | | | | | | | | | 0.93 | | | |
| UTS-1 | | | | | | | | | | 0.87 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.81 | | | | | |
| Upper Bound | | | | | | | | | | 0.95 | | | | | |
| UTS-4 | | | | | | | | | | | | 1.75 | | | |



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Project: L1985339

QC CERTIFICATE OF ANALYSIS VA17194473

| Method Analyte Units LOR | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm |
|----------------------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | <0.02 | <10 | 430 | 0.76 | 0.63 | 1.02 | 2.18 | 72.0 | 18.7 | 90 | 10.60 | 612 | 3.52 | 8.84 | 0.14 |
| Target Range - Lower Bound | <0.02 | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 | 3.22 | 8.73 | 0.07 |
| Upper Bound | 0.04 | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 | 3.96 | 10.80 | 0.29 |
| OGGeo08 | 0.07 | <10 | 120 | 0.70 | 9.70 | 0.84 | 17.40 | 56.8 | 94.6 | 81 | 9.01 | 8310 | 5.02 | 8.19 | 0.19 |
| Target Range - Lower Bound | 0.03 | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | 4.51 | 8.05 | 0.21 |
| Upper Bound | 0.11 | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | 5.53 | 9.95 | 0.45 |
| OREAS 905 | 0.39 | <10 | 250 | 0.96 | 5.45 | 0.34 | 0.34 | 79.1 | 14.0 | 18 | 1.17 | 1590 | 3.51 | 5.78 | 0.10 |
| Target Range - Lower Bound | 0.33 | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 | 3.14 | 5.74 | <0.05 |
| Upper Bound | 0.45 | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 | 3.86 | 7.12 | 0.22 |
| OREAS 920 | <0.02 | <10 | 70 | 0.73 | 0.53 | 0.30 | 0.06 | 70.7 | 15.0 | 41 | 1.88 | 114.5 | 3.54 | 6.76 | 0.12 |
| Target Range - Lower Bound | <0.02 | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | 3.26 | 6.12 | <0.05 |
| Upper Bound | 0.04 | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | 4.00 | 7.60 | 0.22 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17194473

| Method Analyte Units LOR | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm |
|----------------------------|----------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|
| Sample Description | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 0.68 | 0.06 | 0.153 | 1.26 | 35.5 | 31.0 | 1.12 | 410 | 13.10 | 0.31 | 1.04 | 688 | 990 | 1050 | 139.0 |
| Target Range - Lower Bound | 0.64 | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 | 900 | 959 | 132.0 |
| Upper Bound | 0.83 | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 | 1130 | 1175 | 162.0 |
| OGGeo08 | 0.75 | 0.45 | 1.370 | 1.03 | 28.2 | 29.0 | 0.94 | 384 | 876 | 0.28 | 1.02 | 8800 | 790 | 7100 | 120.0 |
| Target Range - Lower Bound | 0.72 | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 | 700 | 6520 | 109.5 |
| Upper Bound | 0.92 | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 | 880 | 7970 | 134.5 |
| OREAS 905 | 1.14 | 0.01 | 0.567 | 0.32 | 39.2 | 4.6 | 0.15 | 355 | 2.72 | 0.09 | 0.32 | 8.2 | 250 | 15.3 | 17.9 |
| Target Range - Lower Bound | 1.08 | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 | | 15.2 | 17.3 |
| Upper Bound | 1.36 | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 | | 19.0 | 21.3 |
| OREAS 920 | 0.54 | <0.01 | 0.029 | 0.39 | 35.8 | 21.2 | 1.05 | 511 | 0.33 | 0.02 | 0.33 | 40.6 | 710 | 20.8 | 22.7 |
| Target Range - Lower Bound | 0.53 | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 | | 19.2 | 22.2 |
| Upper Bound | 0.69 | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 | | 23.9 | 27.4 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17194473

| Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|----------------------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|
| Sample Description | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 0.007 | 0.30 | 2.98 | 6.9 | 1.2 | 3.1 | 75.1 | 0.01 | 0.02 | 21.5 | 0.378 | 0.76 | 5.17 | 100 | 2.91 |
| Target Range - Lower Bound | 0.006 | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 | 4.93 | 90 | 2.44 |
| Upper Bound | 0.010 | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 | 6.13 | 112 | 3.42 |
| OGGeo08 | 1.340 | 2.72 | 20.2 | 6.2 | 11.0 | 12.4 | 60.9 | 0.01 | 0.14 | 15.8 | 0.306 | 1.30 | 4.46 | 79 | 3.08 |
| Target Range - Lower Bound | 1.295 | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | 4.45 | 70 | 2.58 |
| Upper Bound | 1.585 | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | 5.55 | 88 | 3.60 |
| OREAS 905 | <0.001 | 0.07 | 0.95 | 1.6 | 2.7 | 1.2 | 12.8 | <0.01 | 0.07 | 7.9 | 0.021 | 0.11 | 2.16 | 6 | 0.63 |
| Target Range - Lower Bound | <0.001 | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 | 2.08 | 4 | 0.44 |
| Upper Bound | 0.002 | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 | 2.66 | 8 | 0.76 |
| OREAS 920 | <0.001 | 0.03 | 0.60 | 2.8 | 0.8 | 1.0 | 17.3 | 0.01 | 0.02 | 15.1 | 0.107 | 0.14 | 1.96 | 24 | 0.51 |
| Target Range - Lower Bound | <0.001 | <0.01 | 0.45 | 2.5 | 0.4 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | 1.89 | 23 | 0.31 |
| Upper Bound | 0.002 | 0.05 | 0.77 | 3.3 | 1.3 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | 2.42 | 30 | 0.61 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |



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| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|--------------------------|--------------------|------------------|--------------------|
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS313-8 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-3a | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MGeo08 | | 18.35 | 758 | 22.0 |
| Target Range - Lower Bound | | 17.50 | 708 | 18.1 |
| Upper Bound | | 21.5 | 870 | 25.7 |
| OGGeo08 | | 16.30 | 6860 | 21.6 |
| Target Range - Lower Bound | | 15.35 | 6500 | 19.5 |
| Upper Bound | | 18.85 | 7950 | 27.5 |
| OREAS 905 | | 6.86 | 66 | 43.6 |
| Target Range - Lower Bound | | 6.32 | 58 | 39.9 |
| Upper Bound | | 7.84 | 76 | 55.1 |
| OREAS 920 | | 17.30 | 103 | 19.6 |
| Target Range - Lower Bound | | 16.85 | 93 | 17.6 |
| Upper Bound | | 20.7 | 119 | 25.0 |
| SY-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |

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QC CERTIFICATE OF ANALYSIS VA17194473

| Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|----------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|---------------------------------|-------------------------|------------------|-------------------|---------------------|--------------------|------------------|-------------------|----------------------|--------------------|----------------------|
| Sample Description | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 1.64 | | |
| Upper Bound | | | | | | | | | | | | | 1.84 | | |
| UTS-4 | | | | | | | | | | 1.71 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 1.61 | | | | | |
| Upper Bound | | | | | | | | | | 1.87 | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | <0.05 | <0.2 | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.05 | <0.2 | | | | | | |
| Upper Bound | | | | | | | | 0.10 | 0.4 | | | | | | |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 |
| Upper Bound | | | | | | | | | | | | | 0.02 | 0.02 | 0.2 |
| BLANK | | | | | | 6.0 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.5 | | | | | | | | | |
| Upper Bound | | | | | | 6.9 | | | | | | | | | |
| BLANK | | | | | | | | | | | | | <0.01 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | | |
| Upper Bound | | | | | | | | | | | | | 0.02 | | |
| BLANK | | | | | | | | | | <0.01 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.01 | | | | | |
| Upper Bound | | | | | | | | | | 0.02 | | | | | |
| BLANK | | | | | | | | 0.02 | | | | | <0.01 | | |
| Target Range - Lower Bound | | | | | | | | <0.01 | | | | | <0.01 | | |
| Upper Bound | | | | | | | | 0.02 | | | | | 0.02 | | |

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| QC CERTIFICATE OF ANALYSIS | VA17194473 |
|----------------------------|------------|

| Method Analyte Units LOR | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm |
|----------------------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 |
| BLANK | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 |
| Target Range - Lower Bound | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 |
| Upper Bound | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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| Method Analyte Units LOR | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm |
|----------------------------|----------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|
| Sample Description | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | 0.2 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 |
| BLANK | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | 0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 |
| Target Range - Lower Bound | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 |
| Upper Bound | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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| Sample Description | Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm | |
|----------------------------|-----------------------------------|----------------------|-------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|---------------------|---------------------|---------------------|--|
| | | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | |
| STANDARDS | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | |
| BLANK | | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | |
| Target Range - Lower Bound | | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | |
| Upper Bound | | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |



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| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|-----------------------------------|-----------------------------|---------------------------|-----------------------------|
| STANDARDS | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANKS | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | <0.05 | <2 | <0.5 |
| BLANK | | <0.05 | <2 | <0.5 |
| Target Range - Lower Bound | | <0.05 | <2 | <0.5 |
| Upper Bound | | 0.10 | 4 | 1.0 |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |



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| Sample Description | Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|-------------|---------------|--------------|------------|-------------|----------------|--------------|----------------|
| | | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | 0.56 | 1.41 | 345 |
| DUP | | | | | | | | | | | | | | 0.54 | 1.39 | 349 |
| Target Range - Lower Bound | | | | | | | | | | | | | | 0.51 | 1.32 | 330 |
| Upper Bound | | | | | | | | | | | | | | 0.59 | 1.48 | 364 |
| ORIGINAL | | | | | | | 8.9 | | | | | | | | | |
| DUP | | | | | | | 8.9 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 8.4 | | | | | | | | | |
| Upper Bound | | | | | | | 9.4 | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | 0.02 | | | | | |
| DUP | | | | | | | | | | | 0.01 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | <0.01 | | | | | |
| Upper Bound | | | | | | | | | | | 0.02 | | | | | |
| ORIGINAL | | 2 | 6.3 | 40 | 46 | 7.36 | | | | | | | | | | |
| DUP | | 2 | 6.3 | 40 | 46 | 7.36 | | | | | | | | | | |
| Target Range - Lower Bound | | <1 | 5.7 | 37 | 43 | 6.98 | | | | | | | | | | |
| Upper Bound | | 3 | 6.9 | 43 | 49 | 7.74 | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | <0.01 | | |
| DUP | | | | | | | | | | | | | | <0.01 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | <0.01 | | |
| Upper Bound | | | | | | | | | | | | | | 0.02 | | |
| L1985339-9 128568 | | | | | | | | | 0.18 | 0.7 | | | | | | |
| DUP | | | | | | | | | 0.20 | 0.7 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.13 | 0.5 | | | | | | |
| Upper Bound | | | | | | | | | 0.25 | 0.9 | | | | | | |
| L1985339-10 128569 | | | | | | | | 0.26 | | | | 0.21 | | | | |
| DUP | | | | | | | | 0.28 | | | | 0.22 | | | | |
| Target Range - Lower Bound | | | | | | | | 0.25 | | | | 0.20 | | | | |
| Upper Bound | | | | | | | | 0.29 | | | | 0.23 | | | | |
| ORIGINAL | | | | | | | | | | | | | | 0.11 | 1.68 | 53.4 |
| DUP | | | | | | | | | | | | | | 0.12 | 1.71 | 56.8 |
| Target Range - Lower Bound | | | | | | | | | | | | | | 0.10 | 1.60 | 52.2 |
| Upper Bound | | | | | | | | | | | | | | 0.13 | 1.79 | 58.0 |



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| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|-----------------------------------|-----------|----------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-----------|-----------|
| | | Au ppm | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % | Ga ppm | Ge ppm |
| | | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 0.10 | <10 | 100 | 0.40 | 0.68 | 0.10 | 2.13 | 26.6 | 15.0 | 33 | 3.48 | 29.1 | 3.30 | 4.01 | 0.05 |
| DUP | | 0.12 | <10 | 100 | 0.42 | 0.63 | 0.10 | 2.15 | 26.9 | 14.7 | 32 | 3.41 | 30.1 | 3.26 | 3.99 | <0.05 |
| Target Range - Lower Bound | | 0.08 | <10 | 80 | 0.34 | 0.61 | 0.09 | 2.02 | 25.4 | 14.0 | 30 | 3.22 | 28.4 | 3.11 | 3.75 | <0.05 |
| Upper Bound | | 0.14 | 20 | 120 | 0.48 | 0.70 | 0.12 | 2.26 | 28.1 | 15.7 | 35 | 3.67 | 30.8 | 3.45 | 4.25 | 0.10 |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1985339-9 128568 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1985339-10 128569 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | <0.02 | <10 | 60 | 0.81 | 0.86 | 1.27 | 0.41 | 42.3 | 9.0 | 21 | 2.16 | 17.0 | 2.29 | 4.80 | 0.07 |
| DUP | | <0.02 | <10 | 60 | 0.82 | 0.91 | 1.31 | 0.44 | 42.8 | 9.7 | 21 | 2.24 | 21.8 | 2.30 | 5.12 | 0.07 |
| Target Range - Lower Bound | | <0.02 | <10 | 50 | 0.72 | 0.83 | 1.22 | 0.39 | 40.4 | 8.8 | 19 | 2.04 | 18.5 | 2.17 | 4.66 | <0.05 |
| Upper Bound | | 0.04 | 20 | 70 | 0.91 | 0.94 | 1.36 | 0.46 | 44.7 | 9.9 | 23 | 2.36 | 20.3 | 2.42 | 5.26 | 0.10 |

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| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|-----------------------------------|-----------|-----------|-----------|---------|-----------|-----------|---------|-----------|-----------|---------|-----------|-----------|----------|-----------|-----------|
| | | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm |
| | | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 0.03 | 0.51 | 0.076 | 0.06 | 12.9 | 14.0 | 0.32 | 525 | 1.04 | 0.01 | 0.73 | 33.4 | 540 | 78.1 | 7.0 |
| DUP | | 0.02 | 0.49 | 0.071 | 0.06 | 13.4 | 14.0 | 0.32 | 514 | 0.95 | 0.01 | 0.68 | 33.6 | 530 | 76.6 | 6.9 |
| Target Range - Lower Bound | | <0.02 | 0.45 | 0.065 | 0.05 | 12.3 | 13.2 | 0.29 | 489 | 0.90 | <0.01 | 0.62 | 31.6 | 500 | 73.3 | 6.5 |
| Upper Bound | | 0.04 | 0.55 | 0.082 | 0.07 | 14.0 | 14.8 | 0.35 | 550 | 1.09 | 0.02 | 0.79 | 35.4 | 570 | 81.4 | 7.4 |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1985339-9 128568 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1985339-10 128569 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | 0.06 | 0.03 | 0.048 | 0.10 | 21.1 | 25.6 | 0.72 | 456 | 0.32 | 0.04 | 0.80 | 19.3 | 1090 | 18.0 | 14.7 |
| DUP | | 0.06 | 0.03 | 0.051 | 0.10 | 21.7 | 25.4 | 0.73 | 447 | 0.35 | 0.04 | 0.84 | 20.1 | 1100 | 18.1 | 15.6 |
| Target Range - Lower Bound | | 0.04 | 0.02 | 0.042 | 0.09 | 20.1 | 24.1 | 0.68 | 424 | 0.27 | 0.03 | 0.73 | 18.5 | 1030 | 16.9 | 14.3 |
| Upper Bound | | 0.08 | 0.04 | 0.057 | 0.12 | 22.7 | 26.9 | 0.77 | 479 | 0.40 | 0.05 | 0.91 | 20.9 | 1160 | 19.2 | 16.0 |

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Project: L1985339

QC CERTIFICATE OF ANALYSIS VA17194473

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|-----------------------------------|-------------------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-----------|----------|----------|----------|
| | | Re ppm | S % | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm | V ppm | W ppm |
| | | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| | | DUPLICATES | | | | | | | | | | | | | | |
| ORIGINAL | | <0.001 | 0.03 | 2.40 | 3.4 | 0.8 | 0.7 | 19.8 | <0.01 | 0.05 | 1.8 | 0.040 | 0.13 | 0.64 | 50 | 0.20 |
| DUP | | <0.001 | 0.03 | 2.35 | 3.3 | 0.7 | 0.7 | 20.3 | <0.01 | 0.05 | 1.7 | 0.037 | 0.12 | 0.63 | 50 | 0.30 |
| Target Range - Lower Bound | | <0.001 | 0.02 | 2.15 | 3.1 | 0.5 | 0.5 | 18.8 | <0.01 | 0.04 | 1.5 | 0.032 | 0.10 | 0.55 | 47 | 0.18 |
| Upper Bound | | 0.002 | 0.04 | 2.60 | 3.6 | 1.0 | 0.9 | 21.3 | 0.02 | 0.06 | 2.0 | 0.045 | 0.15 | 0.72 | 54 | 0.32 |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1985339-9 128568 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L1985339-10 128569 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | <0.001 | 0.06 | 1.10 | 2.9 | 0.6 | 1.0 | 90.5 | <0.01 | 0.02 | 3.2 | 0.026 | 0.14 | 0.61 | 19 | 0.17 |
| DUP | | <0.001 | 0.06 | 1.14 | 3.1 | 0.8 | 1.1 | 94.5 | <0.01 | 0.02 | 3.2 | 0.026 | 0.13 | 0.64 | 19 | 0.15 |
| Target Range - Lower Bound | | <0.001 | 0.05 | 0.99 | 2.8 | 0.5 | 0.8 | 87.7 | <0.01 | <0.01 | 2.8 | 0.020 | 0.10 | 0.54 | 17 | 0.10 |
| Upper Bound | | 0.002 | 0.07 | 1.25 | 3.3 | 0.9 | 1.3 | 97.3 | 0.02 | 0.03 | 3.6 | 0.032 | 0.17 | 0.71 | 21 | 0.22 |

***** See Appendix Page for comments regarding this certificate *****



ALS Canada Ltd.
 2103 Dollarton Hwy
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 www.alsglobal.com/geochemistry

To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 4 - E
 Total # Pages: 4 (A - E)
 Plus Appendix Pages
 Finalized Date: 5-OCT-2017
 Account: APN

Project: L1985339

| |
|--|
| QC CERTIFICATE OF ANALYSIS VA17194473 |
|--|

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm |
|----------------------------|--------------------------|---------------|----------------|----------------|
| | | 0.05 | 2 | 0.5 |
| DUPLICATES | | | | |
| ORIGINAL | | 3.99 | 240 | 0.7 |
| DUP | | 3.98 | 240 | 0.5 |
| Target Range - Lower Bound | | 3.74 | 226 | <0.5 |
| Upper Bound | | 4.23 | 254 | 1.0 |
| ORIGINAL | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| ORIGINAL | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| ORIGINAL | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| ORIGINAL | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L1985339-9 128568 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L1985339-10 128569 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| ORIGINAL | | 10.70 | 72 | 1.9 |
| DUP | | 11.25 | 73 | 2.0 |
| Target Range - Lower Bound | | 10.40 | 67 | 1.3 |
| Upper Bound | | 11.55 | 78 | 2.6 |

***** See Appendix Page for comments regarding this certificate *****



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100 - 8081 LOUGHEED HWY.
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Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 5-OCT-2017
Account: APN

Project: L1985339

QC CERTIFICATE OF ANALYSIS VA17194473

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



Chain of Custody (COC) / Analytical Request Form



COC Number: 17 28

Page 1 of 1

Canada Toll Free: 1 800 668 9878

L1985339-COFC

www.alsglobal.com

| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | |
|---|---|--|--|--|--|--------------|---|---|-------------------------------------|-----------------------------|--|---------------------------|------------------------------|-----------|--|-------|--|--|--|----------------------|
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (business days) | | 4 day [P4] <input type="checkbox"/> | | 3 day [P3] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | | EMERGENCY | | 1 Business day [E1] <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | Analysis Request | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 2 | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | |
| PO / AFE: TBD | | Requisitioner: | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals- Aqua regia digestion (CP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sukphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | | | | | | | | Number of Containers |
| | | | | | | Composite | R | R | R | R | R | R | | | | | | | | |
| | 128560 | | | 12-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 128561 | | | 12-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 128562 | | | 12-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 128563 | | | 12-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 128564 | | | 12-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 128565 | | | 12-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 128566 | | | 12-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 128567 | | | 12-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 128568 | | | 12-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 128569 | | | 12-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | |
| | | | | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | |
| | | | | | | | | 20.0 | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | |
| Released by: | | Date: | | Time: | | Received by: | | Date: | | Time: | | Received by: | | Date: | | Time: | | | | |
| | | | | | | EITF | | 18 SEP 2017 | | 15:08 | | Michelle | | SEP 18 17 | | 12:55 | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form

4, 9, 4, 4, 5, 6, 9, 11, 10, 8



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 01-SEP-17
Report Date: 14-NOV-17 18:34 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L1985340
Project P.O. #: PO#227382
Job Reference:
C of C Numbers: 17 29
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1985340-1 Waste 16-AUG-17 128165 | L1985340-2 Waste 19-AUG-17 128166 | L1985340-3 Waste 20-AUG-17 128167 | L1985340-4 Waste 20-AUG-17 128168 | L1985340-5 Waste 21-AUG-17 128169 | |
|---|--|--|--|--|--|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.6 | 8.6 | 9.0 | 8.6 | 8.7 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.27 | 0.22 | 0.24 | 0.51 | 0.47 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.6 | <0.3 | 0.3 | 8.1 | 10.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 26 | 23 | 23 | 37 | 34 |
| | NNP (tCaCO3/1Kt) | 25 | 23 | 23 | 29 | 23 |
| | Ratio (NP/MPA) (Unity) | 41.60 | 147.20 | 73.60 | 4.55 | 3.20 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.02 | 0.02 | 0.01 | 0.02 | 0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | <0.01 | <0.01 | <0.01 | 0.24 | 0.33 |
| | Total Sulfur (combustion) (%) | 0.02 | <0.01 | 0.01 | 0.26 | 0.34 |
| Total Metals | Aluminum (Al) (%) | 1.26 | 0.99 | 1.22 | 1.15 | 1.48 |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 0.8 | 1.3 | 0.6 | 1.1 | 1.0 |
| | Barium (Ba) (ppm) | 370 | 200 | 260 | 120 | 310 |
| | Beryllium (Be) (ppm) | 0.26 | 0.37 | 0.36 | 0.36 | 0.29 |
| | Bismuth (Bi) (ppm) | 0.08 | 0.16 | 0.02 | 0.24 | 0.60 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.12 | 0.16 | 0.04 | 0.21 | 0.39 |
| | Calcium (Ca) (%) | 1.02 | 0.90 | 0.99 | 1.39 | 1.32 |
| | Cerium (Ce) (ppm) | 30.2 | 24.1 | 23.6 | 27.5 | 28.9 |
| | Cesium (Cs) (ppm) | 0.49 | 0.34 | 0.36 | 0.30 | 0.74 |
| | Chromium (Cr) (ppm) | 9 | 5 | 6 | 5 | 12 |
| | Cobalt (Co) (ppm) | 7.5 | 5.8 | 6.5 | 6.8 | 10.2 |
| | Copper (Cu) (ppm) | 1225 | 1020 | 88.2 | 2640 | 4640 |
| | Gallium (Ga) (ppm) | 6.22 | 5.72 | 6.44 | 6.89 | 8.25 |
| | Germanium (Ge) (ppm) | 0.13 | 0.13 | 0.14 | 0.12 | 0.15 |
| | Gold (Au) (ppm) | <0.02 | 0.02 | <0.02 | 0.06 | 0.09 |
| | Hafnium (Hf) (ppm) | 0.08 | 0.05 | 0.05 | 0.05 | 0.15 |
| | Indium (In) (ppm) | 0.029 | 0.024 | 0.032 | 0.060 | 0.091 |
| | Iron (Fe) (%) | 2.52 | 2.17 | 2.42 | 2.73 | 3.61 |
| | Lanthanum (La) (ppm) | 16.6 | 12.9 | 12.2 | 14.2 | 15.5 |
| | Lead (Pb) (ppm) | 3.0 | 3.3 | 2.4 | 4.1 | 4.6 |
| | Lithium (Li) (ppm) | 5.9 | 6.8 | 7.5 | 8.4 | 7.6 |
| | Magnesium (Mg) (%) | 0.70 | 0.53 | 0.74 | 0.74 | 1.04 |
| | Manganese (Mn) (ppm) | 617 | 579 | 650 | 538 | 820 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L1985340-6 Waste 24-AUG-17 128170 | L1985340-7 Waste 24-AUG-17 128171 | L1985340-8 Waste 25-AUG-17 128172 | L1985340-9 Waste 25-AUG-17 128173 |
|---|--|--|--|--|
| Grouping | Analyte | | | |
| SOIL | | | | |
| Physical Tests | pH (Unity) | | | |
| | 8.8 | 8.7 | 9.0 | 8.8 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | |
| | 0.67 | 0.93 | 0.38 | 1.02 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | |
| | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | |
| | 1.6 | 0.9 | 0.9 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | |
| | 38 | 47 | 28 | 60 |
| | NNP (tCaCO3/1Kt) | | | |
| | 36 | 46 | 27 | 60 |
| | Ratio (NP/MPA) (Unity) | | | |
| | 24.32 | 50.13 | 29.87 | 192.00 |
| | Sulfate Sulfur (carbonate leach) (%) | | | |
| | <0.01 | <0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | |
| | 0.04 | 0.02 | 0.02 | 0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | | | |
| | 0.01 | 0.01 | 0.01 | <0.01 |
| | Total Sulfur (combustion) (%) | | | |
| | 0.05 | 0.03 | 0.03 | 0.01 |
| Total Metals | Aluminum (Al) (%) | | | |
| | 0.89 | 0.78 | 1.10 | 0.50 |
| | Antimony (Sb) (ppm) | | | |
| | 0.07 | 0.07 | <0.05 | 0.12 |
| | Arsenic (As) (ppm) | | | |
| | 1.7 | 1.4 | 0.8 | 4.8 |
| | Barium (Ba) (ppm) | | | |
| | 120 | 130 | 250 | 40 |
| | Beryllium (Be) (ppm) | | | |
| | 0.40 | 0.46 | 0.28 | 0.56 |
| | Bismuth (Bi) (ppm) | | | |
| | 0.11 | 0.06 | 0.09 | 0.01 |
| | Boron (B) (ppm) | | | |
| | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | |
| | 0.06 | 0.07 | 0.04 | 0.03 |
| | Calcium (Ca) (%) | | | |
| | 1.37 | 1.71 | 1.00 | 1.88 |
| | Cerium (Ce) (ppm) | | | |
| | 27.6 | 26.9 | 23.5 | 25.0 |
| | Cesium (Cs) (ppm) | | | |
| | 0.46 | 0.43 | 0.31 | 0.23 |
| | Chromium (Cr) (ppm) | | | |
| | 5 | 4 | 5 | 3 |
| | Cobalt (Co) (ppm) | | | |
| | 6.5 | 6.8 | 6.1 | 6.1 |
| | Copper (Cu) (ppm) | | | |
| | 685 | 392 | 420 | 32.2 |
| | Gallium (Ga) (ppm) | | | |
| | 5.32 | 4.98 | 6.16 | 3.36 |
| | Germanium (Ge) (ppm) | | | |
| | 0.13 | 0.12 | 0.13 | 0.11 |
| | Gold (Au) (ppm) | | | |
| | 0.02 | <0.02 | 0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | | | |
| | 0.05 | 0.04 | 0.04 | 0.03 |
| | Indium (In) (ppm) | | | |
| | 0.041 | 0.031 | 0.022 | 0.031 |
| | Iron (Fe) (%) | | | |
| | 2.44 | 2.63 | 2.44 | 2.22 |
| | Lanthanum (La) (ppm) | | | |
| | 14.8 | 14.5 | 12.4 | 13.6 |
| | Lead (Pb) (ppm) | | | |
| | 3.5 | 4.4 | 2.1 | 4.2 |
| | Lithium (Li) (ppm) | | | |
| | 5.0 | 4.3 | 6.3 | 1.5 |
| | Magnesium (Mg) (%) | | | |
| | 0.67 | 0.62 | 0.69 | 0.52 |
| | Manganese (Mn) (ppm) | | | |
| | 576 | 646 | 579 | 592 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1985340-1 Waste 16-AUG-17 128165 | L1985340-2 Waste 19-AUG-17 128166 | L1985340-3 Waste 20-AUG-17 128167 | L1985340-4 Waste 20-AUG-17 128168 | L1985340-5 Waste 21-AUG-17 128169 |
|------------------------|--------------------------|---|--|--|--|--|--|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | 2.15 | 1.17 | 0.66 | 1.86 | 1.86 | 1.86 |
| | Nickel (Ni) (ppm) | 10.4 | 2.3 | 2.7 | 3.1 | 21.4 | 21.4 |
| | Niobium (Nb) (ppm) | 0.34 | 0.10 | 0.18 | 0.06 | 0.24 | 0.24 |
| | Phosphorus (P) (ppm) | 710 | 550 | 650 | 800 | 810 | 810 |
| | Potassium (K) (%) | 0.85 | 0.31 | 0.58 | 0.24 | 0.96 | 0.96 |
| | Rhenium (Re) (ppm) | 0.001 | <0.001 | 0.001 | 0.005 | 0.005 | 0.005 |
| | Rubidium (Rb) (ppm) | 41.8 | 15.0 | 26.2 | 11.9 | 48.2 | 48.2 |
| | Scandium (Sc) (ppm) | 4.9 | 4.5 | 7.7 | 4.5 | 6.8 | 6.8 |
| | Selenium (Se) (ppm) | 0.7 | 0.4 | 0.4 | 2.2 | 3.7 | 3.7 |
| | Silver (Ag) (ppm) | 0.70 | 0.26 | 0.03 | 0.50 | 1.53 | 1.53 |
| | Sodium (Na) (%) | 0.07 | 0.06 | 0.10 | 0.06 | 0.07 | 0.07 |
| | Strontium (Sr) (ppm) | 61.2 | 56.8 | 88.5 | 91.2 | 83.4 | 83.4 |
| | Sulfur (S) (%) | 0.03 | 0.01 | 0.01 | 0.28 | 0.35 | 0.35 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.02 | 0.04 | 0.01 | 0.10 | 0.37 | 0.37 |
| | Thallium (Tl) (ppm) | 0.25 | 0.07 | 0.14 | 0.07 | 0.32 | 0.32 |
| | Thorium (Th) (ppm) | 4.1 | 2.8 | 2.7 | 4.0 | 4.0 | 4.0 |
| | Tin (Sn) (ppm) | 0.7 | 0.5 | 0.6 | 0.9 | 0.8 | 0.8 |
| | Titanium (Ti) (%) | 0.140 | 0.040 | 0.091 | 0.026 | 0.165 | 0.165 |
| | Tungsten (W) (ppm) | 0.52 | 0.46 | 0.76 | 0.27 | 0.70 | 0.70 |
| | Uranium (U) (ppm) | 0.28 | 0.26 | 0.20 | 0.30 | 0.32 | 0.32 |
| | Vanadium (V) (ppm) | 61 | 40 | 48 | 48 | 70 | 70 |
| | Yttrium (Y) (ppm) | 8.08 | 9.22 | 8.90 | 8.35 | 8.31 | 8.31 |
| | Zinc (Zn) (ppm) | 75 | 68 | 76 | 66 | 111 | 111 |
| | Zirconium (Zr) (ppm) | 1.9 | 1.0 | 0.9 | 1.7 | 4.5 | 4.5 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.0 | 0.8 | 0.9 | 1.9 | 1.7 | 1.7 |
| Miscellaneous | Carbon (C) (%) | 0.34 | 0.27 | 0.31 | 0.56 | 0.53 | 0.53 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L1985340-6 Waste 24-AUG-17 128170 | L1985340-7 Waste 24-AUG-17 128171 | L1985340-8 Waste 25-AUG-17 128172 | L1985340-9 Waste 25-AUG-17 128173 |
|------------------------|--------------------------|---|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Molybdenum (Mo) (ppm) | 1.51 | 0.80 | 1.34 | 0.63 | |
| | Nickel (Ni) (ppm) | 2.3 | 2.1 | 2.5 | 2.2 | |
| | Niobium (Nb) (ppm) | 0.13 | <0.05 | 0.09 | <0.05 | |
| | Phosphorus (P) (ppm) | 750 | 670 | 560 | 580 | |
| | Potassium (K) (%) | 0.29 | 0.14 | 0.52 | 0.15 | |
| | Rhenium (Re) (ppm) | 0.005 | 0.001 | <0.001 | <0.001 | |
| | Rubidium (Rb) (ppm) | 15.3 | 7.3 | 25.3 | 7.9 | |
| | Scandium (Sc) (ppm) | 4.5 | 3.8 | 4.2 | 4.8 | |
| | Selenium (Se) (ppm) | 0.9 | 0.5 | 0.5 | 0.3 | |
| | Silver (Ag) (ppm) | 0.26 | 0.22 | 0.16 | 0.01 | |
| | Sodium (Na) (%) | 0.06 | 0.06 | 0.07 | 0.05 | |
| | Strontium (Sr) (ppm) | 114.5 | 111.5 | 99.6 | 183.5 | |
| | Sulfur (S) (%) | 0.05 | 0.03 | 0.02 | <0.01 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.03 | 0.03 | 0.03 | <0.01 | |
| | Thallium (Tl) (ppm) | 0.09 | 0.03 | 0.13 | 0.03 | |
| | Thorium (Th) (ppm) | 4.1 | 4.0 | 2.6 | 2.5 | |
| | Tin (Sn) (ppm) | 0.6 | 0.5 | 0.5 | 0.4 | |
| | Titanium (Ti) (%) | 0.042 | 0.006 | 0.079 | <0.005 | |
| | Tungsten (W) (ppm) | 0.30 | 0.38 | 0.57 | 0.10 | |
| | Uranium (U) (ppm) | 0.48 | 0.34 | 0.20 | 0.29 | |
| | Vanadium (V) (ppm) | 45 | 41 | 48 | 34 | |
| | Yttrium (Y) (ppm) | 9.70 | 8.69 | 7.10 | 8.49 | |
| | Zinc (Zn) (ppm) | 71 | 76 | 77 | 75 | |
| | Zirconium (Zr) (ppm) | 1.3 | 1.0 | 0.7 | 1.0 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 2.5 | 3.4 | 1.4 | 3.8 | |
| Miscellaneous | Carbon (C) (%) | 0.72 | 1.02 | 0.44 | 1.08 | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17 29

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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CERTIFICATE VA17194480

Project: L1985340
 P.O. No.: ALSM-CW16-102-APN
 This report is for 9 Other samples submitted to our lab in Vancouver, BC, Canada on 11-SEP-2017.
 The following have access to data associated with this certificate:

| | |
|------------------|-------------|
| ALSEV DATASUBLET | SHANE STACK |
|------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17194480

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm |
|--------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|
| L1985340-1 128165 | | 1.08 | 2 | 0.6 | 25 | 26 | 41.60 | 8.6 | 0.02 | <0.01 | 0.27 | 1.0 | 0.02 | 0.34 | <0.01 | 0.70 |
| L1985340-2 128166 | | 1.10 | 2 | <0.3 | 23 | 23 | 147.20 | 8.6 | <0.01 | <0.01 | 0.22 | 0.8 | 0.02 | 0.27 | <0.01 | 0.26 |
| L1985340-3 128167 | | 1.06 | 2 | 0.3 | 23 | 23 | 73.60 | 9.0 | 0.01 | <0.01 | 0.24 | 0.9 | 0.01 | 0.31 | <0.01 | 0.03 |
| L1985340-4 128168 | | 0.92 | 2 | 8.1 | 29 | 37 | 4.55 | 8.6 | 0.26 | 0.24 | 0.51 | 1.9 | 0.02 | 0.56 | <0.01 | 0.50 |
| L1985340-5 128169 | | 1.06 | 2 | 10.6 | 23 | 34 | 3.20 | 8.7 | 0.34 | 0.33 | 0.47 | 1.7 | 0.01 | 0.53 | <0.01 | 1.53 |
| L1985340-6 128170 | | 1.20 | 2 | 1.6 | 36 | 38 | 24.32 | 8.8 | 0.05 | 0.01 | 0.67 | 2.5 | 0.04 | 0.72 | <0.01 | 0.26 |
| L1985340-7 128171 | | 1.04 | 2 | 0.9 | 46 | 47 | 50.13 | 8.7 | 0.03 | 0.01 | 0.93 | 3.4 | 0.02 | 1.02 | <0.01 | 0.22 |
| L1985340-8 128172 | | 1.20 | 2 | 0.9 | 27 | 28 | 29.87 | 9.0 | 0.03 | 0.01 | 0.38 | 1.4 | 0.02 | 0.44 | 0.01 | 0.16 |
| L1985340-9 128173 | | 1.04 | 2 | 0.3 | 60 | 60 | 192.00 | 8.8 | 0.01 | <0.01 | 1.02 | 3.8 | 0.01 | 1.08 | <0.01 | 0.01 |

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CERTIFICATE OF ANALYSIS VA17194480

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|-----------------------------------|---------|-----------|-----------|----------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|---------|
| | | Al % | As ppm | Au ppm | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % |
| L1985340-1 128165 | | 1.26 | 0.8 | <0.02 | <10 | 370 | 0.26 | 0.08 | 1.02 | 0.12 | 30.2 | 7.5 | 9 | 0.49 | 1225 | 2.52 |
| L1985340-2 128166 | | 0.99 | 1.3 | 0.02 | <10 | 200 | 0.37 | 0.16 | 0.90 | 0.16 | 24.1 | 5.8 | 5 | 0.34 | 1020 | 2.17 |
| L1985340-3 128167 | | 1.22 | 0.6 | <0.02 | <10 | 260 | 0.36 | 0.02 | 0.99 | 0.04 | 23.6 | 6.5 | 6 | 0.36 | 88.2 | 2.42 |
| L1985340-4 128168 | | 1.15 | 1.1 | 0.06 | <10 | 120 | 0.36 | 0.24 | 1.39 | 0.21 | 27.5 | 6.8 | 5 | 0.30 | 2640 | 2.73 |
| L1985340-5 128169 | | 1.48 | 1.0 | 0.09 | <10 | 310 | 0.29 | 0.60 | 1.32 | 0.39 | 28.9 | 10.2 | 12 | 0.74 | 4640 | 3.61 |
| L1985340-6 128170 | | 0.89 | 1.7 | 0.02 | <10 | 120 | 0.40 | 0.11 | 1.37 | 0.06 | 27.6 | 6.5 | 5 | 0.46 | 685 | 2.44 |
| L1985340-7 128171 | | 0.78 | 1.4 | <0.02 | <10 | 130 | 0.46 | 0.06 | 1.71 | 0.07 | 26.9 | 6.8 | 4 | 0.43 | 392 | 2.63 |
| L1985340-8 128172 | | 1.10 | 0.8 | 0.02 | <10 | 250 | 0.28 | 0.09 | 1.00 | 0.04 | 23.5 | 6.1 | 5 | 0.31 | 420 | 2.44 |
| L1985340-9 128173 | | 0.50 | 4.8 | <0.02 | <10 | 40 | 0.56 | 0.01 | 1.88 | 0.03 | 25.0 | 6.1 | 3 | 0.23 | 32.2 | 2.22 |

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CERTIFICATE OF ANALYSIS VA17194480

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|-----------------------------------|-----------|-----------|-----------|-----------|-----------|---------|-----------|-----------|---------|-----------|-----------|---------|-----------|-----------|----------|
| | | Ga ppm | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm |
| L1985340-1 128165 | | 6.22 | 0.13 | 0.08 | <0.01 | 0.029 | 0.85 | 16.6 | 5.9 | 0.70 | 617 | 2.15 | 0.07 | 0.34 | 10.4 | 710 |
| L1985340-2 128166 | | 5.72 | 0.13 | 0.05 | <0.01 | 0.024 | 0.31 | 12.9 | 6.8 | 0.53 | 579 | 1.17 | 0.06 | 0.10 | 2.3 | 550 |
| L1985340-3 128167 | | 6.44 | 0.14 | 0.05 | <0.01 | 0.032 | 0.58 | 12.2 | 7.5 | 0.74 | 650 | 0.66 | 0.10 | 0.18 | 2.7 | 650 |
| L1985340-4 128168 | | 6.89 | 0.12 | 0.05 | <0.01 | 0.060 | 0.24 | 14.2 | 8.4 | 0.74 | 538 | 1.86 | 0.06 | 0.06 | 3.1 | 800 |
| L1985340-5 128169 | | 8.25 | 0.15 | 0.15 | 0.01 | 0.091 | 0.96 | 15.5 | 7.6 | 1.04 | 820 | 1.86 | 0.07 | 0.24 | 21.4 | 810 |
| L1985340-6 128170 | | 5.32 | 0.13 | 0.05 | <0.01 | 0.041 | 0.29 | 14.8 | 5.0 | 0.67 | 576 | 1.51 | 0.06 | 0.13 | 2.3 | 750 |
| L1985340-7 128171 | | 4.98 | 0.12 | 0.04 | <0.01 | 0.031 | 0.14 | 14.5 | 4.3 | 0.62 | 646 | 0.80 | 0.06 | <0.05 | 2.1 | 670 |
| L1985340-8 128172 | | 6.16 | 0.13 | 0.04 | <0.01 | 0.022 | 0.52 | 12.4 | 6.3 | 0.69 | 579 | 1.34 | 0.07 | 0.09 | 2.5 | 560 |
| L1985340-9 128173 | | 3.36 | 0.11 | 0.03 | <0.01 | 0.031 | 0.15 | 13.6 | 1.5 | 0.52 | 592 | 0.63 | 0.05 | <0.05 | 2.2 | 580 |

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CERTIFICATE OF ANALYSIS VA17194480

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|-----------------------------------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-----------|----------|
| | | Pb ppm | Rb ppm | Re ppm | S % | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm |
| L1985340-1 128165 | | 3.0 | 41.8 | 0.001 | 0.03 | <0.05 | 4.9 | 0.7 | 0.7 | 61.2 | <0.01 | 0.02 | 4.1 | 0.140 | 0.25 | 0.28 |
| L1985340-2 128166 | | 3.3 | 15.0 | <0.001 | 0.01 | <0.05 | 4.5 | 0.4 | 0.5 | 56.8 | <0.01 | 0.04 | 2.8 | 0.040 | 0.07 | 0.26 |
| L1985340-3 128167 | | 2.4 | 26.2 | 0.001 | 0.01 | <0.05 | 7.7 | 0.4 | 0.6 | 88.5 | <0.01 | 0.01 | 2.7 | 0.091 | 0.14 | 0.20 |
| L1985340-4 128168 | | 4.1 | 11.9 | 0.005 | 0.28 | <0.05 | 4.5 | 2.2 | 0.9 | 91.2 | <0.01 | 0.10 | 4.0 | 0.026 | 0.07 | 0.30 |
| L1985340-5 128169 | | 4.6 | 48.2 | 0.005 | 0.35 | <0.05 | 6.8 | 3.7 | 0.8 | 83.4 | <0.01 | 0.37 | 4.0 | 0.165 | 0.32 | 0.32 |
| L1985340-6 128170 | | 3.5 | 15.3 | 0.005 | 0.05 | 0.07 | 4.5 | 0.9 | 0.6 | 114.5 | <0.01 | 0.03 | 4.1 | 0.042 | 0.09 | 0.48 |
| L1985340-7 128171 | | 4.4 | 7.3 | 0.001 | 0.03 | 0.07 | 3.8 | 0.5 | 0.5 | 111.5 | <0.01 | 0.03 | 4.0 | 0.006 | 0.03 | 0.34 |
| L1985340-8 128172 | | 2.1 | 25.3 | <0.001 | 0.02 | <0.05 | 4.2 | 0.5 | 0.5 | 99.6 | <0.01 | 0.03 | 2.6 | 0.079 | 0.13 | 0.20 |
| L1985340-9 128173 | | 4.2 | 7.9 | <0.001 | <0.01 | 0.12 | 4.8 | 0.3 | 0.4 | 183.5 | <0.01 | <0.01 | 2.5 | <0.005 | 0.03 | 0.29 |

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| |
|---|
| CERTIFICATE OF ANALYSIS VA17194480 |
|---|

| Sample Description | Method Analyte Units LOR | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|--------------------|-----------------------------------|--------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| L1985340-1 128165 | | 61 | 0.52 | 8.08 | 75 | 1.9 |
| L1985340-2 128166 | | 40 | 0.46 | 9.22 | 68 | 1.0 |
| L1985340-3 128167 | | 48 | 0.76 | 8.90 | 76 | 0.9 |
| L1985340-4 128168 | | 48 | 0.27 | 8.35 | 66 | 1.7 |
| L1985340-5 128169 | | 70 | 0.70 | 8.31 | 111 | 4.5 |
| L1985340-6 128170 | | 45 | 0.30 | 9.70 | 71 | 1.3 |
| L1985340-7 128171 | | 41 | 0.38 | 8.69 | 76 | 1.0 |
| L1985340-8 128172 | | 48 | 0.57 | 7.10 | 77 | 0.7 |
| L1985340-9 128173 | | 34 | 0.10 | 8.49 | 75 | 1.0 |



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CERTIFICATE OF ANALYSIS VA17194480

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

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 Plus Appendix Pages
 Finalized Date: 13-OCT-2017
 Account: APN

QC CERTIFICATE VA17194480

Project: L1985340
 P.O. No.: ALSM-CW16-102-APN
 This report is for 9 Other samples submitted to our lab in Vancouver, BC, Canada on 11-SEP-2017.
 The following have access to data associated with this certificate:

| | |
|------------------|-------------|
| ALSEV DATASUBLET | SHANE STACK |
|------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17194480

| Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|----------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|---------------------------------|-------------------------|------------------|-------------------|---------------------|--------------------|------------------|-------------------|----------------------|--------------------|----------------------|
| Sample Description | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | |
| Buffer pH6 | | | | | | 6.1 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.3 | | | | | | | | | |
| Upper Bound | | | | | | 6.7 | | | | | | | | | |
| CO-ASSAY | | | | | | | | 0.51 | 1.9 | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.42 | 1.5 | | | | | | |
| Upper Bound | | | | | | | | 0.64 | 2.4 | | | | | | |
| DS-1 | | | | | | | 2.54 | | | | 3.12 | | | | |
| Target Range - Lower Bound | | | | | | | 2.51 | | | | 3.01 | | | | |
| Upper Bound | | | | | | | 2.71 | | | | 3.25 | | | | |
| GS313-8 | | | | | | | 1.22 | | | | 0.97 | | | | |
| Target Range - Lower Bound | | | | | | | 1.19 | | | | 0.90 | | | | |
| Upper Bound | | | | | | | 1.29 | | | | 0.98 | | | | |
| KZK-1 | 2 | 25.0 | 32 | 57 | 2.28 | | | | | | | | | | |
| KZK-1 | 2 | 25.0 | 33 | 58 | 2.32 | | | | | | | | | | |
| Target Range - Lower Bound | <1 | 22.9 | 30 | 54 | 2.18 | | | | | | | | | | |
| Upper Bound | >4 | 27.1 | 38 | 64 | 2.53 | | | | | | | | | | |
| MA-2c | | | | | | | | 1.61 | 5.9 | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.50 | 5.5 | | | | | | |
| Upper Bound | | | | | | | | 1.84 | 6.8 | | | | | | |
| OGGeo08 | | | | | | | | | | | | | 19.45 | 2.11 | 119.5 |
| Target Range - Lower Bound | | | | | | | | | | | | | 18.15 | 2.05 | 107.0 |
| Upper Bound | | | | | | | | | | | | | 22.2 | 2.53 | 131.0 |
| OREAS 920 | | | | | | | | | | | | | 0.09 | 2.18 | 4.6 |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.07 | 2.18 | 3.8 |
| Upper Bound | | | | | | | | | | | | | 0.12 | 2.68 | 4.9 |
| UTS-1 | | | | | | | | | | | | 0.87 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | 0.83 | | | |
| Upper Bound | | | | | | | | | | | | 0.93 | | | |
| UTS-1 | | | | | | | | | 0.90 | | | | | | |
| UTS-1 | | | | | | | | | 0.90 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.81 | | | | | | |
| Upper Bound | | | | | | | | | 0.95 | | | | | | |
| UTS-4 | | | | | | | | | | | | 1.73 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | 1.64 | | | |
| Upper Bound | | | | | | | | | | | | 1.84 | | | |
| UTS-4 | | | | | | | | | 1.73 | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17194480

| Method Analyte Units LOR | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm |
|----------------------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OGGeo08 | 0.07 | <10 | 90 | 0.74 | 10.25 | 0.86 | 18.00 | 58.7 | 96.3 | 78 | 8.97 | 8220 | 4.96 | 8.68 | 0.20 |
| Target Range - Lower Bound | 0.03 | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | 4.51 | 8.05 | 0.21 |
| Upper Bound | 0.11 | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | 5.53 | 9.95 | 0.45 |
| OREAS 920 | <0.02 | <10 | 70 | 0.64 | 0.54 | 0.29 | 0.06 | 70.4 | 14.1 | 39 | 1.90 | 109.0 | 3.41 | 6.50 | 0.15 |
| Target Range - Lower Bound | <0.02 | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | 3.26 | 6.12 | <0.05 |
| Upper Bound | 0.04 | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | 4.00 | 7.60 | 0.22 |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17194480

| Method Analyte Units LOR | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm |
|----------------------------|----------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|
| Sample Description | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OGGeo08 | 0.77 | 0.47 | 1.350 | 1.08 | 28.5 | 31.8 | 0.93 | 376 | 857 | 0.27 | 1.23 | 8600 | 770 | 7000 | 122.0 |
| Target Range - Lower Bound | 0.72 | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 | 700 | 6520 | 109.5 |
| Upper Bound | 0.92 | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 | 880 | 7970 | 134.5 |
| OREAS 920 | 0.53 | <0.01 | 0.028 | 0.39 | 35.3 | 19.0 | 1.02 | 488 | 0.33 | 0.01 | 0.35 | 36.0 | 670 | 20.2 | 22.8 |
| Target Range - Lower Bound | 0.53 | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 | | 19.2 | 22.2 |
| Upper Bound | 0.69 | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 | | 23.9 | 27.4 |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17194480

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Re ppm | S % | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm | V ppm | W ppm | |
| | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | 1.335 | 2.72 | 21.3 | 6.5 | 10.7 | 12.5 | 62.1 | 0.01 | 0.15 | 16.4 | 0.303 | 1.32 | 4.66 | 78 | 3.10 | |
| Target Range - Lower Bound | 1.295 | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | 4.45 | 70 | 2.58 | |
| Upper Bound | 1.585 | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | 5.55 | 88 | 3.60 | |
| OREAS 920 | <0.001 | 0.03 | 0.67 | 2.6 | 0.6 | 1.0 | 16.7 | 0.01 | 0.02 | 15.0 | 0.106 | 0.14 | 1.93 | 23 | 0.47 | |
| Target Range - Lower Bound | <0.001 | <0.01 | 0.45 | 2.5 | 0.4 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | 1.89 | 23 | 0.31 | |
| Upper Bound | 0.002 | 0.05 | 0.77 | 3.3 | 1.3 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | 2.42 | 30 | 0.61 | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |



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| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|--------------------------|--------------------|------------------|--------------------|
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| CO-ASSAY | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS313-8 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-2c | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OGGeo08 | | 17.45 | 6680 | 23.3 |
| Target Range - Lower Bound | | 15.35 | 6500 | 19.5 |
| Upper Bound | | 18.85 | 7950 | 27.5 |
| OREAS 920 | | 17.30 | 99 | 20.8 |
| Target Range - Lower Bound | | 16.85 | 93 | 17.6 |
| Upper Bound | | 20.7 | 119 | 25.0 |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |

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| Method Analyte Units LOR | ME-MS41 Au ppm 0.02 | ME-MS41 B ppm 10 | ME-MS41 Ba ppm 10 | ME-MS41 Be ppm 0.05 | ME-MS41 Bi ppm 0.01 | ME-MS41 Ca % 0.01 | ME-MS41 Cd ppm 0.01 | ME-MS41 Ce ppm 0.02 | ME-MS41 Co ppm 0.1 | ME-MS41 Cr ppm 1 | ME-MS41 Cs ppm 0.05 | ME-MS41 Cu ppm 0.2 | ME-MS41 Fe % 0.01 | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 |
|----------------------------|---------------------|------------------|-------------------|---------------------|---------------------|-------------------|---------------------|---------------------|--------------------|------------------|---------------------|--------------------|-------------------|---------------------|---------------------|
| STANDARDS | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | 0.08 |
| Target Range - Lower Bound | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 |
| Upper Bound | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17194480

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | |
| | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | |
| Target Range - Lower Bound | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | |
| Upper Bound | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17194480

| Sample Description | Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|----------------------------|--------------------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|
| STANDARDS | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Target Range - Lower Bound | | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Upper Bound | | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17194480

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|-----------------------------------|-----------------------------|---------------------------|-----------------------------|
| STANDARDS | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANKS | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | <0.05 | <2 | <0.5 |
| Target Range - Lower Bound | | <0.05 | <2 | <0.5 |
| Upper Bound | | 0.10 | 4 | 1.0 |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DUPLICATES | | | | |
| ORIGINAL | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

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QC CERTIFICATE OF ANALYSIS VA17194480

| Sample Description | Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 NP CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|-------------|------------------|--------------|------------|-------------|----------------|--------------|----------------|
| | | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | 4.75 | 0.59 | 28.3 |
| DUP | | | | | | | | | | | | | | 4.83 | 0.59 | 28.7 |
| Target Range - Lower Bound | | | | | | | | | | | | | | 4.54 | 0.55 | 27.0 |
| Upper Bound | | | | | | | | | | | | | | 5.04 | 0.63 | 30.0 |
| L1985340-9 128173 | | 2 | 0.3 | 60 | 60 | 192.00 | 8.8 | | 1.02 | 3.8 | 0.01 | | <0.01 | | | |
| DUP | | 2 | 0.3 | 60 | 60 | 192.00 | 8.9 | | 0.97 | 3.5 | 0.01 | | <0.01 | | | |
| Target Range - Lower Bound | | <1 | <0.3 | 56 | 56 | 182.39 | 8.3 | | 0.90 | 3.3 | <0.01 | | <0.01 | | | |
| Upper Bound | | 3 | 0.6 | 64 | 64 | 201.61 | 9.4 | | 1.09 | 4.0 | 0.03 | | 0.02 | | | |

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| |
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| QC CERTIFICATE OF ANALYSIS VA17194480 |
|--|

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | |
|----------------------------|-------------------|---------|-------|------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|------|------|
| | | | | | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga | Ge |
| | | | | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm |
| | | | | | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| | DUPLICATES | | | | | | | | | | | | | | | | | | |
| ORIGINAL | <0.02 | 20 | 60 | 0.58 | 0.07 | 2.41 | 13.15 | 11.20 | 3.3 | 93 | 1.01 | 160.0 | 1.20 | 3.68 | 0.20 | | | | |
| DUP | <0.02 | 20 | 60 | 0.72 | 0.08 | 2.33 | 12.95 | 10.70 | 3.5 | 93 | 1.01 | 157.0 | 1.18 | 3.76 | 0.21 | | | | |
| Target Range - Lower Bound | <0.02 | <10 | 50 | 0.57 | 0.06 | 2.24 | 12.40 | 10.40 | 3.1 | 87 | 0.91 | 153.0 | 1.12 | 3.48 | 0.14 | | | | |
| Upper Bound | 0.04 | 30 | 70 | 0.73 | 0.09 | 2.50 | 13.70 | 11.50 | 3.7 | 99 | 1.11 | 164.0 | 1.26 | 3.96 | 0.27 | | | | |
| L1985340-9 128173 | | | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17194480

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | |
|----------------------------|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|-----|------|
| | | | | | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P | Pb | Rb |
| | | | | | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm |
| | | | | | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | 0.22 | 1.49 | 0.022 | 0.27 | 8.8 | 2.2 | 0.46 | 216 | 40.9 | 0.01 | 0.14 | 132.0 | 7800 | 4.6 | 12.2 |
| DUP | | | | | 0.18 | 1.49 | 0.017 | 0.27 | 8.6 | 2.7 | 0.46 | 211 | 41.0 | 0.01 | 0.15 | 131.5 | 7620 | 4.7 | 12.9 |
| Target Range - Lower Bound | | | | | 0.17 | 1.37 | 0.014 | 0.25 | 8.1 | 2.2 | 0.43 | 198 | 38.9 | <0.01 | 0.09 | 125.0 | 7310 | 4.2 | 11.8 |
| Upper Bound | | | | | 0.23 | 1.61 | 0.025 | 0.29 | 9.3 | 2.7 | 0.49 | 229 | 43.0 | 0.02 | 0.20 | 138.5 | 8110 | 5.1 | 13.3 |
| L1985340-9 128173 | | | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17194480

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | |
|----------------------------|-------------------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|-----|------|
| | | | | | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U | V | W |
| | | | | | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm |
| | | | | | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| | DUPLICATES | | | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | 0.065 | 0.94 | 11.10 | 1.9 | 33.6 | 0.7 | 96.1 | <0.01 | 0.23 | 1.6 | 0.006 | 0.31 | 8.52 | 639 | 2.79 |
| DUP | | | | | 0.066 | 0.93 | 11.00 | 2.1 | 34.6 | 0.6 | 95.9 | <0.01 | 0.28 | 1.6 | 0.006 | 0.31 | 8.50 | 639 | 3.75 |
| Target Range - Lower Bound | | | | | 0.061 | 0.88 | 10.15 | 1.8 | 32.2 | 0.4 | 91.0 | <0.01 | 0.23 | 1.3 | <0.005 | 0.27 | 8.03 | 606 | 2.97 |
| Upper Bound | | | | | 0.070 | 0.99 | 11.95 | 2.2 | 36.0 | 0.9 | 101.0 | 0.02 | 0.28 | 1.9 | 0.010 | 0.35 | 8.99 | 672 | 3.57 |
| L1985340-9 128173 | | | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |

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| QC CERTIFICATE OF ANALYSIS VA17194480 |
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| Sample Description | Method Analyte Units | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm |
|----------------------------|----------------------|---------------|----------------|----------------|
| | LOR | 0.05 | 2 | 0.5 |
| DUPLICATES | | | | |
| ORIGINAL | | 29.9 | 1240 | 10.1 |
| DUP | | 29.9 | 1220 | 9.5 |
| Target Range - Lower Bound | | 28.4 | 1165 | 8.6 |
| Upper Bound | | 31.4 | 1295 | 11.0 |
| L1985340-9 128173 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |



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QC CERTIFICATE OF ANALYSIS VA17194480

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



Environmental

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1985340-COFC

COC Number: **A 29**

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| Report To Contact and company name below will appear on the final report Company: Minto Explorations Ltd. Contact: Minto Environment - Coordinator Phone: 1-604-759-4659 Company address below will appear on the final report Street: 2100-510 West Georgia St. City/Province: Vancouver, British Columbia Postal Code: V6B 0M3 | | Report Format / Distribution Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax minto_environment@mintomine.com Email 2 Email 3 | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply PRIORITY (Business Days) 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | |
|---|--|---|-----------------------------|--|---|----------------------|-----------------------|-----------------------------|--|---------------------------|--|----------|-----------------------|-----------------------------|--|---------------------------|----------------------|--|--|--|--|--|--|--|--|--|
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Company: Minto Explorations Ltd. Contact: Ruth Cayetano | | Invoice Distribution Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax ap@mintomine.com Email 2 | | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below <table border="1"> <tr> <th>Total Metals- Aqua regia digestion (ICP)</th> <th>Paste pH</th> <th>% Inorganic Carbonate</th> <th>Total Carbon/Sulphur (Leco)</th> <th>AP - determination by % sulphide sulphur</th> <th>Modified NP - (MEND 1997)</th> <th colspan="2">Number of Containers</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> | | | | | | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1997) | Number of Containers | | | | | | | | | |
| Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1997) | Number of Containers | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information ALS Account # / Quote #: Job #: PO / AFE: TBD LSD: | | Oil and Gas Required Fields (client use) AFE/Cost Center: PO# Major/Minor Code: Routing Code: Requisitioner: Location: | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | | Sampler: | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1997) | Number of Containers | | | | | | | | | | | | | | | |
| | | | | Composite | R | R | R | R | R | R | | | | | | | | | | | | | | | | |
| | 128165 | 16-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | |
| | 128166 | 19-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | |
| | 128167 | 20-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | |
| | 128168 | 20-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | |
| | 128169 | 21-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | |
| | 128170 | 24-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | |
| | 128171 | 24-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | |
| | 128172 | 25-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | |
| | 128173 | 25-AUG-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input checked="" type="checkbox"/> INITIAL COOLER TEMPERATURES °C: 20.0 FINAL COOLER TEMPERATURES °C: | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) Released by: Date: Time: | | INITIAL SHIPMENT RECEPTION (lab use only) Received by: Date: Time: | | | FINAL SHIPMENT RECEPTION (lab use only) Received by: Date: Time: | | | | | | | | | | | | | | | | | | | | | |
| Released by: | | Received by: EHF | | | Received by: Michelle | | | | | | | | | | | | | | | | | | | | | |
| Date: | | Date: 1 SEP 2017 | | | Date: SEP 6 '17 | | | | | | | | | | | | | | | | | | | | | |
| Time: | | Time: | | | Time: 12:55 | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC for:

4, 9, 4, 4, 5, 6, 9, 16, 10, 8, 8



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 04-OCT-17
Report Date: 18-DEC-17 14:23 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2002449
Project P.O. #: 228594
Job Reference:
C of C Numbers: 17-30
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2002449-1 Tails AUGUST TAL 2017 | L2002449-2 Waste 30-AUG-17 128174 751-31B | L2002449-3 Waste 15-SEP-17 128175 745-2813 | L2002449-4 Waste 26-SEP-17 144852 799-64 | L2002449-5 Waste 26-SEP-17 144851 805-26 |
|---|--|--|---|---|---|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.2 | 9.0 | 8.9 | 8.5 | 8.8 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.33 | 1.04 | 0.96 | 0.25 | 0.13 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 3.1 | 6.3 | 0.6 | 0.9 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 23 | 62 | 65 | 26 | 17 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 20 | 56 | 64 | 25 | 16 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 7.36 | 9.92 | 104.00 | 27.73 | 27.20 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | 0.01 | 0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | <0.01 | 0.01 | 0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | | | | |
| | 0.10 | 0.19 | 0.01 | 0.03 | 0.02 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.10 | 0.20 | 0.02 | 0.03 | 0.02 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.03 | 0.70 | 0.73 | 1.24 | 1.04 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.06 | 0.05 | 0.11 | 0.40 | 0.16 |
| | Arsenic (As) (ppm) | | | | |
| | 1.6 | 0.9 | 2.1 | 4.9 | 2.5 |
| | Barium (Ba) (ppm) | | | | |
| | 230 | 120 | 100 | 250 | 240 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.25 | 0.32 | 0.54 | 0.42 | 0.35 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.42 | 0.41 | 0.01 | 0.10 | 0.06 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | 10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.38 | 0.13 | 0.04 | 0.25 | 0.14 |
| | Calcium (Ca) (%) | | | | |
| | 0.90 | 2.03 | 2.42 | 1.10 | 0.74 |
| | Cerium (Ce) (ppm) | | | | |
| | 20.5 | 42.4 | 29.8 | 28.7 | 27.5 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.53 | 0.31 | 0.36 | 0.82 | 0.75 |
| | Chromium (Cr) (ppm) | | | | |
| | 6 | 4 | 4 | 21 | 9 |
| | Cobalt (Co) (ppm) | | | | |
| | 7.2 | 6.5 | 5.4 | 8.5 | 6.8 |
| | Copper (Cu) (ppm) | | | | |
| | 2510 | 2430 | 15.7 | 290 | 539 |
| | Gallium (Ga) (ppm) | | | | |
| | 6.68 | 4.16 | 4.56 | 4.84 | 4.94 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.08 | 0.07 | 0.05 | 0.06 | 0.06 |
| | Gold (Au) (ppm) | | | | |
| | 0.11 | 0.07 | <0.02 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.04 | 0.03 | 0.03 | 0.22 | 0.10 |
| | Indium (In) (ppm) | | | | |
| | 0.085 | 0.051 | 0.045 | 0.031 | 0.040 |
| | Iron (Fe) (%) | | | | |
| | 3.85 | 2.74 | 2.27 | 2.55 | 2.81 |
| | Lanthanum (La) (ppm) | | | | |
| | 10.6 | 21.8 | 15.4 | 14.9 | 14.8 |
| | Lead (Pb) (ppm) | | | | |
| | 3.2 | 4.5 | 7.0 | 6.2 | 4.2 |
| | Lithium (Li) (ppm) | | | | |
| | 4.6 | 3.3 | 3.2 | 8.0 | 4.9 |
| | Magnesium (Mg) (%) | | | | |
| | 0.63 | 0.78 | 0.62 | 0.71 | 0.48 |
| | Manganese (Mn) (ppm) | | | | |
| | 669 | 587 | 583 | 546 | 651 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2002449-6 Waste 26-SEP-17 144853 799-65 | L2002449-7 Waste 26-SEP-17 144854 799-65 | L2002449-8 Waste 26-SEP-17 144855 799-65 | L2002449-9 Waste 25-SEP-17 144856 799-66 | L2002449-10 Waste 25-SEP-17 144857 799-66 | |
|---|---|---|---|---|--|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 9.2 | 8.9 | 8.8 | 9.0 | 8.7 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.06 | 0.51 | 0.44 | 0.34 | 0.10 |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.6 | 0.3 | 0.3 | 0.3 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 12 | 47 | 43 | 37 | 16 |
| | NNP (tCaCO3/1Kt) | 11 | 47 | 43 | 37 | 16 |
| | Ratio (NP/MPA) (Unity) | 19.20 | 150.40 | 137.60 | 118.40 | 51.20 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 |
| | Total Sulfur (combustion) (%) | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 |
| Total Metals | Aluminum (Al) (%) | 1.03 | 0.55 | 0.79 | 0.92 | 0.87 |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | 0.06 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 0.7 | 3.6 | 1.2 | 1.1 | 0.8 |
| | Barium (Ba) (ppm) | 190 | 170 | 190 | 270 | 230 |
| | Beryllium (Be) (ppm) | 0.27 | 0.41 | 0.47 | 0.22 | 0.31 |
| | Bismuth (Bi) (ppm) | 0.02 | 0.10 | 0.04 | 0.45 | 0.02 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.08 | 0.09 | 0.08 | 0.20 | 0.05 |
| | Calcium (Ca) (%) | 0.52 | 2.03 | 1.80 | 1.48 | 0.63 |
| | Cerium (Ce) (ppm) | 21.6 | 36.6 | 27.1 | 20.8 | 24.9 |
| | Cesium (Cs) (ppm) | 0.35 | 0.71 | 0.89 | 0.54 | 0.47 |
| | Chromium (Cr) (ppm) | 4 | 3 | 4 | 4 | 4 |
| | Cobalt (Co) (ppm) | 4.9 | 6.4 | 6.1 | 5.7 | 5.6 |
| | Copper (Cu) (ppm) | 288 | 878 | 121.5 | 1255 | 78.8 |
| | Gallium (Ga) (ppm) | 5.18 | 3.12 | 4.24 | 4.60 | 4.62 |
| | Germanium (Ge) (ppm) | 0.05 | 0.05 | 0.06 | 0.06 | 0.07 |
| | Gold (Au) (ppm) | <0.02 | 0.05 | <0.02 | 0.05 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.04 | 0.03 | 0.05 | 0.05 | 0.05 |
| | Indium (In) (ppm) | 0.020 | 0.036 | 0.054 | 0.033 | 0.028 |
| | Iron (Fe) (%) | 2.11 | 2.36 | 2.52 | 2.43 | 2.27 |
| | Lanthanum (La) (ppm) | 12.2 | 19.7 | 13.4 | 11.3 | 12.9 |
| | Lead (Pb) (ppm) | 3.2 | 4.5 | 4.5 | 2.7 | 2.5 |
| | Lithium (Li) (ppm) | 5.8 | 1.8 | 3.0 | 3.4 | 4.2 |
| | Magnesium (Mg) (%) | 0.52 | 0.14 | 0.30 | 0.43 | 0.41 |
| | Manganese (Mn) (ppm) | 539 | 799 | 831 | 753 | 610 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2002449-1 Tails AUGUST TAL 2017 | L2002449-2 Waste 30-AUG-17 128174 751-31B | L2002449-3 Waste 15-SEP-17 128175 745-2813 | L2002449-4 Waste 26-SEP-17 144852 799-64 | L2002449-5 Waste 26-SEP-17 144851 805-26 |
|---|--------------------------|--|--|---|---|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 |
| | Molybdenum (Mo) (ppm) | 2.45 | 0.83 | 0.26 | 1.99 | 2.93 |
| | Nickel (Ni) (ppm) | 3.2 | 2.5 | 2.0 | 18.5 | 7.3 |
| | Niobium (Nb) (ppm) | 0.18 | 0.09 | <0.05 | 0.73 | 0.37 |
| | Phosphorus (P) (ppm) | 740 | 950 | 630 | 800 | 790 |
| | Potassium (K) (%) | 0.54 | 0.22 | 0.10 | 0.23 | 0.46 |
| | Rhenium (Re) (ppm) | 0.002 | 0.003 | <0.001 | 0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | 27.7 | 12.1 | 5.4 | 13.6 | 25.3 |
| | Scandium (Sc) (ppm) | 4.2 | 5.4 | 4.7 | 4.6 | 5.0 |
| | Selenium (Se) (ppm) | 2.0 | 2.0 | <0.2 | 0.3 | 0.4 |
| | Silver (Ag) (ppm) | 0.69 | 0.64 | 0.01 | 0.11 | 0.09 |
| | Sodium (Na) (%) | 0.06 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Strontium (Sr) (ppm) | 64.7 | 198.5 | 114.0 | 51.4 | 35.3 |
| | Sulfur (S) (%) | 0.10 | 0.20 | 0.01 | 0.01 | 0.01 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.22 | 0.09 | 0.01 | 0.02 | 0.02 |
| | Thallium (Tl) (ppm) | 0.22 | 0.08 | 0.03 | 0.13 | 0.21 |
| | Thorium (Th) (ppm) | 3.8 | 6.1 | 2.7 | 4.4 | 4.3 |
| | Tin (Sn) (ppm) | 0.9 | 0.7 | 0.7 | 0.5 | 0.7 |
| | Titanium (Ti) (%) | 0.094 | 0.026 | <0.005 | 0.070 | 0.081 |
| | Tungsten (W) (ppm) | 0.09 | 0.23 | 0.16 | 0.27 | 0.35 |
| | Uranium (U) (ppm) | 0.34 | 0.32 | 0.34 | 0.70 | 0.39 |
| | Vanadium (V) (ppm) | 67 | 49 | 40 | 50 | 58 |
| | Yttrium (Y) (ppm) | 6.01 | 8.67 | 10.05 | 9.08 | 9.36 |
| | Zinc (Zn) (ppm) | 101 | 70 | 78 | 78 | 79 |
| | Zirconium (Zr) (ppm) | 1.1 | 1.0 | 0.7 | 7.2 | 2.8 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.2 | 3.8 | 3.5 | 0.9 | 0.5 |
| Miscellaneous | Carbon (C) (%) | 0.35 | 1.13 | 1.04 | 0.50 | 0.21 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2002449-6 | L2002449-7 | L2002449-8 | L2002449-9 | L2002449-10 |
|------------------------|--------------------------|--------------|---------------|---------------|---------------|---------------|---------------|
| | | Description | Waste | Waste | Waste | Waste | Waste |
| | | Sampled Date | 26-SEP-17 | 26-SEP-17 | 26-SEP-17 | 25-SEP-17 | 25-SEP-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 144853 799-65 | 144854 799-65 | 144855 799-65 | 144856 799-66 | 144857 799-66 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | | 0.96 | 1.76 | 1.07 | 0.90 | 1.00 |
| | Nickel (Ni) (ppm) | | 2.6 | 4.3 | 3.4 | 2.5 | 2.7 |
| | Niobium (Nb) (ppm) | | 0.13 | 0.07 | 0.06 | 0.14 | 0.08 |
| | Phosphorus (P) (ppm) | | 560 | 730 | 670 | 700 | 640 |
| | Potassium (K) (%) | | 0.41 | 0.20 | 0.37 | 0.59 | 0.37 |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| | Rubidium (Rb) (ppm) | | 19.8 | 13.2 | 20.0 | 29.7 | 18.8 |
| | Scandium (Sc) (ppm) | | 3.3 | 3.8 | 8.6 | 4.4 | 5.2 |
| | Selenium (Se) (ppm) | | <0.2 | 0.5 | 0.2 | 0.5 | <0.2 |
| | Silver (Ag) (ppm) | | 0.06 | 0.36 | 0.04 | 0.51 | 0.02 |
| | Sodium (Na) (%) | | 0.07 | 0.05 | 0.05 | 0.06 | 0.06 |
| | Strontium (Sr) (ppm) | | 31.6 | 35.3 | 62.6 | 46.4 | 34.9 |
| | Sulfur (S) (%) | | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | <0.01 | 0.02 | 0.01 | 0.15 | <0.01 |
| | Thallium (Tl) (ppm) | | 0.12 | 0.06 | 0.13 | 0.18 | 0.10 |
| | Thorium (Th) (ppm) | | 3.2 | 5.6 | 3.4 | 3.8 | 2.6 |
| | Tin (Sn) (ppm) | | 0.5 | 0.5 | 0.8 | 0.6 | 0.6 |
| | Titanium (Ti) (%) | | 0.073 | 0.016 | 0.043 | 0.096 | 0.052 |
| | Tungsten (W) (ppm) | | 0.35 | 0.38 | 0.28 | 0.60 | 0.34 |
| | Uranium (U) (ppm) | | 0.19 | 0.25 | 0.28 | 0.25 | 0.19 |
| | Vanadium (V) (ppm) | | 45 | 39 | 51 | 56 | 46 |
| | Yttrium (Y) (ppm) | | 4.68 | 5.76 | 12.65 | 7.85 | 9.65 |
| | Zinc (Zn) (ppm) | | 60 | 67 | 74 | 72 | 63 |
| | Zirconium (Zr) (ppm) | | 0.9 | 0.9 | 1.2 | 1.2 | 0.9 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.2 | 1.9 | 1.6 | 1.2 | 0.4 |
| Miscellaneous | Carbon (C) (%) | | 0.09 | 0.57 | 0.49 | 0.40 | 0.13 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-30

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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CERTIFICATE VA17220118

Project: L2002449
 P.O. No.: 226298
 This report is for 10 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 11-OCT-2017.
 The following have access to data associated with this certificate:

| | | |
|------------------|-------------|--|
| ALSEV DATASUBLET | SHANE STACK | |
|------------------|-------------|--|

| SAMPLE PREPARATION | |
|---------------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|------------------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

To: **ALS ENVIRONMENTAL**
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17220118

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm |
|----------------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|
| L2002449-1 AUGUST TAL 2017 | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 |
| L2002449-2 128174 751-31B | | 1.14 | 2 | 3.1 | 20 | 23 | 7.36 | 8.2 | 0.10 | 0.10 | 0.33 | 1.2 | <0.01 | 0.35 | 0.01 | 0.69 |
| L2002449-3 128175 745-2813 | | 1.14 | 2 | 6.3 | 56 | 62 | 9.92 | 9.0 | 0.20 | 0.19 | 1.04 | 3.8 | 0.01 | 1.13 | 0.01 | 0.64 |
| L2002449-4 144852 799-64 | | 1.10 | 2 | 0.6 | 64 | 65 | 104.00 | 8.9 | 0.02 | 0.01 | 0.96 | 3.5 | 0.01 | 1.04 | <0.01 | 0.01 |
| L2002449-5 144851 805-26 | | 1.10 | 2 | 0.9 | 25 | 26 | 27.73 | 8.5 | 0.03 | 0.03 | 0.25 | 0.9 | <0.01 | 0.50 | <0.01 | 0.11 |
| L2002449-6 144853 799-65 | | 1.12 | 2 | 0.6 | 16 | 17 | 27.20 | 8.8 | 0.02 | 0.02 | 0.13 | 0.5 | <0.01 | 0.21 | <0.01 | 0.09 |
| L2002449-7 144854 799-65 | | 1.16 | 1 | 0.6 | 11 | 12 | 19.20 | 9.2 | 0.02 | 0.02 | 0.06 | 0.2 | <0.01 | 0.09 | <0.01 | 0.06 |
| L2002449-8 144855 799-65 | | 1.10 | 2 | 0.3 | 47 | 47 | 150.40 | 8.9 | 0.01 | 0.01 | 0.51 | 1.9 | <0.01 | 0.57 | <0.01 | 0.36 |
| L2002449-9 144856 799-66 | | 1.08 | 2 | 0.3 | 43 | 43 | 137.60 | 8.8 | 0.01 | 0.01 | 0.44 | 1.6 | <0.01 | 0.49 | <0.01 | 0.04 |
| L2002449-10 144857 799-66 | | 1.14 | 2 | 0.3 | 37 | 37 | 118.40 | 9.0 | 0.01 | 0.01 | 0.34 | 1.2 | <0.01 | 0.40 | <0.01 | 0.51 |
| | | 1.08 | 2 | 0.3 | 16 | 16 | 51.20 | 8.7 | 0.01 | 0.01 | 0.10 | 0.4 | <0.01 | 0.13 | <0.01 | 0.02 |

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CERTIFICATE OF ANALYSIS VA17220118

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe |
| Units | | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % |
| LOR | | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 |
| L2002449-1 AUGUST TAL 2017 | | 1.03 | 1.6 | 0.11 | <10 | 230 | 0.25 | 0.42 | 0.90 | 0.38 | 20.5 | 7.2 | 6 | 0.53 | 2510 | 3.85 |
| L2002449-2 128174 751-31B | | 0.70 | 0.9 | 0.07 | <10 | 120 | 0.32 | 0.41 | 2.03 | 0.13 | 42.4 | 6.5 | 4 | 0.31 | 2430 | 2.74 |
| L2002449-3 128175 745-2813 | | 0.73 | 2.1 | <0.02 | 10 | 100 | 0.54 | 0.01 | 2.42 | 0.04 | 29.8 | 5.4 | 4 | 0.36 | 15.7 | 2.27 |
| L2002449-4 144852 799-64 | | 1.24 | 4.9 | <0.02 | <10 | 250 | 0.42 | 0.10 | 1.10 | 0.25 | 28.7 | 8.5 | 21 | 0.82 | 290 | 2.55 |
| L2002449-5 144851 805-26 | | 1.04 | 2.5 | <0.02 | <10 | 240 | 0.35 | 0.06 | 0.74 | 0.14 | 27.5 | 6.8 | 9 | 0.75 | 539 | 2.81 |
| L2002449-6 144853 799-65 | | 1.03 | 0.7 | <0.02 | <10 | 190 | 0.27 | 0.02 | 0.52 | 0.08 | 21.6 | 4.9 | 4 | 0.35 | 288 | 2.11 |
| L2002449-7 144854 799-65 | | 0.55 | 3.6 | 0.05 | <10 | 170 | 0.41 | 0.10 | 2.03 | 0.09 | 36.6 | 6.4 | 3 | 0.71 | 878 | 2.36 |
| L2002449-8 144855 799-65 | | 0.79 | 1.2 | <0.02 | <10 | 190 | 0.47 | 0.04 | 1.80 | 0.08 | 27.1 | 6.1 | 4 | 0.89 | 121.5 | 2.52 |
| L2002449-9 144856 799-66 | | 0.92 | 1.1 | 0.05 | <10 | 270 | 0.22 | 0.45 | 1.48 | 0.20 | 20.8 | 5.7 | 4 | 0.54 | 1255 | 2.43 |
| L2002449-10 144857 799-66 | | 0.87 | 0.8 | <0.02 | <10 | 230 | 0.31 | 0.02 | 0.63 | 0.05 | 24.9 | 5.6 | 4 | 0.47 | 78.8 | 2.27 |

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CERTIFICATE OF ANALYSIS VA17220118

| Sample Description | Method Analyte Units LOR | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 | ME-MS41 Hg ppm 0.01 | ME-MS41 In ppm 0.005 | ME-MS41 K % 0.01 | ME-MS41 La ppm 0.2 | ME-MS41 Li ppm 0.1 | ME-MS41 Mg % 0.01 | ME-MS41 Mn ppm 5 | ME-MS41 Mo ppm 0.05 | ME-MS41 Na % 0.01 | ME-MS41 Nb ppm 0.05 | ME-MS41 Ni ppm 0.2 | ME-MS41 P ppm 10 |
|----------------------------|-----------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|---------------------------|-----------------------------|-----------------------------|----------------------------|---------------------------|------------------------------|----------------------------|------------------------------|-----------------------------|---------------------------|
| L2002449-1 AUGUST TAL 2017 | | 6.68 | 0.08 | 0.04 | <0.01 | 0.085 | 0.54 | 10.6 | 4.6 | 0.63 | 669 | 2.45 | 0.06 | 0.18 | 3.2 | 740 |
| L2002449-2 128174 751-31B | | 4.16 | 0.07 | 0.03 | <0.01 | 0.051 | 0.22 | 21.8 | 3.3 | 0.78 | 587 | 0.83 | 0.05 | 0.09 | 2.5 | 950 |
| L2002449-3 128175 745-2813 | | 4.56 | 0.05 | 0.03 | <0.01 | 0.045 | 0.10 | 15.4 | 3.2 | 0.62 | 583 | 0.26 | 0.05 | <0.05 | 2.0 | 630 |
| L2002449-4 144852 799-64 | | 4.84 | 0.06 | 0.22 | 0.02 | 0.031 | 0.23 | 14.9 | 8.0 | 0.71 | 546 | 1.99 | 0.05 | 0.73 | 18.5 | 800 |
| L2002449-5 144851 805-26 | | 4.94 | 0.06 | 0.10 | <0.01 | 0.040 | 0.46 | 14.8 | 4.9 | 0.48 | 651 | 2.93 | 0.05 | 0.37 | 7.3 | 790 |
| L2002449-6 144853 799-65 | | 5.18 | 0.05 | 0.04 | <0.01 | 0.020 | 0.41 | 12.2 | 5.8 | 0.52 | 539 | 0.96 | 0.07 | 0.13 | 2.6 | 560 |
| L2002449-7 144854 799-65 | | 3.12 | 0.05 | 0.03 | <0.01 | 0.036 | 0.20 | 19.7 | 1.8 | 0.14 | 799 | 1.76 | 0.05 | 0.07 | 4.3 | 730 |
| L2002449-8 144855 799-65 | | 4.24 | 0.06 | 0.05 | <0.01 | 0.054 | 0.37 | 13.4 | 3.0 | 0.30 | 831 | 1.07 | 0.05 | 0.06 | 3.4 | 670 |
| L2002449-9 144856 799-66 | | 4.60 | 0.06 | 0.05 | <0.01 | 0.033 | 0.59 | 11.3 | 3.4 | 0.43 | 753 | 0.90 | 0.06 | 0.14 | 2.5 | 700 |
| L2002449-10 144857 799-66 | | 4.62 | 0.07 | 0.05 | <0.01 | 0.028 | 0.37 | 12.9 | 4.2 | 0.41 | 610 | 1.00 | 0.06 | 0.08 | 2.7 | 640 |

***** See Appendix Page for comments regarding this certificate *****



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CERTIFICATE OF ANALYSIS VA17220118

| Sample Description | Method Analyte Units LOR | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm |
|----------------------------|-----------------------------------|----------------------|----------------------|----------------------|-------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|---------------------|
| L2002449-1 AUGUST TAL 2017 | | 3.2 | 27.7 | 0.002 | 0.10 | 0.06 | 4.2 | 2.0 | 0.9 | 64.7 | <0.01 | 0.22 | 3.8 | 0.094 | 0.22 | 0.34 |
| L2002449-2 128174 751-31B | | 4.5 | 12.1 | 0.003 | 0.20 | 0.05 | 5.4 | 2.0 | 0.7 | 198.5 | <0.01 | 0.09 | 6.1 | 0.026 | 0.08 | 0.32 |
| L2002449-3 128175 745-2813 | | 7.0 | 5.4 | <0.001 | 0.01 | 0.11 | 4.7 | <0.2 | 0.7 | 114.0 | <0.01 | 0.01 | 2.7 | <0.005 | 0.03 | 0.34 |
| L2002449-4 144852 799-64 | | 6.2 | 13.6 | 0.001 | 0.01 | 0.40 | 4.6 | 0.3 | 0.5 | 51.4 | <0.01 | 0.02 | 4.4 | 0.070 | 0.13 | 0.70 |
| L2002449-5 144851 805-26 | | 4.2 | 25.3 | 0.001 | 0.01 | 0.16 | 5.0 | 0.4 | 0.7 | 35.3 | <0.01 | 0.02 | 4.3 | 0.081 | 0.21 | 0.39 |
| L2002449-6 144853 799-65 | | 3.2 | 19.8 | <0.001 | <0.01 | <0.05 | 3.3 | <0.2 | 0.5 | 31.6 | <0.01 | <0.01 | 3.2 | 0.073 | 0.12 | 0.19 |
| L2002449-7 144854 799-65 | | 4.5 | 13.2 | <0.001 | <0.01 | <0.05 | 3.8 | 0.5 | 0.5 | 35.3 | <0.01 | 0.02 | 5.6 | 0.016 | 0.06 | 0.25 |
| L2002449-8 144855 799-65 | | 4.5 | 20.0 | <0.001 | <0.01 | 0.06 | 8.6 | 0.2 | 0.8 | 62.6 | <0.01 | 0.01 | 3.4 | 0.043 | 0.13 | 0.28 |
| L2002449-9 144856 799-66 | | 2.7 | 29.7 | <0.001 | 0.01 | <0.05 | 4.4 | 0.5 | 0.6 | 46.4 | <0.01 | 0.15 | 3.8 | 0.096 | 0.18 | 0.25 |
| L2002449-10 144857 799-66 | | 2.5 | 18.8 | <0.001 | <0.01 | <0.05 | 5.2 | <0.2 | 0.6 | 34.9 | <0.01 | <0.01 | 2.6 | 0.052 | 0.10 | 0.19 |



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| |
|---|
| CERTIFICATE OF ANALYSIS VA17220118 |
|---|

| Sample Description | Method Analyte Units LOR | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|-----------------------------------|--------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| L2002449-1 AUGUST TAL 2017 | | 67 | 0.09 | 6.01 | 101 | 1.1 |
| L2002449-2 128174 751-31B | | 49 | 0.23 | 8.67 | 70 | 1.0 |
| L2002449-3 128175 745-2813 | | 40 | 0.16 | 10.05 | 78 | 0.7 |
| L2002449-4 144852 799-64 | | 50 | 0.27 | 9.08 | 78 | 7.2 |
| L2002449-5 144851 805-26 | | 58 | 0.35 | 9.36 | 79 | 2.8 |
| L2002449-6 144853 799-65 | | 45 | 0.35 | 4.68 | 60 | 0.9 |
| L2002449-7 144854 799-65 | | 39 | 0.38 | 5.76 | 67 | 0.9 |
| L2002449-8 144855 799-65 | | 51 | 0.28 | 12.65 | 74 | 1.2 |
| L2002449-9 144856 799-66 | | 56 | 0.60 | 7.85 | 72 | 1.2 |
| L2002449-10 144857 799-66 | | 46 | 0.34 | 9.65 | 63 | 0.9 |
| | | | | | | |



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CERTIFICATE OF ANALYSIS VA17220118

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|--------|----------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | S-CAL06a |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



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QC CERTIFICATE VA17230122

Project: L2010504

This report is for 8 Soil samples submitted to our lab in Vancouver, BC, Canada on 23-OCT-2017.

The following have access to data associated with this certificate:

| | | |
|---|------------------|----------------------------|
| ELSE VANCOUVER WEBTRIEVE SHANE STACK | ALSEV DATASUBLET | SOFTWARE DEVELOPMENT GROUP |
|---|------------------|----------------------------|

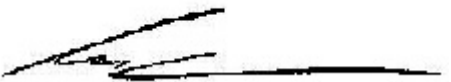
| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| SCR-41 | Screen to -180um and save both |

| ANALYTICAL PROCEDURES | |
|-----------------------|---|
| ALS CODE | DESCRIPTION |
| C-GAS05 | Inorganic Carbon (CO2) |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS |
| OA-VOL08m | Modified NP |
| S-IR08 | Total Sulphur (Leco) LECO |
| OA-ELE07 | Paste pH |
| S-CAL06a | Sulfide Sulfur (calculated*) |
| S-GRA06a | Sulfate Sulfur (HCl leachable) WST-SEQ |

To: **ALS ENVIRONMENTAL**
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17230122

| Method Analyte Units LOR | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | S-IR08 | C-GAS05 | C-GAS05 | S-GRA06a | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------------|-----------|------------|------------|------------|-----------|----------|--------|---------|---------|----------|---------|---------|---------|---------|---------|
| Sample Description | FIZZ RAT | MPA | NNP | NP | Ratio (N) | pH | S | C | CO2 | S | Ag | Al | As | Au | B |
| | Unity | tCaCO3/1Kt | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | ppm | % | ppm | ppm | ppm |
| | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.1 | 0.02 | 10 |

STANDARDS

| | | | | | | | | | | | | | | | | |
|----------------------------|----|------|----|----|------|-----|------|------|-----|--|-------|------|-------|-------|-----|--|
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.3 | | | | | | | | | | |
| Upper Bound | | | | | | 6.7 | | | | | | | | | | |
| CO-ASSAY | | | | | | | | 0.47 | 1.7 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.42 | 1.5 | | | | | | | |
| Upper Bound | | | | | | | | 0.64 | 2.4 | | | | | | | |
| DS-1 | | | | | | | 2.63 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 2.51 | | | | | | | | | |
| Upper Bound | | | | | | | 2.71 | | | | | | | | | |
| GS313-8 | | | | | | | 1.23 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 1.19 | | | | | | | | | |
| Upper Bound | | | | | | | 1.29 | | | | | | | | | |
| KZK-1 | 2 | 25.0 | 31 | 56 | 2.24 | | | | | | | | | | | |
| KZK-1 | 2 | 25.0 | 32 | 57 | 2.28 | | | | | | | | | | | |
| Target Range - Lower Bound | <1 | 22.9 | 30 | 54 | 2.18 | | | | | | | | | | | |
| Upper Bound | >4 | 27.1 | 38 | 64 | 2.53 | | | | | | | | | | | |
| MA-2c | | | | | | | | 1.56 | 5.7 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.50 | 5.5 | | | | | | | |
| Upper Bound | | | | | | | | 1.84 | 6.8 | | | | | | | |
| OGGeo08 | | | | | | | | | | | 19.30 | 2.12 | 122.5 | 0.07 | <10 | |
| Target Range - Lower Bound | | | | | | | | | | | 18.15 | 2.05 | 107.0 | 0.03 | <10 | |
| Upper Bound | | | | | | | | | | | 22.2 | 2.53 | 131.0 | 0.11 | 30 | |
| OREAS 920 | | | | | | | | | | | 0.10 | 2.22 | 4.9 | <0.02 | <10 | |
| Target Range - Lower Bound | | | | | | | | | | | 0.07 | 2.18 | 3.8 | <0.02 | <10 | |
| Upper Bound | | | | | | | | | | | 0.12 | 2.68 | 4.9 | 0.04 | 20 | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17230122

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % | Ga ppm | Ge ppm | Hf ppm | Hg ppm | |
| | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | 90 | 0.80 | 11.55 | 0.85 | 18.65 | 65.8 | 96.4 | 79 | 9.66 | 8160 | 4.93 | 8.15 | 0.19 | 0.76 | 0.48 | |
| Target Range - Lower Bound | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | 4.51 | 8.05 | 0.21 | 0.72 | 0.41 | |
| Upper Bound | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | 5.53 | 9.95 | 0.45 | 0.92 | 0.57 | |
| OREAS 920 | 70 | 0.79 | 0.59 | 0.30 | 0.06 | 77.0 | 13.7 | 40 | 1.88 | 110.0 | 3.42 | 6.25 | 0.10 | 0.54 | <0.01 | |
| Target Range - Lower Bound | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | 3.26 | 6.12 | <0.05 | 0.53 | <0.01 | |
| Upper Bound | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | 4.00 | 7.60 | 0.22 | 0.69 | 0.02 | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17230122

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | Re ppm | S % | |
| | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 | 0.01 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | 1.535 | 1.05 | 32.2 | 32.3 | 0.92 | 368 | 843 | 0.28 | 0.90 | 8570 | 780 | 7000 | 125.5 | 1.450 | 2.64 | |
| Target Range - Lower Bound | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 | 700 | 6520 | 109.5 | 1.295 | 2.51 | |
| Upper Bound | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 | 880 | 7970 | 134.5 | 1.585 | 3.09 | |
| OREAS 920 | 0.029 | 0.40 | 38.6 | 21.7 | 1.01 | 480 | 0.33 | 0.01 | 0.34 | 37.6 | 680 | 22.4 | 24.1 | <0.001 | 0.03 | |
| Target Range - Lower Bound | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 | | 19.2 | 22.2 | <0.001 | <0.01 | |
| Upper Bound | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 | | 23.9 | 27.4 | 0.002 | 0.05 | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm | V ppm | W ppm | Y ppm | Zn ppm |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OGGeo08 | 18.55 | 6.2 | 10.5 | 13.5 | 67.0 | 0.01 | 0.19 | 18.3 | 0.297 | 1.24 | 4.61 | 77 | 2.78 | 17.75 | 6730 |
| Target Range - Lower Bound | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | 4.45 | 70 | 2.58 | 15.35 | 6500 |
| Upper Bound | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | 5.55 | 88 | 3.60 | 18.85 | 7950 |
| OREAS 920 | 0.55 | 2.7 | 0.4 | 1.0 | 18.0 | 0.01 | 0.01 | 16.3 | 0.115 | 0.13 | 1.94 | 23 | 0.45 | 18.30 | 98 |
| Target Range - Lower Bound | 0.45 | 2.5 | 0.4 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | 1.89 | 23 | 0.31 | 16.85 | 93 |
| Upper Bound | 0.77 | 3.3 | 1.3 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | 2.42 | 30 | 0.61 | 20.7 | 119 |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17230122

| Sample Description | Method Analyte Units LOR | |
|----------------------------|-----------------------------------|--|
| | ME-MS41 Zr ppm 0.5 | |
| STANDARDS | | |
| Buffer pH6 | | |
| Buffer pH6 | | |
| Target Range - Lower Bound | | |
| Upper Bound | | |
| CO-ASSAY | | |
| Target Range - Lower Bound | | |
| Upper Bound | | |
| DS-1 | | |
| Target Range - Lower Bound | | |
| Upper Bound | | |
| GS313-8 | | |
| Target Range - Lower Bound | | |
| Upper Bound | | |
| KZK-1 | | |
| KZK-1 | | |
| Target Range - Lower Bound | | |
| Upper Bound | | |
| MA-2c | | |
| Target Range - Lower Bound | | |
| Upper Bound | | |
| OGGeo08 | 23.7 | |
| Target Range - Lower Bound | 19.5 | |
| Upper Bound | 27.5 | |
| OREAS 920 | 21.7 | |
| Target Range - Lower Bound | 17.6 | |
| Upper Bound | 25.0 | |
| UTS-1 | | |
| Target Range - Lower Bound | | |
| Upper Bound | | |
| UTS-4 | | |
| Target Range - Lower Bound | | |
| Upper Bound | | |

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QC CERTIFICATE OF ANALYSIS VA17230122

| Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm |
|----------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|---------------------------------|-------------------------|------------------|-------------------|---------------------|--------------------|----------------------|--------------------|----------------------|----------------------|---------------------|
| Sample Description | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.1 | 0.02 | 10 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | <0.05 | <0.2 | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.05 | <0.2 | | | | | | |
| Upper Bound | | | | | | | | 0.10 | 0.4 | | | | | | |
| BLANK | | | | | | | | | | | <0.01 | <0.01 | <0.1 | <0.02 | <10 |
| Target Range - Lower Bound | | | | | | | | | | | <0.01 | <0.01 | <0.1 | <0.02 | <10 |
| Upper Bound | | | | | | | | | | | 0.02 | 0.02 | 0.2 | 0.04 | 20 |
| BLANK | | | | | | 6.0 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.5 | | | | | | | | | |
| Upper Bound | | | | | | 6.9 | | | | | | | | | |
| BLANK | | | | | | | | | | <0.01 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.01 | | | | | |
| Upper Bound | | | | | | | | | | 0.02 | | | | | |
| BLANK | | | | | | | <0.01 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | <0.01 | | | | | | | | |
| Upper Bound | | | | | | | 0.02 | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| L2010504-5 GTP17-16 S1 | | | | | | | 0.08 | | | | | | | | |
| DUP | | | | | | | 0.08 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 0.07 | | | | | | | | |
| Upper Bound | | | | | | | 0.09 | | | | | | | | |
| L2010504-8 TP31 | 1 | 0.9 | 9 | 10 | 10.67 | | | <0.05 | <0.2 | 0.01 | | | | | |
| DUP | 1 | 0.9 | 9 | 10 | 10.67 | | | <0.05 | <0.2 | 0.02 | | | | | |
| Target Range - Lower Bound | <1 | 0.6 | 8 | 9 | 10.13 | | | <0.05 | <0.2 | <0.01 | | | | | |
| Upper Bound | 2 | 1.2 | 10 | 12 | 11.21 | | | 0.10 | 0.4 | 0.02 | | | | | |
| ORIGINAL | | | | | | | | | | | 0.03 | 0.81 | 62.2 | <0.02 | <10 |
| DUP | | | | | | | | | | | 0.05 | 0.84 | 64.4 | <0.02 | <10 |
| Target Range - Lower Bound | | | | | | | | | | | 0.03 | 0.77 | 60.0 | <0.02 | <10 |
| Upper Bound | | | | | | | | | | | 0.05 | 0.88 | 66.6 | 0.04 | 20 |
| ORIGINAL | | | | | | 8.1 | | | | | | | | | |
| DUP | | | | | | 8.1 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 7.6 | | | | | | | | | |
| Upper Bound | | | | | | 8.6 | | | | | | | | | |



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Project: L2010504

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| Method Analyte Units LOR | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm | ME-MS41 Hf ppm | ME-MS41 Hg ppm |
|----------------------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|
| Sample Description | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | 0.02 | 0.01 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | <0.02 | <0.01 |
| Target Range - Lower Bound | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 | <0.02 | <0.01 |
| Upper Bound | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 | 0.04 | 0.02 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| L2010504-5 GTP17-16 S1 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L2010504-8 TP31 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| ORIGINAL | 90 | 0.41 | 0.10 | 0.12 | 0.08 | 37.3 | 6.7 | 14 | 0.91 | 9.7 | 1.62 | 2.81 | 0.05 | 0.02 | 0.03 |
| DUP | 90 | 0.36 | 0.09 | 0.13 | 0.10 | 39.8 | 6.8 | 15 | 0.98 | 12.4 | 1.65 | 2.87 | 0.05 | 0.02 | 0.05 |
| Target Range - Lower Bound | 70 | 0.32 | 0.08 | 0.11 | 0.08 | 36.6 | 6.3 | 13 | 0.85 | 10.5 | 1.54 | 2.65 | <0.05 | <0.02 | 0.03 |
| Upper Bound | 110 | 0.45 | 0.11 | 0.14 | 0.10 | 40.5 | 7.2 | 16 | 1.04 | 11.6 | 1.73 | 3.03 | 0.10 | 0.04 | 0.05 |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |



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 Account: APN

Project: L2010504

QC CERTIFICATE OF ANALYSIS VA17230122

| Method Analyte Units LOR | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % |
|-----------------------------------|----------------------|-------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|-------------------|
| Sample Description | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | 0.001 | 0.01 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.005 | <0.01 | <0.2 | 0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | <0.001 | <0.01 |
| Target Range - Lower Bound | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | <0.001 | <0.01 |
| Upper Bound | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 | 0.002 | 0.02 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| L2010504-5 GTP17-16 S1 DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L2010504-8 TP31 DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| ORIGINAL | 0.017 | 0.08 | 19.2 | 6.2 | 0.16 | 898 | 0.85 | 0.01 | 1.51 | 6.7 | 320 | 9.4 | 10.0 | <0.001 | 0.01 |
| DUP | 0.019 | 0.08 | 20.5 | 6.2 | 0.17 | 918 | 1.14 | 0.01 | 1.54 | 9.4 | 330 | 11.7 | 10.6 | <0.001 | 0.01 |
| Target Range - Lower Bound | 0.012 | 0.07 | 18.7 | 5.8 | 0.15 | 858 | 0.90 | <0.01 | 1.40 | 7.4 | 300 | 9.8 | 9.7 | <0.001 | <0.01 |
| Upper Bound | 0.024 | 0.09 | 21.0 | 6.6 | 0.18 | 958 | 1.09 | 0.02 | 1.65 | 8.7 | 350 | 11.3 | 10.9 | 0.002 | 0.02 |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

***** See Appendix Page for comments regarding this certificate *****



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 Account: APN

Project: L2010504

QC CERTIFICATE OF ANALYSIS VA17230122

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|-------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm | V ppm | W ppm | Y ppm | Zn ppm |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 | <2 |
| Target Range - Lower Bound | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 | <0.05 | <2 |
| Upper Bound | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 | 0.10 | 4 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| L2010504-5 GTP17-16 S1 DUP | 1.40 | 2.5 | <0.2 | 0.4 | 12.9 | <0.01 | <0.01 | 13.0 | 0.044 | 0.12 | 3.79 | 26 | 0.11 | 9.25 | 38 |
| Target Range - Lower Bound | 1.52 | 2.6 | <0.2 | 0.5 | 14.1 | <0.01 | <0.01 | 14.1 | 0.047 | 0.13 | 4.07 | 27 | 0.11 | 9.85 | 40 |
| Upper Bound | 1.30 | 2.3 | <0.2 | <0.2 | 12.6 | <0.01 | <0.01 | 12.7 | 0.038 | 0.10 | 3.68 | 24 | <0.05 | 9.02 | 35 |
| ORIGINAL | 1.62 | 2.8 | 0.4 | 0.7 | 14.4 | 0.02 | 0.02 | 14.4 | 0.053 | 0.15 | 4.18 | 29 | 0.17 | 10.10 | 43 |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

***** See Appendix Page for comments regarding this certificate *****



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Project: L2010504

QC CERTIFICATE OF ANALYSIS VA17230122

| Sample Description | Method Analyte Units LOR | |
|--|-----------------------------------|-------------------|
| | ME-MS41 Zr ppm 0.5 | |
| | | BLANKS |
| BLANK Target Range - Lower Bound Upper Bound | | |
| BLANK Target Range - Lower Bound Upper Bound | <0.5 <0.5 1.0 | |
| BLANK Target Range - Lower Bound Upper Bound | | |
| BLANK Target Range - Lower Bound Upper Bound | | |
| BLANK Target Range - Lower Bound Upper Bound | | |
| | | DUPLICATES |
| L2010504-5 GTP17-16 S1 DUP Target Range - Lower Bound Upper Bound | | |
| L2010504-8 TP31 DUP Target Range - Lower Bound Upper Bound | | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | 0.9 0.9 <0.5 1.0 | |
| ORIGINAL DUP Target Range - Lower Bound Upper Bound | | |



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Finalized Date: 14-NOV-2017
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QC CERTIFICATE OF ANALYSIS VA17230122

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|-----------|----------|---------|----------|
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 |
| OA-VOL08m | S-CAL06a | SCR-41 | S-GRA06a |
| S-IR08 | WEI-21 | | |



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| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular (R) <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax: minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td rowspan="4" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Metals - Aqua regia digestion (ICP)</td> <td rowspan="4" style="writing-mode: vertical-rl; transform: rotate(180deg);">Paste pH</td> <td rowspan="4" style="writing-mode: vertical-rl; transform: rotate(180deg);">% Inorganic Carbonate</td> <td rowspan="4" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Carbon/Sulphur (Leop)</td> <td rowspan="4" style="writing-mode: vertical-rl; transform: rotate(180deg);">AP - determination by % sulphide sulphur</td> <td rowspan="4" style="writing-mode: vertical-rl; transform: rotate(180deg);">Modified NP - (MEND 1991)</td> <td colspan="7" rowspan="4"></td> <td rowspan="4" style="writing-mode: vertical-rl; transform: rotate(180deg);">Number of Containers</td> </tr> <tr> <td colspan="7"></td> </tr> <tr> <td colspan="7"></td> </tr> <tr> <td colspan="7"></td> </tr> </table> | | | | | | | Total Metals - Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leop) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | | | | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Metals - Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leop) | AP - determination by % sulphide sulphur | | | | | | | | | | | | | | | | | | | | | | Modified NP - (MEND 1991) | | | | | | | | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | | | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | | | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | | | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: TBD | | | | | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | | | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | | ALS Contact: | | Sampler: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>ALS Sample # (lab use only)</th> <th colspan="2">Sample Identification and/or Coordinates (This description will appear on the report)</th> <th>Date (dd-mmm-yy)</th> <th>Time (hh:mm)</th> <th>Sample Type</th> <th>Total Metals - Aqua regia digestion (ICP)</th> <th>Paste pH</th> <th>% Inorganic Carbonate</th> <th>Total Carbon/Sulphur (Leop)</th> <th>AP - determination by % sulphide sulphur</th> <th>Modified NP - (MEND 1991)</th> <th>Number of Containers</th> </tr> </thead> <tbody> <tr> <td></td> <td colspan="2">AUGUST TAL 2017</td> <td></td> <td></td> <td>Composite</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td></td> </tr> <tr> <td></td> <td>128174</td> <td>751-31B</td> <td>30/08/17</td> <td></td> <td>TAILS</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>128175</td> <td>745-2813</td> <td>15/09/17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>144852</td> <td>799-64</td> <td>26/09/17</td> <td></td> <td>waste</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>144851</td> <td>805-26</td> <td>26/09/17</td> <td></td> <td>waste</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>144853</td> <td>799-65</td> <td>26/09/17</td> <td></td> <td>waste</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>144854</td> <td>799-65</td> <td>26/09/17</td> <td></td> <td>waste</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>144855</td> <td>799-65</td> <td>26/09/17</td> <td></td> <td>waste</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>144856</td> <td>799-66</td> <td>25/09/17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>144857</td> <td>799-66</td> <td>25/09/17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> </tbody> </table> | | | | | | | | | | | | ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals - Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leop) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | AUGUST TAL 2017 | | | | Composite | R | R | R | R | R | R | | | 128174 | 751-31B | 30/08/17 | | TAILS | X | X | X | X | X | X | | | 128175 | 745-2813 | 15/09/17 | | WASTE | X | X | X | X | X | X | | | 144852 | 799-64 | 26/09/17 | | waste | X | X | X | X | X | X | | | 144851 | 805-26 | 26/09/17 | | waste | X | X | X | X | X | X | | | 144853 | 799-65 | 26/09/17 | | waste | X | X | X | X | X | X | | | 144854 | 799-65 | 26/09/17 | | waste | X | X | X | X | X | X | | | 144855 | 799-65 | 26/09/17 | | waste | X | X | X | X | X | X | | | 144856 | 799-66 | 25/09/17 | | WASTE | X | X | X | X | X | X | | | 144857 | 799-66 | 25/09/17 | | WASTE | X | X | X | X | X | X | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals - Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leop) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | AUGUST TAL 2017 | | | | Composite | R | R | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 128174 | 751-31B | 30/08/17 | | TAILS | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 128175 | 745-2813 | 15/09/17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 144852 | 799-64 | 26/09/17 | | waste | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 144851 | 805-26 | 26/09/17 | | waste | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 144853 | 799-65 | 26/09/17 | | waste | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 144854 | 799-65 | 26/09/17 | | waste | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 144855 | 799-65 | 26/09/17 | | waste | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 144856 | 799-66 | 25/09/17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 144857 | 799-66 | 25/09/17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | INITIAL COOLER TEMPERATURES °C | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 14.0 | | | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: | | Date: | | Time: | | Received by: | | Date: | | Time: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | LHF | | 4082017 | | 14:50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | ② JC | | 10/5/17 13:25 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 30-OCT-17
Report Date: 15-JAN-18 13:25 (MT)
Version: FINAL REV. 3

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2015579
Project P.O. #: 228594
Job Reference:
C of C Numbers:
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

15-JAN-2018 Please note, the sample type, COC and sampling date for L2015579-10 have been revised for this report as requested.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2015579-1 Tails 04-SEP-17 SEP TAC 2017 | L2015579-2 Waste 30-SEP-17 144858 | L2015579-3 Waste 03-OCT-17 144859 | L2015579-4 Waste 03-OCT-17 144860 | L2015579-5 Waste 07-OCT-17 144861 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.2 | 8.2 | 8.9 | 8.8 | 7.9 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.30 | 0.22 | 0.19 | 0.44 | 0.31 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 2.5 | 0.6 | 3.1 | 0.3 | 1.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 24 | 24 | 20 | 39 | 25 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 22 | 23 | 17 | 39 | 23 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 9.60 | 38.40 | 6.40 | 124.80 | 16.00 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | 0.01 | 0.01 | 0.03 | <0.01 | 0.02 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | 0.05 | 0.03 | 0.03 | <0.01 | 0.02 |
| | Sulfide Sulfur (T minus HCl leach) (%) | | | | |
| | 0.03 | <0.01 | 0.07 | 0.01 | 0.03 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.08 | 0.02 | 0.10 | 0.01 | 0.05 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.04 | 1.08 | 1.15 | 0.94 | 1.20 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.06 | 0.39 | <0.05 | <0.05 | 0.57 |
| | Arsenic (As) (ppm) | | | | |
| | 1.4 | 5.2 | 1.0 | 1.0 | 7.5 |
| | Barium (Ba) (ppm) | | | | |
| | 170 | 290 | 260 | 230 | 280 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.26 | 0.40 | 0.22 | 0.35 | 0.51 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.55 | 0.09 | 0.11 | 0.05 | 0.13 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.40 | 0.23 | 0.15 | 0.03 | 0.29 |
| | Calcium (Ca) (%) | | | | |
| | 0.94 | 1.04 | 0.71 | 1.51 | 1.30 |
| | Cerium (Ce) (ppm) | | | | |
| | 19.35 | 29.9 | 46.8 | 36.6 | 32.0 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.48 | 0.80 | 0.92 | 0.82 | 0.85 |
| | Chromium (Cr) (ppm) | | | | |
| | 6 | 19 | 5 | 5 | 31 |
| | Cobalt (Co) (ppm) | | | | |
| | 7.5 | 8.1 | 6.7 | 6.7 | 9.8 |
| | Copper (Cu) (ppm) | | | | |
| | 3190 | 224 | 1110 | 18.5 | 78.3 |
| | Gallium (Ga) (ppm) | | | | |
| | 7.47 | 4.40 | 6.20 | 5.32 | 4.38 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.11 | 0.10 | 0.13 | 0.12 | 0.09 |
| | Gold (Au) (ppm) | | | | |
| | 0.15 | <0.02 | 0.02 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.04 | 0.20 | 0.04 | 0.06 | 0.27 |
| | Indium (In) (ppm) | | | | |
| | 0.094 | 0.029 | 0.039 | 0.031 | 0.025 |
| | Iron (Fe) (%) | | | | |
| | 4.07 | 2.41 | 2.61 | 2.88 | 2.41 |
| | Lanthanum (La) (ppm) | | | | |
| | 10.4 | 15.3 | 25.9 | 18.3 | 16.2 |
| | Lead (Pb) (ppm) | | | | |
| | 3.8 | 4.8 | 6.0 | 2.4 | 6.8 |
| | Lithium (Li) (ppm) | | | | |
| | 5.9 | 7.3 | 5.8 | 4.0 | 9.2 |
| | Magnesium (Mg) (%) | | | | |
| | 0.63 | 0.57 | 0.63 | 0.54 | 0.59 |
| | Manganese (Mn) (ppm) | | | | |
| | 735 | 526 | 596 | 692 | 534 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2015579-6 Waste 09-OCT-17 144862 | L2015579-7 Waste 10-OCT-17 144863 | L2015579-8 Waste 12-OCT-17 144864 | L2015579-9 Waste 14-OCT-17 144865 | L2015579-10 Waste 15-OCT-17 144866 |
|-----------------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 7.8 | 8.6 | 7.5 | 7.9 | 7.7 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.22 | 0.08 | 0.19 | 0.30 | 0.20 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 1 | 1 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 1.3 | 0.6 | 1.6 | 1.6 | 1.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 19 | 12 | 12 | 30 | 18 |
| | NNP (tCaCO3/1Kt) | 18 | 11 | 10 | 28 | 17 |
| | Ratio (NP/MPA) (Unity) | 15.20 | 19.20 | 7.68 | 19.20 | 14.40 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | 0.03 | 0.01 | 0.01 | 0.01 | 0.03 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.01 | 0.01 | 0.04 | 0.04 | 0.01 |
| | Total Sulfur (combustion) (%) | 0.04 | 0.02 | 0.05 | 0.05 | 0.04 |
| Total Metals | Aluminum (Al) (%) | 1.28 | 1.16 | 1.19 | 1.57 | 1.82 |
| | Antimony (Sb) (ppm) | 0.55 | <0.05 | 0.55 | 0.77 | 0.77 |
| | Arsenic (As) (ppm) | 7.2 | 1.5 | 7.2 | 9.3 | 10.4 |
| | Barium (Ba) (ppm) | 290 | 110 | 280 | 400 | 380 |
| | Beryllium (Be) (ppm) | 0.50 | 0.22 | 0.49 | 0.69 | 0.74 |
| | Bismuth (Bi) (ppm) | 0.12 | 0.10 | 0.11 | 0.16 | 0.20 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.25 | 0.31 | 0.23 | 0.40 | 0.37 |
| | Calcium (Ca) (%) | 1.01 | 0.44 | 0.84 | 1.37 | 0.94 |
| | Cerium (Ce) (ppm) | 30.2 | 27.1 | 28.2 | 35.7 | 38.4 |
| | Cesium (Cs) (ppm) | 0.88 | 0.93 | 0.80 | 1.46 | 1.58 |
| | Chromium (Cr) (ppm) | 29 | 6 | 27 | 38 | 40 |
| | Cobalt (Co) (ppm) | 9.3 | 6.6 | 9.0 | 12.4 | 13.5 |
| | Copper (Cu) (ppm) | 90.9 | 2440 | 105.0 | 96.6 | 124.0 |
| | Gallium (Ga) (ppm) | 4.43 | 6.89 | 4.32 | 5.33 | 5.92 |
| | Germanium (Ge) (ppm) | 0.09 | 0.13 | 0.09 | 0.10 | 0.11 |
| | Gold (Au) (ppm) | <0.02 | 0.04 | <0.02 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.26 | 0.05 | 0.24 | 0.31 | 0.31 |
| | Indium (In) (ppm) | 0.026 | 0.053 | 0.027 | 0.029 | 0.035 |
| | Iron (Fe) (%) | 2.54 | 3.20 | 2.42 | 2.97 | 3.24 |
| | Lanthanum (La) (ppm) | 15.0 | 14.9 | 14.3 | 17.8 | 19.3 |
| | Lead (Pb) (ppm) | 6.7 | 9.4 | 6.2 | 8.8 | 10.2 |
| | Lithium (Li) (ppm) | 9.2 | 6.1 | 8.9 | 12.2 | 14.5 |
| | Magnesium (Mg) (%) | 0.58 | 0.54 | 0.55 | 0.82 | 0.84 |
| | Manganese (Mn) (ppm) | 515 | 890 | 541 | 654 | 653 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2015579-1 | L2015579-2 | L2015579-3 | L2015579-4 | L2015579-5 |
|------------------------|--------------------------|--------------|--------------|------------|------------|------------|------------|
| | | Description | Tails | Waste | Waste | Waste | Waste |
| | | Sampled Date | 04-SEP-17 | 30-SEP-17 | 03-OCT-17 | 03-OCT-17 | 07-OCT-17 |
| | | Sampled Time | | | | | |
| | | Client ID | SEP TAC 2017 | 144858 | 144859 | 144860 | 144861 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.01 | 0.05 | <0.01 | <0.01 | 0.04 |
| | Molybdenum (Mo) (ppm) | | 2.42 | 1.16 | 5.25 | 5.77 | 1.25 |
| | Nickel (Ni) (ppm) | | 3.8 | 15.7 | 2.3 | 2.3 | 24.6 |
| | Niobium (Nb) (ppm) | | 0.15 | 0.59 | 0.28 | 0.11 | 1.19 |
| | Phosphorus (P) (ppm) | | 770 | 840 | 780 | 780 | 880 |
| | Potassium (K) (%) | | 0.43 | 0.34 | 0.74 | 0.45 | 0.17 |
| | Rhenium (Re) (ppm) | | 0.002 | 0.001 | 0.004 | 0.001 | 0.002 |
| | Rubidium (Rb) (ppm) | | 22.8 | 19.6 | 40.6 | 21.9 | 10.7 |
| | Scandium (Sc) (ppm) | | 4.4 | 5.2 | 6.0 | 6.9 | 5.8 |
| | Selenium (Se) (ppm) | | 2.1 | 0.4 | 0.6 | 0.2 | 0.3 |
| | Silver (Ag) (ppm) | | 0.93 | 0.07 | 0.30 | 0.02 | 0.11 |
| | Sodium (Na) (%) | | 0.04 | 0.04 | 0.06 | 0.06 | 0.05 |
| | Strontium (Sr) (ppm) | | 68.9 | 53.2 | 44.6 | 105.5 | 73.2 |
| | Sulfur (S) (%) | | 0.08 | 0.02 | 0.10 | 0.01 | 0.05 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.26 | 0.01 | 0.05 | 0.02 | 0.02 |
| | Thallium (Tl) (ppm) | | 0.19 | 0.16 | 0.32 | 0.13 | 0.13 |
| | Thorium (Th) (ppm) | | 4.0 | 3.7 | 8.2 | 4.6 | 4.2 |
| | Tin (Sn) (ppm) | | 0.8 | 0.6 | 1.0 | 0.7 | 0.5 |
| | Titanium (Ti) (%) | | 0.077 | 0.090 | 0.126 | 0.068 | 0.079 |
| | Tungsten (W) (ppm) | | 0.06 | 0.76 | 0.38 | 0.16 | 0.64 |
| | Uranium (U) (ppm) | | 0.37 | 0.47 | 0.27 | 0.35 | 0.87 |
| | Vanadium (V) (ppm) | | 66 | 53 | 61 | 63 | 52 |
| | Yttrium (Y) (ppm) | | 5.93 | 9.88 | 7.05 | 11.45 | 10.30 |
| | Zinc (Zn) (ppm) | | 108 | 68 | 86 | 69 | 61 |
| | Zirconium (Zr) (ppm) | | 1.2 | 6.2 | 1.2 | 1.3 | 8.9 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 1.1 | 0.8 | 0.7 | 1.6 | 1.1 |
| Miscellaneous | Carbon (C) (%) | | 0.36 | 0.44 | 0.26 | 0.50 | 1.06 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L2015579-6 Waste 09-OCT-17 144862 | L2015579-7 Waste 10-OCT-17 144863 | L2015579-8 Waste 12-OCT-17 144864 | L2015579-9 Waste 14-OCT-17 144865 | L2015579-10 Waste 15-OCT-17 144866 |
|------------------------|--------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.04 | <0.01 | 0.02 | 0.05 | 0.07 | |
| | Molybdenum (Mo) (ppm) | 1.33 | 9.99 | 3.20 | 2.87 | 1.48 | |
| | Nickel (Ni) (ppm) | 22.7 | 2.3 | 23.2 | 39.1 | 38.4 | |
| | Niobium (Nb) (ppm) | 1.03 | 0.26 | 1.10 | 0.82 | 0.90 | |
| | Phosphorus (P) (ppm) | 830 | 780 | 770 | 900 | 800 | |
| | Potassium (K) (%) | 0.19 | 0.63 | 0.17 | 0.24 | 0.27 | |
| | Rhenium (Re) (ppm) | 0.001 | 0.001 | 0.001 | 0.003 | 0.002 | |
| | Rubidium (Rb) (ppm) | 11.8 | 40.8 | 11.4 | 14.4 | 16.5 | |
| | Scandium (Sc) (ppm) | 5.4 | 6.0 | 5.2 | 6.5 | 6.8 | |
| | Selenium (Se) (ppm) | 0.3 | 0.8 | 0.2 | 0.5 | 0.4 | |
| | Silver (Ag) (ppm) | 0.11 | 0.44 | 0.10 | 0.16 | 0.18 | |
| | Sodium (Na) (%) | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 | |
| | Strontium (Sr) (ppm) | 61.9 | 24.7 | 53.8 | 74.4 | 61.2 | |
| | Sulfur (S) (%) | 0.04 | 0.02 | 0.04 | 0.04 | 0.04 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.04 | 0.07 | 0.04 | 0.03 | 0.03 | |
| | Thallium (Tl) (ppm) | 0.12 | 0.39 | 0.11 | 0.17 | 0.18 | |
| | Thorium (Th) (ppm) | 4.1 | 8.8 | 3.8 | 5.1 | 5.6 | |
| | Tin (Sn) (ppm) | 0.5 | 1.4 | 0.5 | 0.6 | 0.7 | |
| | Titanium (Ti) (%) | 0.086 | 0.113 | 0.074 | 0.074 | 0.072 | |
| | Tungsten (W) (ppm) | 0.62 | 0.37 | 1.02 | 1.23 | 0.46 | |
| | Uranium (U) (ppm) | 0.86 | 0.29 | 0.81 | 1.05 | 1.26 | |
| | Vanadium (V) (ppm) | 55 | 67 | 52 | 60 | 62 | |
| | Yttrium (Y) (ppm) | 9.56 | 7.39 | 9.23 | 12.20 | 12.70 | |
| | Zinc (Zn) (ppm) | 63 | 135 | 61 | 87 | 95 | |
| | Zirconium (Zr) (ppm) | 8.8 | 1.7 | 8.0 | 10.3 | 10.8 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.8 | 0.3 | 0.7 | 1.1 | 0.7 | |
| Miscellaneous | Carbon (C) (%) | 1.10 | 0.10 | 1.58 | 1.17 | 1.19 | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page: 1
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 Plus Appendix Pages
 Finalized Date: 30-NOV-2017
 Account: APN

CERTIFICATE VA17240482

Project: L2015579

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 3-NOV-2017.

The following have access to data associated with this certificate:

| | |
|------------------|-------------|
| ALSEV DATASUBLET | SHANE STACK |
|------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
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BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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 Finalized Date: 30-NOV-2017
 Account: APN

Project: L2015579

CERTIFICATE OF ANALYSIS VA17240482

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm |
|-------------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|
| L2015579-1 SEP TAC 2017 | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 |
| L2015579-2 144858 | | 1.12 | 2 | 2.5 | 22 | 24 | 9.60 | 8.2 | 0.08 | 0.03 | 0.30 | 1.1 | 0.05 | 0.36 | 0.01 | 0.93 |
| L2015579-3 144859 | | 1.08 | 2 | 0.6 | 23 | 24 | 38.40 | 8.2 | 0.02 | <0.01 | 0.22 | 0.8 | 0.03 | 0.44 | 0.01 | 0.07 |
| L2015579-4 144860 | | 1.06 | 2 | 3.1 | 17 | 20 | 6.40 | 8.9 | 0.10 | 0.07 | 0.19 | 0.7 | 0.03 | 0.26 | 0.03 | 0.30 |
| L2015579-5 144861 | | 0.98 | 2 | 0.3 | 39 | 39 | 124.80 | 8.8 | 0.01 | 0.01 | 0.44 | 1.6 | <0.01 | 0.50 | <0.01 | 0.02 |
| L2015579-6 144862 | | 1.08 | 2 | 1.6 | 23 | 25 | 16.00 | 7.9 | 0.05 | 0.03 | 0.31 | 1.1 | 0.02 | 1.06 | 0.02 | 0.11 |
| L2015579-7 144863 | | 1.08 | 2 | 1.3 | 18 | 19 | 15.20 | 7.8 | 0.04 | 0.01 | 0.22 | 0.8 | 0.03 | 1.10 | 0.01 | 0.11 |
| L2015579-8 144864 | | 1.06 | 1 | 0.6 | 11 | 12 | 19.20 | 8.6 | 0.02 | 0.01 | 0.08 | 0.3 | 0.01 | 0.10 | <0.01 | 0.44 |
| L2015579-9 144865 | | 1.16 | 1 | 1.6 | 10 | 12 | 7.68 | 7.5 | 0.05 | 0.04 | 0.19 | 0.7 | 0.01 | 1.58 | <0.01 | 0.10 |
| L2015579-10 144866 | | 1.08 | 2 | 1.6 | 28 | 30 | 19.20 | 7.9 | 0.05 | 0.04 | 0.30 | 1.1 | 0.01 | 1.17 | <0.01 | 0.16 |
| L2015579-10 144866 | | 1.08 | 2 | 1.3 | 17 | 18 | 14.40 | 7.7 | 0.04 | 0.01 | 0.20 | 0.7 | 0.03 | 1.19 | <0.01 | 0.18 |

***** See Appendix Page for comments regarding this certificate *****



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 Total # Pages: 2 (A - E)
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 Finalized Date: 30-NOV-2017
 Account: APN

Project: L2015579

CERTIFICATE OF ANALYSIS VA17240482

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|-------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | Analyte | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu |
| Units | | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm |
| LOR | | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 |
| L2015579-1 SEP TAC 2017 | | 1.04 | 1.4 | 0.15 | <10 | 170 | 0.26 | 0.55 | 0.94 | 0.40 | 19.35 | 7.5 | 6 | 0.48 | 3190 |
| L2015579-2 144858 | | 1.08 | 5.2 | <0.02 | <10 | 290 | 0.40 | 0.09 | 1.04 | 0.23 | 29.9 | 8.1 | 19 | 0.80 | 224 |
| L2015579-3 144859 | | 1.15 | 1.0 | 0.02 | <10 | 260 | 0.22 | 0.11 | 0.71 | 0.15 | 46.8 | 6.7 | 5 | 0.92 | 1110 |
| L2015579-4 144860 | | 0.94 | 1.0 | <0.02 | <10 | 230 | 0.35 | 0.05 | 1.51 | 0.03 | 36.6 | 6.7 | 5 | 0.82 | 18.5 |
| L2015579-5 144861 | | 1.20 | 7.5 | <0.02 | <10 | 280 | 0.51 | 0.13 | 1.30 | 0.29 | 32.0 | 9.8 | 31 | 0.85 | 78.3 |
| L2015579-6 144862 | | 1.28 | 7.2 | <0.02 | <10 | 290 | 0.50 | 0.12 | 1.01 | 0.25 | 30.2 | 9.3 | 29 | 0.88 | 90.9 |
| L2015579-7 144863 | | 1.16 | 1.5 | 0.04 | <10 | 110 | 0.22 | 0.10 | 0.44 | 0.31 | 27.1 | 6.6 | 6 | 0.93 | 2440 |
| L2015579-8 144864 | | 1.19 | 7.2 | <0.02 | <10 | 280 | 0.49 | 0.11 | 0.84 | 0.23 | 28.2 | 9.0 | 27 | 0.80 | 105.0 |
| L2015579-9 144865 | | 1.57 | 9.3 | <0.02 | <10 | 400 | 0.69 | 0.16 | 1.37 | 0.40 | 35.7 | 12.4 | 38 | 1.46 | 96.6 |
| L2015579-10 144866 | | 1.82 | 10.4 | <0.02 | <10 | 380 | 0.74 | 0.20 | 0.94 | 0.37 | 38.4 | 13.5 | 40 | 1.58 | 124.0 |

***** See Appendix Page for comments regarding this certificate *****



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 2 - C
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 30-NOV-2017
 Account: APN

Project: L2015579

CERTIFICATE OF ANALYSIS VA17240482

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|-------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P |
| Units | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm |
| LOR | | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 |
| L2015579-1 SEP TAC 2017 | | 7.47 | 0.11 | 0.04 | 0.01 | 0.094 | 0.43 | 10.4 | 5.9 | 0.63 | 735 | 2.42 | 0.04 | 0.15 | 3.8 | 770 |
| L2015579-2 144858 | | 4.40 | 0.10 | 0.20 | 0.05 | 0.029 | 0.34 | 15.3 | 7.3 | 0.57 | 526 | 1.16 | 0.04 | 0.59 | 15.7 | 840 |
| L2015579-3 144859 | | 6.20 | 0.13 | 0.04 | <0.01 | 0.039 | 0.74 | 25.9 | 5.8 | 0.63 | 596 | 5.25 | 0.06 | 0.28 | 2.3 | 780 |
| L2015579-4 144860 | | 5.32 | 0.12 | 0.06 | <0.01 | 0.031 | 0.45 | 18.3 | 4.0 | 0.54 | 692 | 5.77 | 0.06 | 0.11 | 2.3 | 780 |
| L2015579-5 144861 | | 4.38 | 0.09 | 0.27 | 0.04 | 0.025 | 0.17 | 16.2 | 9.2 | 0.59 | 534 | 1.25 | 0.05 | 1.19 | 24.6 | 880 |
| L2015579-6 144862 | | 4.43 | 0.09 | 0.26 | 0.04 | 0.026 | 0.19 | 15.0 | 9.2 | 0.58 | 515 | 1.33 | 0.05 | 1.03 | 22.7 | 830 |
| L2015579-7 144863 | | 6.89 | 0.13 | 0.05 | <0.01 | 0.053 | 0.63 | 14.9 | 6.1 | 0.54 | 890 | 9.99 | 0.05 | 0.26 | 2.3 | 780 |
| L2015579-8 144864 | | 4.32 | 0.09 | 0.24 | 0.02 | 0.027 | 0.17 | 14.3 | 8.9 | 0.55 | 541 | 3.20 | 0.04 | 1.10 | 23.2 | 770 |
| L2015579-9 144865 | | 5.33 | 0.10 | 0.31 | 0.05 | 0.029 | 0.24 | 17.8 | 12.2 | 0.82 | 654 | 2.87 | 0.04 | 0.82 | 39.1 | 900 |
| L2015579-10 144866 | | 5.92 | 0.11 | 0.31 | 0.07 | 0.035 | 0.27 | 19.3 | 14.5 | 0.84 | 653 | 1.48 | 0.04 | 0.90 | 38.4 | 800 |



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 2 - D
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 30-NOV-2017
 Account: APN

Project: L2015579

CERTIFICATE OF ANALYSIS VA17240482

| Sample Description | Method Analyte Units LOR | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Tl % | ME-MS41 Tl ppm | ME-MS41 U ppm |
|-------------------------|-----------------------------------|----------------------|----------------------|----------------------|-------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|---------------------|
| L2015579-1 SEP TAC 2017 | | 3.8 | 22.8 | 0.002 | 0.08 | 0.06 | 4.4 | 2.1 | 0.8 | 68.9 | <0.01 | 0.26 | 4.0 | 0.077 | 0.19 | 0.37 |
| L2015579-2 144858 | | 4.8 | 19.6 | 0.001 | 0.02 | 0.39 | 5.2 | 0.4 | 0.6 | 53.2 | <0.01 | 0.01 | 3.7 | 0.090 | 0.16 | 0.47 |
| L2015579-3 144859 | | 6.0 | 40.6 | 0.004 | 0.10 | <0.05 | 6.0 | 0.6 | 1.0 | 44.6 | <0.01 | 0.05 | 8.2 | 0.126 | 0.32 | 0.27 |
| L2015579-4 144860 | | 2.4 | 21.9 | 0.001 | 0.01 | <0.05 | 6.9 | 0.2 | 0.7 | 105.5 | <0.01 | 0.02 | 4.6 | 0.068 | 0.13 | 0.35 |
| L2015579-5 144861 | | 6.8 | 10.7 | 0.002 | 0.05 | 0.57 | 5.8 | 0.3 | 0.5 | 73.2 | <0.01 | 0.02 | 4.2 | 0.079 | 0.13 | 0.87 |
| L2015579-6 144862 | | 6.7 | 11.8 | 0.001 | 0.04 | 0.55 | 5.4 | 0.3 | 0.5 | 61.9 | <0.01 | 0.04 | 4.1 | 0.086 | 0.12 | 0.86 |
| L2015579-7 144863 | | 9.4 | 40.8 | 0.001 | 0.02 | <0.05 | 6.0 | 0.8 | 1.4 | 24.7 | <0.01 | 0.07 | 8.8 | 0.113 | 0.39 | 0.29 |
| L2015579-8 144864 | | 6.2 | 11.4 | 0.001 | 0.04 | 0.55 | 5.2 | 0.2 | 0.5 | 53.8 | <0.01 | 0.04 | 3.8 | 0.074 | 0.11 | 0.81 |
| L2015579-9 144865 | | 8.8 | 14.4 | 0.003 | 0.04 | 0.77 | 6.5 | 0.5 | 0.6 | 74.4 | <0.01 | 0.03 | 5.1 | 0.074 | 0.17 | 1.05 |
| L2015579-10 144866 | | 10.2 | 16.5 | 0.002 | 0.04 | 0.77 | 6.8 | 0.4 | 0.7 | 61.2 | <0.01 | 0.03 | 5.6 | 0.072 | 0.18 | 1.26 |



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
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Page: 2 - E
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 30-NOV-2017
 Account: APN

Project: L2015579

| |
|---|
| CERTIFICATE OF ANALYSIS VA17240482 |
|---|

| Sample Description | Method Analyte Units LOR | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|-------------------------|-----------------------------------|--------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| L2015579-1 SEP TAC 2017 | | 66 | 0.06 | 5.93 | 108 | 1.2 |
| L2015579-2 144858 | | 53 | 0.76 | 9.88 | 68 | 6.2 |
| L2015579-3 144859 | | 61 | 0.38 | 7.05 | 86 | 1.2 |
| L2015579-4 144860 | | 63 | 0.16 | 11.45 | 69 | 1.3 |
| L2015579-5 144861 | | 52 | 0.64 | 10.30 | 61 | 8.9 |
| L2015579-6 144862 | | 55 | 0.62 | 9.56 | 63 | 8.8 |
| L2015579-7 144863 | | 67 | 0.37 | 7.39 | 135 | 1.7 |
| L2015579-8 144864 | | 52 | 1.02 | 9.23 | 61 | 8.0 |
| L2015579-9 144865 | | 60 | 1.23 | 12.20 | 87 | 10.3 |
| L2015579-10 144866 | | 62 | 0.46 | 12.70 | 95 | 10.8 |
| | | | | | | |



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Page: Appendix 1
Total # Appendix Pages: 1
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Account: APN

Project: L2015579

CERTIFICATE OF ANALYSIS VA17240482

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



Chain of Custody (COC) / Analytical Request Form

Chain of Custody (COC) / Analytical Request Form



L2015579-COFC

COC Number 17-31

Page 1 of 1

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Canada Toll Free: 1 800 658 9878

Contact and company name below will appear on the final report

Report To: **Mafco Explorations Ltd.**
 Company: **Mafco Explorations Ltd.**
 Contact: **Brian Environment - Coordinator**
 Phone: **1-800-759-4859**
 Company address below will appear on the final report

Street: **2100-510 West Georgia St.**
 City/Province: **Vancouver, British Columbia**
 Postal Code: **V6B 0H3**

Invoice To: **Same as Report To**
 Copy of Invoice with Report: YES NO
 Company: **Mafco Explorations Ltd.**
 Contact: **Ruth Cayetano**

ALS Account # / Quote #: _____
 Job #: _____
 PO / A/E: **TBD**
 LSD: _____

ALS Lab Work Order # (lab use only): _____
 Sample Identification and/or Coordinates (This description will appear on the report):
SEP TAR 2017. ✓

ALS Sample # (lab use only): _____
 Date (dd-mm-yy): _____
 Time (hh:mm): _____
 Sampler: _____
 Sample Type: _____
 Composite: _____

ALS Contact: _____
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 Composite: _____

ALS Contact: _____
 Date (dd-mm-yy): _____
 Time (hh:mm): _____
 Sampler: _____
 Sample Type: _____
 Composite: _____

Select Services Listed Below - Please confirm all EAP 1818 with your ALS - numbers will apply

| | | | | |
|-------------|-------------------------------------|--|--|--------------------------|
| Regular [R] | <input checked="" type="checkbox"/> | Standard TAR & Formed by 3pm - business days - no surcharges apply | 1 Business day [E] | <input type="checkbox"/> |
| 2 day [P2] | <input type="checkbox"/> | | Same Day, Weekend or Statutory holiday [E] | <input type="checkbox"/> |
| 3 day [P3] | <input type="checkbox"/> | | | |
| 4 day [P4] | <input type="checkbox"/> | | | |

For this form to be processed according to the service level specified, you will be required to provide the following information:

Invoice Format (F), Processed (P) or Formed and Processed (FP) below

Analysis Request

Total Metals - Aqua regia digestion (ICP)

Paste pH

% Inorganic Carbonate

Total Carbon/Sulphur (Leco)

AP - determination by % sulphide sulphur

Modified NP - (MEND 1991)

Number of Containers

Drinking Water (DW) Samples (client use)

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Are samples taken from a Regulated CW System? YES NO

Are samples for human drinking water use? YES NO

Shipping Release (client use)

DATE: **26 Oct 2017**

Time: _____

Received by: _____

Date: _____

Initial Shipment Reception (lab use only)

DATE: _____

Time: _____

Received by: _____

Date: _____

Final Shipment Reception (lab use only)

DATE: _____

Time: _____

Received by: _____

Date: _____

Sample Condition as Received (lab use only)

Frozen

Ice Packs

Cooling Inlaid

Initial Cooler Temperatures °C: _____

Final Cooler Temperatures °C: _____

SIF Observations Yes No

Custody seal intact Yes No

White - Laboratory Copy

Yellow - Client Copy

Failure to complete all portions of this form may delay analysis. Please refer to the form LEGALLY by the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

1 of 4 - white - report copy

1 of 4 - white - report copy



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 10-NOV-17
Report Date: 15-JAN-18 13:18 (MT)
Version: FINAL REV. 2

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2021778
Project P.O. #: PO#228594
Job Reference:
C of C Numbers: 17-32
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

15-JAN-2018 Please note, the sample type and COC have been revised for this report as requested.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

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ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2021778-1 Waste 16-OCT-17 144867 | L2021778-2 Waste 18-OCT-17 144868 | L2021778-3 Waste 19-OCT-17 144869 | L2021778-4 Waste 21-OCT-17 144870 | L2021778-5 Waste 22-OCT-17 144871 |
|-----------------------------------|---|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.6 | 8.0 | 7.9 | 8.2 | 8.5 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.19 | 0.23 | 0.24 | 0.28 | <0.05 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 1 |
| | MPA (tCaCO3/1Kt) | 0.3 | 1.3 | 2.2 | 1.3 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 22 | 23 | 22 | 27 | 10 |
| | NNP (tCaCO3/1Kt) | 22 | 22 | 20 | 26 | 9 |
| | Ratio (NP/MPA) (Unity) | 70.40 | 18.40 | 10.06 | 21.60 | 16.00 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | <0.01 | <0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | 0.05 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.01 | <0.01 | 0.07 | 0.04 | 0.02 |
| | Total Sulfur (combustion) (%) | 0.01 | 0.04 | 0.07 | 0.04 | 0.02 |
| Total Metals | Aluminum (Al) (%) | 0.96 | 1.18 | 1.58 | 0.98 | 1.08 |
| | Antimony (Sb) (ppm) | <0.05 | 0.55 | 0.72 | 0.44 | 0.06 |
| | Arsenic (As) (ppm) | 1.6 | 7.0 | 9.8 | 7.6 | 1.7 |
| | Barium (Ba) (ppm) | 220 | 290 | 340 | 290 | 190 |
| | Beryllium (Be) (ppm) | 0.27 | 0.48 | 0.65 | 0.37 | 0.35 |
| | Bismuth (Bi) (ppm) | 0.16 | 0.09 | 0.16 | 0.08 | 0.03 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.18 | 0.22 | 0.35 | 0.20 | 0.14 |
| | Calcium (Ca) (%) | 0.98 | 1.11 | 1.17 | 1.33 | 0.54 |
| | Cerium (Ce) (ppm) | 27.1 | 29.5 | 34.9 | 23.0 | 27.8 |
| | Cesium (Cs) (ppm) | 0.40 | 0.92 | 1.42 | 0.68 | 0.32 |
| | Chromium (Cr) (ppm) | 5 | 23 | 36 | 24 | 4 |
| | Cobalt (Co) (ppm) | 6.5 | 8.1 | 13.4 | 7.5 | 6.0 |
| | Copper (Cu) (ppm) | 1475 | 132.0 | 81.5 | 68.5 | 474 |
| | Gallium (Ga) (ppm) | 5.28 | 4.56 | 5.36 | 3.48 | 5.70 |
| | Germanium (Ge) (ppm) | 0.07 | 0.06 | 0.07 | 0.06 | 0.06 |
| | Gold (Au) (ppm) | 0.03 | <0.02 | <0.02 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.04 | 0.20 | 0.28 | 0.22 | 0.04 |
| | Indium (In) (ppm) | 0.035 | 0.027 | 0.029 | 0.019 | 0.025 |
| | Iron (Fe) (%) | 2.67 | 2.48 | 2.99 | 2.31 | 2.33 |
| | Lanthanum (La) (ppm) | 14.8 | 15.2 | 17.4 | 11.7 | 15.2 |
| | Lead (Pb) (ppm) | 5.5 | 5.9 | 8.4 | 4.7 | 3.1 |
| | Lithium (Li) (ppm) | 4.7 | 7.6 | 11.7 | 6.5 | 8.4 |
| | Magnesium (Mg) (%) | 0.46 | 0.58 | 0.81 | 0.52 | 0.54 |
| | Manganese (Mn) (ppm) | 819 | 513 | 639 | 420 | 708 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2021778-6 Waste 22-OCT-17 144872 | L2021778-7 Waste 25-OCT-17 144873 | L2021778-8 Waste 24-OCT-17 144874 | L2021778-9 Waste 24-OCT-17 144875 | |
|---|--|--|--|--|-------|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | 8.6 | 8.5 | 8.5 | 8.8 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.15 | 0.36 | <0.05 | 0.10 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 1 | 2 |
| | MPA (tCaCO3/1Kt) | 0.6 | 0.9 | 0.3 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 19 | 36 | 5 | 16 |
| | NNP (tCaCO3/1Kt) | 18 | 35 | 5 | 15 |
| | Ratio (NP/MPA) (Unity) | 30.40 | 38.40 | 16.00 | 25.60 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | 0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | 0.03 | 0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.02 | 0.03 | <0.01 | 0.01 |
| | Total Sulfur (combustion) (%) | 0.02 | 0.03 | 0.01 | 0.02 |
| Total Metals | Aluminum (Al) (%) | 0.93 | 0.79 | 0.84 | 1.15 |
| | Antimony (Sb) (ppm) | <0.05 | 0.40 | 0.07 | <0.05 |
| | Arsenic (As) (ppm) | 1.2 | 7.2 | 2.7 | 0.8 |
| | Barium (Ba) (ppm) | 230 | 230 | 180 | 320 |
| | Beryllium (Be) (ppm) | 0.32 | 0.31 | 0.40 | 0.28 |
| | Bismuth (Bi) (ppm) | 0.24 | 0.07 | 0.02 | 0.05 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.18 | 0.17 | 0.12 | 0.07 |
| | Calcium (Ca) (%) | 0.81 | 1.61 | 0.29 | 0.69 |
| | Cerium (Ce) (ppm) | 28.6 | 20.3 | 32.7 | 28.7 |
| | Cesium (Cs) (ppm) | 0.56 | 0.57 | 1.16 | 0.57 |
| | Chromium (Cr) (ppm) | 4 | 22 | 4 | 5 |
| | Cobalt (Co) (ppm) | 6.4 | 6.6 | 6.4 | 6.1 |
| | Copper (Cu) (ppm) | 871 | 26.2 | 135.5 | 665 |
| | Gallium (Ga) (ppm) | 4.94 | 2.84 | 4.50 | 5.83 |
| | Germanium (Ge) (ppm) | 0.09 | 0.06 | 0.10 | 0.08 |
| | Gold (Au) (ppm) | 0.03 | <0.02 | <0.02 | 0.02 |
| | Hafnium (Hf) (ppm) | 0.07 | 0.20 | 0.05 | 0.05 |
| | Indium (In) (ppm) | 0.037 | 0.015 | 0.036 | 0.041 |
| | Iron (Fe) (%) | 2.56 | 1.92 | 2.55 | 2.62 |
| | Lanthanum (La) (ppm) | 15.6 | 10.4 | 17.0 | 15.1 |
| | Lead (Pb) (ppm) | 2.5 | 4.0 | 2.7 | 2.2 |
| | Lithium (Li) (ppm) | 4.3 | 5.4 | 4.2 | 5.3 |
| | Magnesium (Mg) (%) | 0.47 | 0.46 | 0.32 | 0.59 |
| | Manganese (Mn) (ppm) | 777 | 362 | 460 | 636 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2021778-1 Waste 16-OCT-17 144867 | L2021778-2 Waste 18-OCT-17 144868 | L2021778-3 Waste 19-OCT-17 144869 | L2021778-4 Waste 21-OCT-17 144870 | L2021778-5 Waste 22-OCT-17 144871 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | 0.04 | 0.06 | 0.04 | <0.01 |
| | Molybdenum (Mo) (ppm) | 2.54 | 2.01 | 1.37 | 1.08 | 2.90 |
| | Nickel (Ni) (ppm) | 2.3 | 20.3 | 35.8 | 19.7 | 2.4 |
| | Niobium (Nb) (ppm) | 0.16 | 1.06 | 0.94 | 0.78 | 0.23 |
| | Phosphorus (P) (ppm) | 770 | 770 | 810 | 750 | 700 |
| | Potassium (K) (%) | 0.44 | 0.27 | 0.24 | 0.15 | 0.34 |
| | Rhenium (Re) (ppm) | 0.001 | 0.004 | 0.002 | 0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | 22.2 | 14.7 | 15.5 | 8.3 | 16.1 |
| | Scandium (Sc) (ppm) | 4.5 | 5.4 | 6.5 | 4.7 | 3.9 |
| | Selenium (Se) (ppm) | 0.6 | 0.4 | 0.5 | 0.4 | <0.2 |
| | Silver (Ag) (ppm) | 0.34 | 0.10 | 0.15 | 0.08 | 0.09 |
| | Sodium (Na) (%) | 0.05 | 0.05 | 0.04 | 0.06 | 0.05 |
| | Strontium (Sr) (ppm) | 40.8 | 63.0 | 65.9 | 69.4 | 43.5 |
| | Sulfur (S) (%) | 0.02 | 0.05 | 0.06 | 0.04 | 0.01 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.09 | 0.02 | 0.03 | 0.01 | 0.01 |
| | Thallium (Tl) (ppm) | 0.12 | 0.12 | 0.15 | 0.08 | 0.09 |
| | Thorium (Th) (ppm) | 4.8 | 3.8 | 4.8 | 3.0 | 3.2 |
| | Tin (Sn) (ppm) | 0.6 | 0.5 | 0.6 | 0.4 | 0.6 |
| | Titanium (Ti) (%) | 0.062 | 0.070 | 0.069 | 0.074 | 0.055 |
| | Tungsten (W) (ppm) | 0.19 | 0.42 | 0.33 | 0.44 | 0.25 |
| | Uranium (U) (ppm) | 0.33 | 0.71 | 1.21 | 0.66 | 0.25 |
| | Vanadium (V) (ppm) | 51 | 50 | 58 | 50 | 49 |
| | Yttrium (Y) (ppm) | 8.35 | 9.87 | 11.40 | 8.18 | 7.44 |
| | Zinc (Zn) (ppm) | 86 | 76 | 86 | 48 | 71 |
| | Zirconium (Zr) (ppm) | 1.1 | 6.5 | 9.3 | 7.5 | 0.9 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.7 | 0.9 | 0.9 | 1.0 | 0.2 |
| Miscellaneous | Carbon (C) (%) | 0.25 | 0.70 | 0.99 | 0.60 | 0.09 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L2021778-6 Waste 22-OCT-17 144872 | L2021778-7 Waste 25-OCT-17 144873 | L2021778-8 Waste 24-OCT-17 144874 | L2021778-9 Waste 24-OCT-17 144875 |
|------------------------|--------------------------|---|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | 0.04 | 0.01 | <0.01 | |
| | Molybdenum (Mo) (ppm) | 1.84 | 0.71 | 1.60 | 0.93 | |
| | Nickel (Ni) (ppm) | 2.3 | 17.2 | 2.7 | 2.6 | |
| | Niobium (Nb) (ppm) | 0.18 | 0.41 | 0.13 | 0.23 | |
| | Phosphorus (P) (ppm) | 800 | 790 | 790 | 710 | |
| | Potassium (K) (%) | 0.51 | 0.12 | 0.42 | 0.70 | |
| | Rhenium (Re) (ppm) | <0.001 | <0.001 | <0.001 | 0.001 | |
| | Rubidium (Rb) (ppm) | 26.8 | 6.5 | 25.0 | 32.5 | |
| | Scandium (Sc) (ppm) | 4.9 | 4.5 | 8.3 | 7.4 | |
| | Selenium (Se) (ppm) | 0.3 | 0.3 | 0.2 | 0.5 | |
| | Silver (Ag) (ppm) | 0.27 | 0.05 | 0.01 | 0.11 | |
| | Sodium (Na) (%) | 0.05 | 0.05 | 0.05 | 0.07 | |
| | Strontium (Sr) (ppm) | 44.9 | 76.6 | 23.9 | 42.6 | |
| | Sulfur (S) (%) | 0.01 | 0.03 | 0.01 | 0.01 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.07 | 0.01 | <0.01 | 0.01 | |
| | Thallium (Tl) (ppm) | 0.15 | 0.07 | 0.12 | 0.18 | |
| | Thorium (Th) (ppm) | 5.0 | 2.6 | 4.5 | 3.6 | |
| | Tin (Sn) (ppm) | 0.5 | 0.3 | 0.8 | 0.6 | |
| | Titanium (Ti) (%) | 0.077 | 0.064 | 0.057 | 0.107 | |
| | Tungsten (W) (ppm) | 0.24 | 0.51 | 0.27 | 0.27 | |
| | Uranium (U) (ppm) | 0.22 | 0.54 | 0.18 | 0.18 | |
| | Vanadium (V) (ppm) | 55 | 42 | 51 | 59 | |
| | Yttrium (Y) (ppm) | 10.10 | 7.77 | 11.85 | 9.10 | |
| | Zinc (Zn) (ppm) | 83 | 40 | 63 | 74 | |
| | Zirconium (Zr) (ppm) | 1.4 | 6.6 | 1.2 | 0.9 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.5 | 1.3 | <0.2 | 0.4 | |
| Miscellaneous | Carbon (C) (%) | 0.20 | 0.59 | 0.04 | 0.15 | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-32

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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CERTIFICATE VA17252208

Project: L2021778

This report is for 9 Other samples submitted to our lab in Vancouver, BC, Canada on 16-NOV-2017.

The following have access to data associated with this certificate:

| | | |
|------------------|-------------|--|
| ALSEV DATASUBLET | SHANE STACK | |
|------------------|-------------|--|

| SAMPLE PREPARATION | |
|---------------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|------------------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17252208

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm |
|--------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|
| L2021778-1 144867 | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 |
| L2021778-2 144868 | | 1.10 | 2 | 0.3 | 22 | 22 | 70.40 | 8.6 | 0.01 | 0.01 | 0.19 | 0.7 | <0.01 | 0.25 | 0.01 | 0.34 |
| L2021778-3 144869 | | 1.08 | 2 | 1.3 | 22 | 23 | 18.40 | 8.0 | 0.04 | <0.01 | 0.23 | 0.9 | 0.05 | 0.70 | <0.01 | 0.10 |
| L2021778-4 144870 | | 1.08 | 2 | 2.2 | 20 | 22 | 10.06 | 7.9 | 0.07 | 0.07 | 0.24 | 0.9 | <0.01 | 0.99 | <0.01 | 0.15 |
| L2021778-5 144871 | | 1.08 | 2 | 1.3 | 26 | 27 | 21.60 | 8.2 | 0.04 | 0.04 | 0.28 | 1.0 | <0.01 | 0.60 | 0.01 | 0.08 |
| L2021778-6 144872 | | 1.12 | 1 | 0.6 | 9 | 10 | 16.00 | 8.5 | 0.02 | 0.02 | <0.05 | 0.2 | <0.01 | 0.09 | <0.01 | 0.09 |
| L2021778-7 144873 | | 1.00 | 2 | 0.6 | 18 | 19 | 30.40 | 8.6 | 0.02 | 0.02 | 0.15 | 0.5 | <0.01 | 0.20 | <0.01 | 0.27 |
| L2021778-8 144874 | | 1.12 | 2 | 0.9 | 35 | 36 | 38.40 | 8.5 | 0.03 | 0.03 | 0.36 | 1.3 | <0.01 | 0.59 | 0.01 | 0.05 |
| L2021778-9 144875 | | 1.08 | 1 | 0.3 | 5 | 5 | 16.00 | 8.5 | 0.01 | <0.01 | <0.05 | <0.2 | 0.03 | 0.04 | 0.01 | 0.01 |
| | | 1.06 | 2 | 0.6 | 15 | 16 | 25.60 | 8.8 | 0.02 | 0.01 | 0.10 | 0.4 | 0.01 | 0.15 | <0.01 | 0.11 |



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CERTIFICATE OF ANALYSIS VA17252208

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|-----------------------------------|---------|-----------|-----------|----------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|---------|
| | | Al % | As ppm | Au ppm | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % |
| L2021778-1 144867 | | 0.96 | 1.6 | 0.03 | <10 | 220 | 0.27 | 0.16 | 0.98 | 0.18 | 27.1 | 6.5 | 5 | 0.40 | 1475 | 2.67 |
| L2021778-2 144868 | | 1.18 | 7.0 | <0.02 | <10 | 290 | 0.48 | 0.09 | 1.11 | 0.22 | 29.5 | 8.1 | 23 | 0.92 | 132.0 | 2.48 |
| L2021778-3 144869 | | 1.58 | 9.8 | <0.02 | <10 | 340 | 0.65 | 0.16 | 1.17 | 0.35 | 34.9 | 13.4 | 36 | 1.42 | 81.5 | 2.99 |
| L2021778-4 144870 | | 0.98 | 7.6 | <0.02 | <10 | 290 | 0.37 | 0.08 | 1.33 | 0.20 | 23.0 | 7.5 | 24 | 0.68 | 68.5 | 2.31 |
| L2021778-5 144871 | | 1.08 | 1.7 | <0.02 | <10 | 190 | 0.35 | 0.03 | 0.54 | 0.14 | 27.8 | 6.0 | 4 | 0.32 | 474 | 2.33 |
| L2021778-6 144872 | | 0.93 | 1.2 | 0.03 | <10 | 230 | 0.32 | 0.24 | 0.81 | 0.18 | 28.6 | 6.4 | 4 | 0.56 | 871 | 2.56 |
| L2021778-7 144873 | | 0.79 | 7.2 | <0.02 | <10 | 230 | 0.31 | 0.07 | 1.61 | 0.17 | 20.3 | 6.6 | 22 | 0.57 | 26.2 | 1.92 |
| L2021778-8 144874 | | 0.84 | 2.7 | <0.02 | <10 | 180 | 0.40 | 0.02 | 0.29 | 0.12 | 32.7 | 6.4 | 4 | 1.16 | 135.5 | 2.55 |
| L2021778-9 144875 | | 1.15 | 0.8 | 0.02 | <10 | 320 | 0.28 | 0.05 | 0.69 | 0.07 | 28.7 | 6.1 | 5 | 0.57 | 665 | 2.62 |

***** See Appendix Page for comments regarding this certificate *****



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CERTIFICATE OF ANALYSIS VA17252208

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P |
| Units | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm |
| LOR | | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 |
| L2021778-1 144867 | | 5.28 | 0.07 | 0.04 | <0.01 | 0.035 | 0.44 | 14.8 | 4.7 | 0.46 | 819 | 2.54 | 0.05 | 0.16 | 2.3 | 770 |
| L2021778-2 144868 | | 4.56 | 0.06 | 0.20 | 0.04 | 0.027 | 0.27 | 15.2 | 7.6 | 0.58 | 513 | 2.01 | 0.05 | 1.06 | 20.3 | 770 |
| L2021778-3 144869 | | 5.36 | 0.07 | 0.28 | 0.06 | 0.029 | 0.24 | 17.4 | 11.7 | 0.81 | 639 | 1.37 | 0.04 | 0.94 | 35.8 | 810 |
| L2021778-4 144870 | | 3.48 | 0.06 | 0.22 | 0.04 | 0.019 | 0.15 | 11.7 | 6.5 | 0.52 | 420 | 1.08 | 0.06 | 0.78 | 19.7 | 750 |
| L2021778-5 144871 | | 5.70 | 0.06 | 0.04 | <0.01 | 0.025 | 0.34 | 15.2 | 8.4 | 0.54 | 708 | 2.90 | 0.05 | 0.23 | 2.4 | 700 |
| L2021778-6 144872 | | 4.94 | 0.09 | 0.07 | <0.01 | 0.037 | 0.51 | 15.6 | 4.3 | 0.47 | 777 | 1.84 | 0.05 | 0.18 | 2.3 | 800 |
| L2021778-7 144873 | | 2.84 | 0.06 | 0.20 | 0.04 | 0.015 | 0.12 | 10.4 | 5.4 | 0.46 | 362 | 0.71 | 0.05 | 0.41 | 17.2 | 790 |
| L2021778-8 144874 | | 4.50 | 0.10 | 0.05 | 0.01 | 0.036 | 0.42 | 17.0 | 4.2 | 0.32 | 460 | 1.60 | 0.05 | 0.13 | 2.7 | 790 |
| L2021778-9 144875 | | 5.83 | 0.08 | 0.05 | <0.01 | 0.041 | 0.70 | 15.1 | 5.3 | 0.59 | 636 | 0.93 | 0.07 | 0.23 | 2.6 | 710 |

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CERTIFICATE OF ANALYSIS VA17252208

| Sample Description | Method Analyte Units LOR | ME-MS41 Pb ppm 0.2 | ME-MS41 Rb ppm 0.1 | ME-MS41 Re ppm 0.001 | ME-MS41 S % 0.01 | ME-MS41 Sb ppm 0.05 | ME-MS41 Sc ppm 0.1 | ME-MS41 Se ppm 0.2 | ME-MS41 Sn ppm 0.2 | ME-MS41 Sr ppm 0.2 | ME-MS41 Ta ppm 0.01 | ME-MS41 Te ppm 0.01 | ME-MS41 Th ppm 0.2 | ME-MS41 Tl % 0.005 | ME-MS41 Tl ppm 0.02 | ME-MS41 U ppm 0.05 |
|--------------------|-----------------------------------|-----------------------------|-----------------------------|-------------------------------|---------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|-----------------------------|
| L2021778-1 144867 | | 5.5 | 22.2 | 0.001 | 0.02 | <0.05 | 4.5 | 0.6 | 0.6 | 40.8 | <0.01 | 0.09 | 4.8 | 0.062 | 0.12 | 0.33 |
| L2021778-2 144868 | | 5.9 | 14.7 | 0.004 | 0.05 | 0.55 | 5.4 | 0.4 | 0.5 | 63.0 | <0.01 | 0.02 | 3.8 | 0.070 | 0.12 | 0.71 |
| L2021778-3 144869 | | 8.4 | 15.5 | 0.002 | 0.06 | 0.72 | 6.5 | 0.5 | 0.6 | 65.9 | <0.01 | 0.03 | 4.8 | 0.069 | 0.15 | 1.21 |
| L2021778-4 144870 | | 4.7 | 8.3 | 0.001 | 0.04 | 0.44 | 4.7 | 0.4 | 0.4 | 69.4 | <0.01 | 0.01 | 3.0 | 0.074 | 0.08 | 0.66 |
| L2021778-5 144871 | | 3.1 | 16.1 | 0.001 | 0.01 | 0.06 | 3.9 | <0.2 | 0.6 | 43.5 | <0.01 | 0.01 | 3.2 | 0.055 | 0.09 | 0.25 |
| L2021778-6 144872 | | 2.5 | 26.8 | <0.001 | 0.01 | <0.05 | 4.9 | 0.3 | 0.5 | 44.9 | <0.01 | 0.07 | 5.0 | 0.077 | 0.15 | 0.22 |
| L2021778-7 144873 | | 4.0 | 6.5 | <0.001 | 0.03 | 0.40 | 4.5 | 0.3 | 0.3 | 76.6 | <0.01 | 0.01 | 2.6 | 0.064 | 0.07 | 0.54 |
| L2021778-8 144874 | | 2.7 | 25.0 | <0.001 | 0.01 | 0.07 | 8.3 | 0.2 | 0.8 | 23.9 | <0.01 | <0.01 | 4.5 | 0.057 | 0.12 | 0.18 |
| L2021778-9 144875 | | 2.2 | 32.5 | 0.001 | 0.01 | <0.05 | 7.4 | 0.5 | 0.6 | 42.6 | <0.01 | 0.01 | 3.6 | 0.107 | 0.18 | 0.18 |



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| |
|---|
| CERTIFICATE OF ANALYSIS VA17252208 |
|---|

| Sample Description | Method Analyte Units LOR | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|--------------------|-----------------------------------|--------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| L2021778-1 144867 | | 51 | 0.19 | 8.35 | 86 | 1.1 |
| L2021778-2 144868 | | 50 | 0.42 | 9.87 | 76 | 6.5 |
| L2021778-3 144869 | | 58 | 0.33 | 11.40 | 86 | 9.3 |
| L2021778-4 144870 | | 50 | 0.44 | 8.18 | 48 | 7.5 |
| L2021778-5 144871 | | 49 | 0.25 | 7.44 | 71 | 0.9 |
| L2021778-6 144872 | | 55 | 0.24 | 10.10 | 83 | 1.4 |
| L2021778-7 144873 | | 42 | 0.51 | 7.77 | 40 | 6.6 |
| L2021778-8 144874 | | 51 | 0.27 | 11.85 | 63 | 1.2 |
| L2021778-9 144875 | | 59 | 0.27 | 9.10 | 74 | 0.9 |



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CERTIFICATE OF ANALYSIS VA17252208

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



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Chain of Custody (COC) / Analytical Request Form



L2021778-COFC

IC Number 17-32

Page 1 of 1

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Customer and company name below will appear on the final report

Report To: **Militia Environmental Ltd.**
 Company: **Militia Environmental - Coordinator**
 Contact: **1-804-759-4658**
 Phone: **Company address below will appear on the final report**
 Street: **2100-510 West Georgia St.**
 City/Province: **Vancouver, British Columbia**
 Postal Code: **V6B 0M3**
 Invoice To: YES NO
 Copy of Invoice with Report: YES NO
 Company: **Militia Environmental Ltd.**
 Contact: **Ruth Cayetano**

Report Format / Distribution
 Select Report Format: PDF DOCX EXCEL (xlsx)
 Quality Control (QC) Report with Report: YES NO
 Compare Results to Criteria on Report - provide details below if box checked
 Select Distributor: EMAIL MAIL FAX
 Email 1 or Fax: **militia_environmental@shaw.ca**
 Email 2
 Email 3
 Invoice Distribution
 Select Invoice Distribution: EMAIL MAIL FAX
 Email 1 or Fax: **ap@environmental.com**
 Email 2
 Project Information
 ALS Account # / Quote #: **Oil and Gas Required Fields (client use)**
 Job #: **ALERT Center**
 PO / AFE: **TBO**
 Requester: **Requester Code:**
 Location: **Routing Code:**
 ALS Contact: **ALS Contact:**

Submit Service Level Below - Please confirm all ESR TATs with your client - standard times will apply
 Regular (R) Standard TAT if moved by 3 pm - business days - no surcharge apply
 4 day (P4)
 3 day (P3)
 2 day (P2)
 1 Business day (E1)
 Same Day, Weekend or Statutory Holiday (E0)
 Data and Times Required for all ESR TATs:
 For this test can be performed according to the service level selected, you will be contacted.
 Analysis Request
 Update Report (P), Preserve (P) or Report and Preserve (RP) below
 Number of Containers

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mm-yy) | Time (hh:mm) | Sample Type | Composite | Total Metals - Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) |
|-----------------------------|---|-----------------|--------------|-------------|-----------|---|----------|-----------------------|-----------------------------|--|---------------------------|
| 14458107 | 11-OCT-13 WASTE | 11-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458108 | 12-OCT-13 | 12-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458109 | 13-OCT-13 | 13-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458110 | 14-OCT-13 | 14-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458111 | 15-OCT-13 | 15-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458112 | 16-OCT-13 | 16-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458113 | 17-OCT-13 | 17-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458114 | 18-OCT-13 | 18-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458115 | 19-OCT-13 | 19-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458116 | 20-OCT-13 | 20-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458117 | 21-OCT-13 | 21-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458118 | 22-OCT-13 | 22-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458119 | 23-OCT-13 | 23-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |
| 14458120 | 24-OCT-13 | 24-OCT-13 | 14:15 | WASTE | X | X | X | X | X | X | X |

Drinking Water (DW) Samples (client use)
 Are samples taken from a Regulated DW System? YES NO
 Are samples for human drinking water use? YES NO
 Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (Electronic COC only)

SHIPMENT RELEASE (client use)
 Released by: **[Signature]** Date: **28 OCT 2017**
 INITIAL SHIPMENT RECEPTION (lab use only)
 Received by: _____ Date: _____
 WHITE - LABORATORY COPY YELLOW - CLIENT COPY

REFER TO BACK PAGE FOR ALSTLOCATIONS AND SHIPPING INFORMATION
 Refer to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By use of this form, the user acknowledges and agrees with the Terms and Conditions specified on the back page of the white report copy.
 If any water samples are taken from a Regulated Drinking Water (DW) System, the user must indicate on the back page of the white report copy.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 20-NOV-17
Report Date: 17-JAN-18 13:20 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2024827
Project P.O. #: PO#228594
Job Reference:
C of C Numbers: 17-33
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2024827-1 waste 27-OCT-17 145576 | L2024827-2 waste 27-OCT-17 145577 | L2024827-3 waste 29-OCT-17 145578 | L2024827-4 waste 29-OCT-17 145579 | L2024827-5 tail 31-OCT-17 OCT TAIL 2017 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 7.9 | 8.1 | 8.3 | 8.3 | 8.0 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.27 | 0.44 | 0.20 | <0.05 | 0.26 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 2 | 2 | 2 | 1 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 1.6 | 0.9 | 0.6 | 0.3 | 3.1 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 23 | 42 | 22 | 9 | 21 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 21 | 41 | 21 | 9 | 18 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 14.72 | 44.80 | 35.20 | 28.80 | 6.72 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | 0.02 | <0.01 | 0.01 | <0.01 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | | | | |
| | 0.05 | 0.03 | 0.02 | 0.01 | 0.10 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.05 | 0.03 | 0.02 | 0.01 | 0.10 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.36 | 1.35 | 1.02 | 1.10 | 1.15 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.62 | 0.84 | 0.37 | 0.05 | 0.06 |
| | Arsenic (As) (ppm) | | | | |
| | 8.6 | 8.3 | 3.4 | 1.2 | 1.1 |
| | Barium (Ba) (ppm) | | | | |
| | 320 | 330 | 220 | 150 | 240 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.55 | 0.63 | 0.43 | 0.38 | 0.27 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.15 | 0.13 | 0.07 | 0.03 | 0.49 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.30 | 0.36 | 0.18 | 0.09 | 0.33 |
| | Calcium (Ca) (%) | | | | |
| | 1.18 | 1.75 | 0.95 | 0.39 | 0.88 |
| | Cerium (Ce) (ppm) | | | | |
| | 29.3 | 32.1 | 23.6 | 20.5 | 20.0 |
| | Cesium (Cs) (ppm) | | | | |
| | 1.21 | 1.41 | 0.60 | 0.28 | 0.55 |
| | Chromium (Cr) (ppm) | | | | |
| | 32 | 33 | 18 | 4 | 7 |
| | Cobalt (Co) (ppm) | | | | |
| | 11.2 | 10.7 | 7.1 | 5.8 | 7.4 |
| | Copper (Cu) (ppm) | | | | |
| | 134.5 | 59.1 | 85.5 | 184.5 | 2260 |
| | Gallium (Ga) (ppm) | | | | |
| | 4.48 | 4.45 | 4.10 | 5.74 | 7.64 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.06 | 0.08 | 0.06 | 0.07 | 0.09 |
| | Gold (Au) (ppm) | | | | |
| | <0.02 | <0.02 | <0.02 | <0.02 | 0.09 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.23 | 0.29 | 0.18 | 0.05 | 0.05 |
| | Indium (In) (ppm) | | | | |
| | 0.028 | 0.028 | 0.025 | 0.024 | 0.083 |
| | Iron (Fe) (%) | | | | |
| | 2.85 | 2.72 | 2.12 | 2.21 | 4.23 |
| | Lanthanum (La) (ppm) | | | | |
| | 14.7 | 15.7 | 12.1 | 10.0 | 9.9 |
| | Lead (Pb) (ppm) | | | | |
| | 8.1 | 7.9 | 4.4 | 2.9 | 3.4 |
| | Lithium (Li) (ppm) | | | | |
| | 10.1 | 11.1 | 8.2 | 9.7 | 5.5 |
| | Magnesium (Mg) (%) | | | | |
| | 0.76 | 0.80 | 0.56 | 0.53 | 0.67 |
| | Manganese (Mn) (ppm) | | | | |
| | 610 | 566 | 494 | 632 | 676 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2024827-6 waste 30-OCT-17 145580 | L2024827-7 waste 30-OCT-17 145581 | L2024827-8 waste 01-NOV-17 145583 | L2024827-9 waste 01-NOV-17 145582 | L2024827-10 waste 04-NOV-17 145584 |
|-----------------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.4 | 8.2 | 8.3 | 8.4 | 8.2 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.22 | <0.05 | <0.05 | 0.36 | 0.29 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 1 | 1 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.3 | 0.3 | 0.3 | 0.6 | 0.9 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 24 | 6 | 8 | 36 | 32 |
| | NNP (tCaCO3/1Kt) | 24 | 6 | 8 | 35 | 31 |
| | Ratio (NP/MPA) (Unity) | 76.80 | 19.20 | 25.60 | 57.60 | 34.13 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | 0.02 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | 0.01 | 0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.01 | 0.01 | <0.01 | 0.01 | 0.03 |
| | Total Sulfur (combustion) (%) | 0.01 | 0.01 | 0.01 | 0.02 | 0.03 |
| Total Metals | Aluminum (Al) (%) | 0.93 | 0.84 | 1.18 | 0.84 | 1.10 |
| | Antimony (Sb) (ppm) | 0.32 | 0.05 | 0.06 | 0.39 | 0.61 |
| | Arsenic (As) (ppm) | 5.2 | 3.2 | 3.3 | 6.4 | 7.8 |
| | Barium (Ba) (ppm) | 240 | 220 | 340 | 230 | 520 |
| | Beryllium (Be) (ppm) | 0.37 | 0.33 | 0.33 | 0.34 | 0.55 |
| | Bismuth (Bi) (ppm) | 0.06 | 0.06 | 0.05 | 0.07 | 0.11 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.15 | 0.16 | 0.12 | 0.19 | 0.27 |
| | Calcium (Ca) (%) | 1.03 | 0.30 | 0.38 | 1.49 | 1.41 |
| | Cerium (Ce) (ppm) | 24.4 | 26.3 | 22.6 | 23.5 | 30.8 |
| | Cesium (Cs) (ppm) | 0.64 | 0.44 | 0.73 | 0.61 | 1.01 |
| | Chromium (Cr) (ppm) | 16 | 4 | 6 | 25 | 26 |
| | Cobalt (Co) (ppm) | 6.5 | 6.0 | 6.2 | 6.6 | 9.2 |
| | Copper (Cu) (ppm) | 170.5 | 1040 | 1325 | 49.4 | 401 |
| | Gallium (Ga) (ppm) | 3.88 | 4.45 | 5.89 | 3.08 | 4.13 |
| | Germanium (Ge) (ppm) | 0.06 | 0.08 | 0.09 | 0.06 | 0.07 |
| | Gold (Au) (ppm) | <0.02 | 0.02 | <0.02 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.17 | 0.07 | 0.08 | 0.22 | 0.29 |
| | Indium (In) (ppm) | 0.026 | 0.054 | 0.038 | 0.019 | 0.029 |
| | Iron (Fe) (%) | 2.20 | 2.38 | 2.65 | 1.99 | 2.39 |
| | Lanthanum (La) (ppm) | 12.4 | 14.1 | 10.4 | 12.2 | 15.0 |
| | Lead (Pb) (ppm) | 3.9 | 3.8 | 2.6 | 4.0 | 6.0 |
| | Lithium (Li) (ppm) | 6.3 | 4.5 | 6.3 | 6.1 | 9.3 |
| | Magnesium (Mg) (%) | 0.48 | 0.33 | 0.53 | 0.50 | 0.67 |
| | Manganese (Mn) (ppm) | 452 | 409 | 459 | 406 | 449 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L2024827-1 waste 27-OCT-17 145576 | L2024827-2 waste 27-OCT-17 145577 | L2024827-3 waste 29-OCT-17 145578 | L2024827-4 waste 29-OCT-17 145579 | L2024827-5 tail 31-OCT-17 OCT TAIL 2017 |
|------------------------|--------------------------|---|--|--|--|--|--|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.05 | 0.05 | 0.02 | <0.01 | 0.01 | |
| | Molybdenum (Mo) (ppm) | 1.33 | 1.43 | 1.07 | 2.25 | 2.78 | |
| | Nickel (Ni) (ppm) | 30.4 | 30.9 | 15.0 | 2.0 | 2.8 | |
| | Niobium (Nb) (ppm) | 0.45 | 0.28 | 0.51 | 0.16 | 0.28 | |
| | Phosphorus (P) (ppm) | 820 | 970 | 800 | 640 | 750 | |
| | Potassium (K) (%) | 0.20 | 0.21 | 0.25 | 0.30 | 0.61 | |
| | Rhenium (Re) (ppm) | 0.002 | 0.001 | 0.001 | 0.001 | 0.003 | |
| | Rubidium (Rb) (ppm) | 12.7 | 12.2 | 13.1 | 14.9 | 31.5 | |
| | Scandium (Sc) (ppm) | 5.3 | 5.4 | 4.3 | 3.6 | 4.2 | |
| | Selenium (Se) (ppm) | 0.4 | 0.4 | 0.3 | 0.3 | 1.9 | |
| | Silver (Ag) (ppm) | 0.16 | 0.13 | 0.05 | 0.04 | 0.75 | |
| | Sodium (Na) (%) | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 | |
| | Strontium (Sr) (ppm) | 68.0 | 80.4 | 46.9 | 30.8 | 61.3 | |
| | Sulfur (S) (%) | 0.06 | 0.03 | 0.01 | <0.01 | 0.11 | |
| | Tantalum (Ta) (ppm) | <0.01 | 0.03 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.02 | 0.02 | 0.01 | 0.01 | 0.26 | |
| | Thallium (Tl) (ppm) | 0.14 | 0.15 | 0.11 | 0.10 | 0.26 | |
| | Thorium (Th) (ppm) | 4.4 | 4.2 | 3.0 | 2.3 | 3.6 | |
| | Tin (Sn) (ppm) | 0.5 | 0.5 | 0.5 | 0.5 | 0.9 | |
| | Titanium (Ti) (%) | 0.067 | 0.069 | 0.068 | 0.042 | 0.104 | |
| | Tungsten (W) (ppm) | 0.50 | 0.82 | 0.47 | 0.18 | 0.10 | |
| | Uranium (U) (ppm) | 0.86 | 0.87 | 0.48 | 0.30 | 0.36 | |
| | Vanadium (V) (ppm) | 53 | 51 | 43 | 44 | 74 | |
| | Yttrium (Y) (ppm) | 9.93 | 11.60 | 8.84 | 10.10 | 6.12 | |
| | Zinc (Zn) (ppm) | 81 | 76 | 59 | 65 | 116 | |
| | Zirconium (Zr) (ppm) | 7.9 | 9.2 | 5.4 | 0.9 | 1.2 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.0 | 1.6 | 0.7 | <0.2 | 1.0 | |
| Miscellaneous | Carbon (C) (%) | 0.91 | 0.89 | 0.39 | 0.06 | 0.30 | |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2024827-6 | L2024827-7 | L2024827-8 | L2024827-9 | L2024827-10 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|-------------|
| | | Description | waste | waste | waste | waste | waste |
| | | Sampled Date | 30-OCT-17 | 30-OCT-17 | 01-NOV-17 | 01-NOV-17 | 04-NOV-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 145580 | 145581 | 145583 | 145582 | 145584 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.02 | <0.01 | 0.01 | 0.03 | 0.05 |
| | Molybdenum (Mo) (ppm) | | 1.68 | 2.53 | 1.37 | 2.64 | 1.75 |
| | Nickel (Ni) (ppm) | | 12.2 | 2.6 | 3.2 | 15.1 | 22.6 |
| | Niobium (Nb) (ppm) | | 0.47 | 0.24 | 0.36 | 0.34 | 0.36 |
| | Phosphorus (P) (ppm) | | 760 | 820 | 1040 | 790 | 940 |
| | Potassium (K) (%) | | 0.26 | 0.40 | 0.64 | 0.14 | 0.15 |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | <0.001 | 0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | | 14.1 | 21.1 | 38.0 | 8.4 | 9.3 |
| | Scandium (Sc) (ppm) | | 4.5 | 5.6 | 6.7 | 4.4 | 4.7 |
| | Selenium (Se) (ppm) | | 0.6 | 0.5 | 0.6 | 0.6 | 0.6 |
| | Silver (Ag) (ppm) | | 0.05 | 0.11 | 0.12 | 0.06 | 0.15 |
| | Sodium (Na) (%) | | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 |
| | Strontium (Sr) (ppm) | | 50.2 | 21.3 | 25.0 | 67.6 | 58.4 |
| | Sulfur (S) (%) | | 0.01 | <0.01 | <0.01 | 0.01 | 0.03 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.01 | 0.02 | 0.06 | 0.01 | 0.03 |
| | Thallium (Tl) (ppm) | | 0.11 | 0.14 | 0.25 | 0.10 | 0.10 |
| | Thorium (Th) (ppm) | | 3.3 | 2.9 | 2.3 | 3.3 | 4.7 |
| | Tin (Sn) (ppm) | | 0.5 | 0.7 | 1.0 | 0.3 | 0.6 |
| | Titanium (Ti) (%) | | 0.067 | 0.054 | 0.115 | 0.061 | 0.063 |
| | Tungsten (W) (ppm) | | 0.50 | 0.24 | 0.32 | 0.49 | 0.17 |
| | Uranium (U) (ppm) | | 0.38 | 0.23 | 0.19 | 0.47 | 0.81 |
| | Vanadium (V) (ppm) | | 46 | 52 | 67 | 43 | 50 |
| | Yttrium (Y) (ppm) | | 8.52 | 11.45 | 10.10 | 7.93 | 10.65 |
| | Zinc (Zn) (ppm) | | 55 | 72 | 76 | 43 | 61 |
| | Zirconium (Zr) (ppm) | | 5.2 | 1.5 | 2.0 | 6.7 | 10.1 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 0.8 | <0.2 | <0.2 | 1.3 | 1.1 |
| Miscellaneous | Carbon (C) (%) | | 0.40 | 0.03 | 0.05 | 0.60 | 0.60 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-33

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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Page: 1
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 Plus Appendix Pages
 Finalized Date: 19-DEC-2017
 Account: APN

CERTIFICATE VA17259183

Project: L2024827

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 24-NOV-2017.

The following have access to data associated with this certificate:

| | | |
|------------------|-------------|--|
| ALSEV DATASUBLET | SHANE STACK | |
|------------------|-------------|--|

| SAMPLE PREPARATION | |
|---------------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|------------------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
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BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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Project: L2024827

CERTIFICATE OF ANALYSIS VA17259183

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm |
|--------------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|
| | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 |
| L2024827-1-145576 | | 1.10 | 2 | 1.6 | 21 | 23 | 14.72 | 7.9 | 0.05 | 0.05 | 0.27 | 1.0 | <0.01 | 0.91 | 0.02 | 0.16 |
| L2024827-2-145577 | | 1.06 | 2 | 0.9 | 41 | 42 | 44.80 | 8.1 | 0.03 | 0.03 | 0.44 | 1.6 | <0.01 | 0.89 | <0.01 | 0.13 |
| L2024827-3-145578 | | 1.06 | 2 | 0.6 | 21 | 22 | 35.20 | 8.3 | 0.02 | 0.02 | 0.20 | 0.7 | <0.01 | 0.39 | 0.01 | 0.05 |
| L2024827-4-145579 | | 1.04 | 1 | 0.3 | 9 | 9 | 28.80 | 8.3 | 0.01 | 0.01 | <0.05 | <0.2 | <0.01 | 0.06 | <0.01 | 0.04 |
| L2024827-5 OCT TAIL 2017 | | 1.02 | 2 | 3.1 | 18 | 21 | 6.72 | 8.0 | 0.10 | 0.10 | 0.26 | 1.0 | <0.01 | 0.30 | 0.01 | 0.75 |
| L2024827-6-145580 | | 1.06 | 2 | 0.3 | 24 | 24 | 76.80 | 8.4 | 0.01 | 0.01 | 0.22 | 0.8 | <0.01 | 0.40 | <0.01 | 0.05 |
| L2024827-7-145581 | | 1.04 | 1 | 0.3 | 6 | 6 | 19.20 | 8.2 | 0.01 | 0.01 | <0.05 | <0.2 | <0.01 | 0.03 | 0.02 | 0.11 |
| L2024827-8-145583 | | 1.06 | 1 | 0.3 | 8 | 8 | 25.60 | 8.3 | 0.01 | <0.01 | <0.05 | <0.2 | 0.01 | 0.05 | <0.01 | 0.12 |
| L2024827-9-145582 | | 1.06 | 2 | 0.6 | 35 | 36 | 57.60 | 8.4 | 0.02 | 0.01 | 0.36 | 1.3 | 0.01 | 0.60 | <0.01 | 0.06 |
| L2024827-10-145584 | | 1.06 | 2 | 0.9 | 31 | 32 | 34.13 | 8.2 | 0.03 | 0.03 | 0.29 | 1.1 | <0.01 | 0.60 | <0.01 | 0.15 |

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CERTIFICATE OF ANALYSIS VA17259183

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe |
| Units | | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % |
| LOR | | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 |
| L2024827-1-145576 | | 1.36 | 8.6 | <0.02 | <10 | 320 | 0.55 | 0.15 | 1.18 | 0.30 | 29.3 | 11.2 | 32 | 1.21 | 134.5 | 2.85 |
| L2024827-2-145577 | | 1.35 | 8.3 | <0.02 | <10 | 330 | 0.63 | 0.13 | 1.75 | 0.36 | 32.1 | 10.7 | 33 | 1.41 | 59.1 | 2.72 |
| L2024827-3-145578 | | 1.02 | 3.4 | <0.02 | <10 | 220 | 0.43 | 0.07 | 0.95 | 0.18 | 23.6 | 7.1 | 18 | 0.60 | 85.5 | 2.12 |
| L2024827-4-145579 | | 1.10 | 1.2 | <0.02 | <10 | 150 | 0.38 | 0.03 | 0.39 | 0.09 | 20.5 | 5.8 | 4 | 0.28 | 184.5 | 2.21 |
| L2024827-5 OCT TAIL 2017 | | 1.15 | 1.1 | 0.09 | <10 | 240 | 0.27 | 0.49 | 0.88 | 0.33 | 20.0 | 7.4 | 7 | 0.55 | 2260 | 4.23 |
| L2024827-6-145580 | | 0.93 | 5.2 | <0.02 | <10 | 240 | 0.37 | 0.06 | 1.03 | 0.15 | 24.4 | 6.5 | 16 | 0.64 | 170.5 | 2.20 |
| L2024827-7-145581 | | 0.84 | 3.2 | 0.02 | <10 | 220 | 0.33 | 0.06 | 0.30 | 0.16 | 26.3 | 6.0 | 4 | 0.44 | 1040 | 2.38 |
| L2024827-8-145583 | | 1.18 | 3.3 | <0.02 | <10 | 340 | 0.33 | 0.05 | 0.38 | 0.12 | 22.6 | 6.2 | 6 | 0.73 | 1325 | 2.65 |
| L2024827-9-145582 | | 0.84 | 6.4 | <0.02 | <10 | 230 | 0.34 | 0.07 | 1.49 | 0.19 | 23.5 | 6.6 | 25 | 0.61 | 49.4 | 1.99 |
| L2024827-10-145584 | | 1.10 | 7.8 | <0.02 | <10 | 520 | 0.55 | 0.11 | 1.41 | 0.27 | 30.8 | 9.2 | 26 | 1.01 | 401 | 2.39 |

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CERTIFICATE OF ANALYSIS VA17259183

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P |
| Units | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm |
| LOR | | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 |
| L2024827-1-145576 | | 4.48 | 0.06 | 0.23 | 0.05 | 0.028 | 0.20 | 14.7 | 10.1 | 0.76 | 610 | 1.33 | 0.04 | 0.45 | 30.4 | 820 |
| L2024827-2-145577 | | 4.45 | 0.08 | 0.29 | 0.05 | 0.028 | 0.21 | 15.7 | 11.1 | 0.80 | 566 | 1.43 | 0.04 | 0.28 | 30.9 | 970 |
| L2024827-3-145578 | | 4.10 | 0.06 | 0.18 | 0.02 | 0.025 | 0.25 | 12.1 | 8.2 | 0.56 | 494 | 1.07 | 0.04 | 0.51 | 15.0 | 800 |
| L2024827-4-145579 | | 5.74 | 0.07 | 0.05 | <0.01 | 0.024 | 0.30 | 10.0 | 9.7 | 0.53 | 632 | 2.25 | 0.04 | 0.16 | 2.0 | 640 |
| L2024827-5 OCT TAIL 2017 | | 7.64 | 0.09 | 0.05 | 0.01 | 0.083 | 0.61 | 9.9 | 5.5 | 0.67 | 676 | 2.78 | 0.05 | 0.28 | 2.8 | 750 |
| L2024827-6-145580 | | 3.88 | 0.06 | 0.17 | 0.02 | 0.026 | 0.26 | 12.4 | 6.3 | 0.48 | 452 | 1.68 | 0.03 | 0.47 | 12.2 | 760 |
| L2024827-7-145581 | | 4.45 | 0.08 | 0.07 | <0.01 | 0.054 | 0.40 | 14.1 | 4.5 | 0.33 | 409 | 2.53 | 0.03 | 0.24 | 2.6 | 820 |
| L2024827-8-145583 | | 5.89 | 0.09 | 0.08 | 0.01 | 0.038 | 0.64 | 10.4 | 6.3 | 0.53 | 459 | 1.37 | 0.04 | 0.36 | 3.2 | 1040 |
| L2024827-9-145582 | | 3.08 | 0.06 | 0.22 | 0.03 | 0.019 | 0.14 | 12.2 | 6.1 | 0.50 | 406 | 2.64 | 0.04 | 0.34 | 15.1 | 790 |
| L2024827-10-145584 | | 4.13 | 0.07 | 0.29 | 0.05 | 0.029 | 0.15 | 15.0 | 9.3 | 0.67 | 449 | 1.75 | 0.04 | 0.36 | 22.6 | 940 |

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Project: L2024827

CERTIFICATE OF ANALYSIS VA17259183

| Sample Description | Method Analyte Units LOR | ME-MS41 Pb ppm | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Tl % | ME-MS41 Tl ppm | ME-MS41 U ppm |
|--------------------------|-----------------------------------|----------------------|----------------------|----------------------|-------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|---------------------|
| L2024827-1-145576 | | 8.1 | 12.7 | 0.002 | 0.06 | 0.62 | 5.3 | 0.4 | 0.5 | 68.0 | <0.01 | 0.02 | 4.4 | 0.067 | 0.14 | 0.86 |
| L2024827-2-145577 | | 7.9 | 12.2 | 0.001 | 0.03 | 0.84 | 5.4 | 0.4 | 0.5 | 80.4 | 0.03 | 0.02 | 4.2 | 0.069 | 0.15 | 0.87 |
| L2024827-3-145578 | | 4.4 | 13.1 | 0.001 | 0.01 | 0.37 | 4.3 | 0.3 | 0.5 | 46.9 | <0.01 | 0.01 | 3.0 | 0.068 | 0.11 | 0.48 |
| L2024827-4-145579 | | 2.9 | 14.9 | 0.001 | <0.01 | 0.05 | 3.6 | 0.3 | 0.5 | 30.8 | <0.01 | 0.01 | 2.3 | 0.042 | 0.10 | 0.30 |
| L2024827-5 OCT TAIL 2017 | | 3.4 | 31.5 | 0.003 | 0.11 | 0.06 | 4.2 | 1.9 | 0.9 | 61.3 | <0.01 | 0.26 | 3.6 | 0.104 | 0.26 | 0.36 |
| L2024827-6-145580 | | 3.9 | 14.1 | <0.001 | 0.01 | 0.32 | 4.5 | 0.6 | 0.5 | 50.2 | <0.01 | 0.01 | 3.3 | 0.067 | 0.11 | 0.38 |
| L2024827-7-145581 | | 3.8 | 21.1 | <0.001 | <0.01 | 0.05 | 5.6 | 0.5 | 0.7 | 21.3 | <0.01 | 0.02 | 2.9 | 0.054 | 0.14 | 0.23 |
| L2024827-8-145583 | | 2.6 | 38.0 | <0.001 | <0.01 | 0.06 | 6.7 | 0.6 | 1.0 | 25.0 | <0.01 | 0.06 | 2.3 | 0.115 | 0.25 | 0.19 |
| L2024827-9-145582 | | 4.0 | 8.4 | 0.001 | 0.01 | 0.39 | 4.4 | 0.6 | 0.3 | 67.6 | <0.01 | 0.01 | 3.3 | 0.061 | 0.10 | 0.47 |
| L2024827-10-145584 | | 6.0 | 9.3 | 0.001 | 0.03 | 0.61 | 4.7 | 0.6 | 0.6 | 58.4 | <0.01 | 0.03 | 4.7 | 0.063 | 0.10 | 0.81 |

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| |
|---|
| CERTIFICATE OF ANALYSIS VA17259183 |
|---|

| | Method Analyte Units LOR | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|--------------------------|-----------------------------------|--------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| L2024827-1-145576 | | 53 | 0.50 | 9.93 | 81 | 7.9 |
| L2024827-2-145577 | | 51 | 0.82 | 11.60 | 76 | 9.2 |
| L2024827-3-145578 | | 43 | 0.47 | 8.84 | 59 | 5.4 |
| L2024827-4-145579 | | 44 | 0.18 | 10.10 | 65 | 0.9 |
| L2024827-5 OCT TAIL 2017 | | 74 | 0.10 | 6.12 | 116 | 1.2 |
| L2024827-6-145580 | | 46 | 0.50 | 8.52 | 55 | 5.2 |
| L2024827-7-145581 | | 52 | 0.24 | 11.45 | 72 | 1.5 |
| L2024827-8-145583 | | 67 | 0.32 | 10.10 | 76 | 2.0 |
| L2024827-9-145582 | | 43 | 0.49 | 7.93 | 43 | 6.7 |
| L2024827-10-145584 | | 50 | 0.17 | 10.65 | 61 | 10.1 |
| | | | | | | |



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CERTIFICATE OF ANALYSIS VA17259183

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



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QC CERTIFICATE VA17259183

Project: L2024827

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 24-NOV-2017.

The following have access to data associated with this certificate:

| | |
|------------------|-------------|
| ALSEV DATASUBLET | SHANE STACK |
|------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17259183

| Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % | | | |
|----------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|---------------------------------|-------------------------|------------------|--------------------|-------------------|---------------------|--------------------|------------------|-------------------|----------------------|--------------------|--|-------|------|
| Sample Description | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | | | |
| STANDARDS | | | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.3 | | | | | | | | | | | | |
| Upper Bound | | | | | | 6.7 | | | | | | | | | | | | |
| DS-1 | | | | | | | 2.70 | | | | | | 3.18 | | | | | |
| Target Range - Lower Bound | | | | | | | 2.51 | | | | | | 3.01 | | | | | |
| Upper Bound | | | | | | | 2.71 | | | | | | 3.25 | | | | | |
| GS313-8 | | | | | | | 1.22 | | | | | | 0.96 | | | | | |
| Target Range - Lower Bound | | | | | | | 1.19 | | | | | | 0.90 | | | | | |
| Upper Bound | | | | | | | 1.29 | | | | | | 0.98 | | | | | |
| KZK-1 | 2 | 25.0 | 31 | 56 | 2.24 | | | | | | | | | | | | | |
| KZK-1 | 2 | 25.0 | 32 | 57 | 2.28 | | | | | | | | | | | | | |
| Target Range - Lower Bound | <1 | 22.9 | 30 | 54 | 2.18 | | | | | | | | | | | | | |
| Upper Bound | >4 | 27.1 | 38 | 64 | 2.53 | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | 2.34 | 8.6 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 2.31 | 8.4 | | | | | | | | |
| Upper Bound | | | | | | | | | 2.77 | 10.2 | | | | | | | | |
| MRGeo08 | | | | | | | | | | | | | | | | | 4.47 | 2.59 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | 4.00 | 2.44 |
| Upper Bound | | | | | | | | | | | | | | | | | 4.92 | 3.00 |
| OGGeo08 | | | | | | | | | | | | | | | | | 19.15 | 2.23 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | 18.15 | 2.05 |
| Upper Bound | | | | | | | | | | | | | | | | | 22.2 | 2.53 |
| OREAS 905 | | | | | | | | | | | | | | | | | 0.53 | 0.76 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | 0.45 | 0.73 |
| Upper Bound | | | | | | | | | | | | | | | | | 0.58 | 0.91 |
| OREAS 920 | | | | | | | | | | | | | | | | | 0.10 | 2.36 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | 0.07 | 2.18 |
| Upper Bound | | | | | | | | | | | | | | | | | 0.12 | 2.68 |
| SY-4 | | | | | | | | | 0.86 | 3.1 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.84 | 3.0 | | | | | | | | |
| Upper Bound | | | | | | | | | 1.08 | 4.0 | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | | 0.87 | |
| UTS-1 | | | | | | | | | | | | | | | | | 0.86 | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | 0.83 | |
| Upper Bound | | | | | | | | | | | | | | | | | 0.93 | |
| UTS-1 | | | | | | | | | | | | | | | | | 0.85 | |

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QC CERTIFICATE OF ANALYSIS VA17259183

| Sample Description | Method Analyte Units LOR | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm |
|----------------------------|--------------------------|----------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | | 32.4 | <0.02 | <10 | 440 | 0.75 | 0.64 | 1.09 | 2.24 | 72.2 | 18.1 | 92 | 11.55 | 646 | 3.72 | 8.92 |
| Target Range - Lower Bound | | 29.6 | <0.02 | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 | 3.22 | 8.73 |
| Upper Bound | | 36.4 | 0.04 | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 | 3.96 | 10.80 |
| OGGeo08 | | 120.0 | 0.06 | 10 | 120 | 0.81 | 9.91 | 0.89 | 18.95 | 59.0 | 92.5 | 81 | 9.25 | 8400 | 4.99 | 8.39 |
| Target Range - Lower Bound | | 107.0 | 0.03 | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | 4.51 | 8.05 |
| Upper Bound | | 131.0 | 0.11 | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | 5.53 | 9.95 |
| OREAS 905 | | 33.3 | 0.40 | <10 | 240 | 0.94 | 5.41 | 0.34 | 0.34 | 75.9 | 13.8 | 16 | 1.17 | 1605 | 3.53 | 5.83 |
| Target Range - Lower Bound | | 28.4 | 0.33 | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 | 3.14 | 5.74 |
| Upper Bound | | 35.0 | 0.45 | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 | 3.86 | 7.12 |
| OREAS 920 | | 4.9 | <0.02 | <10 | 80 | 0.81 | 0.61 | 0.31 | 0.06 | 69.1 | 14.0 | 43 | 1.86 | 111.0 | 3.50 | 6.50 |
| Target Range - Lower Bound | | 3.8 | <0.02 | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | 3.26 | 6.12 |
| Upper Bound | | 4.9 | 0.04 | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | 4.00 | 7.60 |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |

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| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | |
| | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 0.13 | 0.71 | 0.07 | 0.155 | 1.29 | 36.2 | 30.3 | 1.18 | 436 | 14.05 | 0.33 | 1.04 | 736 | 1050 | 1115 | |
| Target Range - Lower Bound | 0.07 | 0.64 | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 | 900 | 959 | |
| Upper Bound | 0.29 | 0.83 | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 | 1130 | 1175 | |
| OGGeo08 | 0.20 | 0.73 | 0.45 | 1.390 | 1.06 | 30.1 | 30.3 | 0.95 | 394 | 880 | 0.28 | 1.00 | 8810 | 810 | 7210 | |
| Target Range - Lower Bound | 0.21 | 0.72 | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 | 700 | 6520 | |
| Upper Bound | 0.45 | 0.92 | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 | 880 | 7970 | |
| OREAS 905 | 0.09 | 1.18 | 0.03 | 0.566 | 0.31 | 37.9 | 4.4 | 0.15 | 359 | 2.93 | 0.08 | 0.23 | 8.4 | 250 | 15.3 | |
| Target Range - Lower Bound | <0.05 | 1.08 | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 | | 15.2 | |
| Upper Bound | 0.22 | 1.36 | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 | | 19.0 | |
| OREAS 920 | 0.11 | 0.58 | <0.01 | 0.031 | 0.40 | 34.9 | 22.2 | 1.08 | 518 | 0.34 | 0.02 | 0.36 | 37.4 | 710 | 20.7 | |
| Target Range - Lower Bound | <0.05 | 0.53 | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 | | 19.2 | |
| Upper Bound | 0.22 | 0.69 | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 | | 23.9 | |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |

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| Method Analyte Units LOR | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Tl % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm |
|----------------------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|
| Sample Description | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 142.5 | 0.007 | 0.33 | 3.00 | 6.8 | 1.0 | 3.3 | 81.2 | 0.01 | 0.02 | 22.2 | 0.407 | 0.80 | 5.44 | 102 |
| Target Range - Lower Bound | 132.0 | 0.006 | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 | 4.93 | 90 |
| Upper Bound | 162.0 | 0.010 | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 | 6.13 | 112 |
| OGGeo08 | 121.5 | 1.345 | 2.68 | 18.15 | 6.1 | 9.9 | 13.2 | 62.2 | <0.01 | 0.16 | 15.9 | 0.299 | 1.40 | 4.54 | 80 |
| Target Range - Lower Bound | 109.5 | 1.295 | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | 4.45 | 70 |
| Upper Bound | 134.5 | 1.585 | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | 5.55 | 88 |
| OREAS 905 | 17.9 | <0.001 | 0.07 | 0.94 | 1.7 | 2.0 | 1.2 | 13.7 | <0.01 | 0.07 | 8.0 | 0.021 | 0.11 | 2.16 | 6 |
| Target Range - Lower Bound | 17.3 | <0.001 | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 | 2.08 | 4 |
| Upper Bound | 21.3 | 0.002 | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 | 2.66 | 8 |
| OREAS 920 | 22.7 | <0.001 | 0.02 | 0.56 | 2.8 | 0.2 | 1.0 | 16.0 | 0.01 | 0.01 | 14.8 | 0.114 | 0.15 | 2.01 | 24 |
| Target Range - Lower Bound | 22.2 | <0.001 | <0.01 | 0.45 | 2.5 | <0.2 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | 1.89 | 23 |
| Upper Bound | 27.4 | 0.002 | 0.05 | 0.77 | 3.3 | 0.7 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | 2.42 | 30 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |

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| Method Analyte Units LOR | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|-----------------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS313-8 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-3a | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MRGeo08 | 2.98 | 19.05 | 830 | 21.5 |
| Target Range - Lower Bound | 2.44 | 17.50 | 708 | 18.1 |
| Upper Bound | 3.42 | 21.5 | 870 | 25.7 |
| OGGeo08 | 3.03 | 15.65 | 7000 | 23.6 |
| Target Range - Lower Bound | 2.58 | 15.35 | 6500 | 19.5 |
| Upper Bound | 3.60 | 18.85 | 7950 | 27.5 |
| OREAS 905 | 0.60 | 6.88 | 67 | 44.5 |
| Target Range - Lower Bound | 0.44 | 6.32 | 58 | 39.9 |
| Upper Bound | 0.76 | 7.84 | 76 | 55.1 |
| OREAS 920 | 0.45 | 17.30 | 104 | 20.9 |
| Target Range - Lower Bound | 0.31 | 16.85 | 93 | 17.6 |
| Upper Bound | 0.61 | 20.7 | 119 | 25.0 |
| SY-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |

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| Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % |
|--------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|---------------------------------|-------------------------|------------------|--------------------|-------------------|---------------------|--------------------|------------------|-------------------|----------------------|--------------------|
| Sample Description | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |

STANDARDS

| |
|----------------------------|
| Target Range - Lower Bound |
| Upper Bound |
| UTS-4 |
| Target Range - Lower Bound |
| Upper Bound |
| UTS-4 |
| Target Range - Lower Bound |
| Upper Bound |

| |
|------|
| 0.81 |
| 0.95 |
| 1.78 |
| 1.64 |
| 1.84 |
| 1.67 |
| 1.61 |
| 1.87 |

BLANKS

| |
|----------------------------|
| BLANK |
| Target Range - Lower Bound |
| Upper Bound |
| BLANK |
| BLANK |
| Target Range - Lower Bound |
| Upper Bound |
| BLANK |
| Target Range - Lower Bound |
| Upper Bound |
| BLANK |
| BLANK |
| Target Range - Lower Bound |
| Upper Bound |
| BLANK |
| Target Range - Lower Bound |
| Upper Bound |
| BLANK |
| Target Range - Lower Bound |
| Upper Bound |

| | |
|-------|-------|
| <0.05 | <0.2 |
| <0.05 | <0.2 |
| 0.10 | 0.4 |
| 6.0 | |
| 5.5 | |
| 6.9 | |
| | <0.01 |
| | <0.01 |
| | <0.01 |
| | 0.02 |
| | <0.01 |
| | <0.01 |
| | 0.02 |
| | <0.01 |
| | <0.01 |
| | 0.02 |



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| Method Analyte Units LOR | ME-MS41 As ppm 0.1 | ME-MS41 Au ppm 0.02 | ME-MS41 B ppm 10 | ME-MS41 Ba ppm 10 | ME-MS41 Be ppm 0.05 | ME-MS41 Bi ppm 0.01 | ME-MS41 Ca % 0.01 | ME-MS41 Cd ppm 0.01 | ME-MS41 Ce ppm 0.02 | ME-MS41 Co ppm 0.1 | ME-MS41 Cr ppm 1 | ME-MS41 Cs ppm 0.05 | ME-MS41 Cu ppm 0.2 | ME-MS41 Fe % 0.01 | ME-MS41 Ga ppm 0.05 |
|----------------------------|--------------------|---------------------|------------------|-------------------|---------------------|---------------------|-------------------|---------------------|---------------------|--------------------|------------------|---------------------|--------------------|-------------------|---------------------|
| STANDARDS | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.1 | <0.02 | <10 | <10 | <0.05 | 0.01 | <0.01 | 0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 |
| BLANK | 0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 |
| Target Range - Lower Bound | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 |
| Upper Bound | 0.2 | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17259183

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | |
| | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | 0.1 | <0.01 | <5 | <0.05 | <0.01 | 0.06 | <0.2 | <10 | <0.2 | |
| BLANK | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | |
| Target Range - Lower Bound | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | |
| Upper Bound | 0.10 | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
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| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
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| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17259183

| Method Analyte Units LOR | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm |
|----------------------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|
| Sample Description | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.1 | <0.001 | <0.01 | 0.06 | 0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 |
| BLANK | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 |
| Target Range - Lower Bound | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 |
| Upper Bound | 0.2 | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
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| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17259183

| Sample Description | Method Analyte Units LOR | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|-----------------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| STANDARDS | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| UTS-4 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| UTS-4 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| BLANKS | | | | | |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| BLANK | | <0.05 | <0.05 | <2 | <0.5 |
| BLANK | | <0.05 | <0.05 | <2 | <0.5 |
| Target Range - Lower Bound | | <0.05 | <0.05 | <2 | <0.5 |
| Upper Bound | | 0.10 | 0.10 | 4 | 1.0 |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| BLANK | | | | | |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17259183

| Sample Description | Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|--------------|
| | | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | 0.07 | 2.22 |
| DUP | | | | | | | | | | | | | | | 0.07 | 2.25 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 0.06 | 2.11 |
| Upper Bound | | | | | | | | | | | | | | | 0.08 | 2.36 |
| L2024827-5 OCT TAIL 2017 | | | | | | | | | | | | | | | 0.75 | 1.15 |
| DUP | | | | | | | | | | | | | | | 0.78 | 1.18 |
| Target Range - Lower Bound | | | | | | | | | | | | | | | 0.72 | 1.10 |
| Upper Bound | | | | | | | | | | | | | | | 0.81 | 1.23 |
| L2024827-7-145581 | | | | | | | | | | | | | | | 0.02 | |
| DUP | | | | | | | | | | | | | | | 0.02 | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | <0.01 | |
| Upper Bound | | | | | | | | | | | | | | | 0.03 | |
| L2024827-10-145584 | | 2 | 0.9 | 31 | 32 | 34.13 | | 0.03 | 0.03 | 0.29 | 1.1 | <0.01 | 0.60 | <0.01 | | |
| DUP | | 2 | 1.3 | 31 | 32 | 25.60 | | 0.04 | 0.04 | 0.30 | 1.1 | <0.01 | 0.62 | 0.01 | | |
| Target Range - Lower Bound | | <1 | 0.7 | 28 | 29 | 28.36 | | 0.02 | 0.02 | 0.23 | 0.8 | <0.01 | 0.58 | <0.01 | | |
| Upper Bound | | 3 | 1.5 | 34 | 35 | 31.37 | | 0.05 | 0.05 | 0.36 | 1.4 | 0.02 | 0.64 | 0.02 | | |
| L2027460-5 145589 | | | | | | | 8.6 | | | | | | | | | |
| DUP | | | | | | | 8.6 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | 8.1 | | | | | | | | | |
| Upper Bound | | | | | | | 9.1 | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17259183

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| | Analyte | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | |
| Units | | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | |
| LOR | | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 10.0 | <0.02 | 10 | 130 | 0.57 | 0.04 | 3.23 | 0.03 | 26.8 | 19.0 | 159 | 2.16 | 30.1 | 3.23 | 10.30 |
| DUP | | 10.4 | <0.02 | <10 | 130 | 0.55 | 0.04 | 3.29 | 0.02 | 27.5 | 18.7 | 160 | 2.26 | 29.5 | 3.26 | 10.10 |
| Target Range - Lower Bound | | 9.6 | <0.02 | <10 | 110 | 0.48 | 0.03 | 3.09 | <0.01 | 25.8 | 17.8 | 151 | 2.05 | 28.6 | 3.07 | 9.64 |
| Upper Bound | | 10.8 | 0.04 | 20 | 150 | 0.64 | 0.05 | 3.43 | 0.04 | 28.5 | 19.9 | 168 | 2.37 | 31.0 | 3.42 | 10.75 |
| L2024827-5 OCT TAIL 2017 | | 1.1 | 0.09 | <10 | 240 | 0.27 | 0.49 | 0.88 | 0.33 | 20.0 | 7.4 | 7 | 0.55 | 2260 | 4.23 | 7.64 |
| DUP | | 1.1 | 0.14 | <10 | 240 | 0.26 | 0.47 | 0.90 | 0.32 | 19.95 | 7.6 | 7 | 0.56 | 2320 | 4.33 | 7.73 |
| Target Range - Lower Bound | | 0.9 | 0.09 | <10 | 210 | 0.20 | 0.45 | 0.84 | 0.30 | 18.95 | 7.0 | 6 | 0.48 | 2210 | 4.06 | 7.25 |
| Upper Bound | | 1.3 | 0.14 | 20 | 270 | 0.33 | 0.51 | 0.94 | 0.35 | 21.0 | 8.0 | 8 | 0.63 | 2370 | 4.50 | 8.12 |
| L2024827-7-145581 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L2024827-10-145584 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L2027460-5 145589 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17259183

| Sample Description | Method Analyte Units LOR | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 | ME-MS41 Hg ppm 0.01 | ME-MS41 In ppm 0.005 | ME-MS41 K % 0.01 | ME-MS41 La ppm 0.2 | ME-MS41 Li ppm 0.1 | ME-MS41 Mg % 0.01 | ME-MS41 Mn ppm 5 | ME-MS41 Mo ppm 0.05 | ME-MS41 Na % 0.01 | ME-MS41 Nb ppm 0.05 | ME-MS41 Ni ppm 0.2 | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 |
|----------------------------|-----------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|---------------------------|-----------------------------|-----------------------------|----------------------------|---------------------------|------------------------------|----------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|
| | | DUPLICATES | | | | | | | | | | | | | | |
| ORIGINAL | | 0.23 | 0.62 | 0.01 | 0.018 | 0.04 | 12.0 | 51.4 | 2.93 | 689 | 0.39 | 0.05 | 0.09 | 35.7 | 610 | 20.7 |
| DUP | | 0.21 | 0.65 | 0.01 | 0.016 | 0.04 | 12.6 | 50.3 | 2.93 | 694 | 0.38 | 0.05 | 0.10 | 35.3 | 620 | 20.2 |
| Target Range - Lower Bound | | 0.16 | 0.58 | <0.01 | 0.011 | 0.03 | 11.5 | 48.2 | 2.77 | 652 | 0.32 | 0.04 | <0.05 | 33.5 | 570 | 19.2 |
| Upper Bound | | 0.28 | 0.69 | 0.02 | 0.023 | 0.05 | 13.1 | 53.5 | 3.09 | 731 | 0.45 | 0.06 | 0.10 | 37.5 | 660 | 21.7 |
| L2024827-5 OCT TAIL 2017 | | 0.09 | 0.05 | 0.01 | 0.083 | 0.61 | 9.9 | 5.5 | 0.67 | 676 | 2.78 | 0.05 | 0.28 | 2.8 | 750 | 3.4 |
| DUP | | 0.08 | 0.04 | 0.01 | 0.090 | 0.62 | 10.3 | 5.2 | 0.68 | 686 | 3.01 | 0.05 | 0.26 | 2.9 | 760 | 3.4 |
| Target Range - Lower Bound | | <0.05 | <0.02 | <0.01 | 0.077 | 0.57 | 9.4 | 5.0 | 0.63 | 642 | 2.70 | 0.04 | 0.21 | 2.5 | 710 | 3.0 |
| Upper Bound | | 0.10 | 0.07 | 0.02 | 0.096 | 0.66 | 10.8 | 5.7 | 0.72 | 720 | 3.09 | 0.06 | 0.33 | 3.2 | 800 | 3.8 |
| L2024827-7-145581 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L2024827-10-145584 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L2027460-5 145589 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17259183

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U | V |
| Units | | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm |
| LOR | | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 1.3 | <0.001 | 0.11 | 0.54 | 6.5 | <0.2 | 0.6 | 871 | <0.01 | 0.02 | 1.1 | 0.232 | <0.02 | 0.66 | 71 |
| DUP | | 1.4 | <0.001 | 0.11 | 0.56 | 6.3 | <0.2 | 0.6 | 883 | <0.01 | 0.01 | 1.1 | 0.239 | <0.02 | 0.66 | 73 |
| Target Range - Lower Bound | | 1.2 | <0.001 | 0.09 | 0.46 | 6.0 | <0.2 | 0.4 | 833 | <0.01 | <0.01 | 0.8 | 0.219 | <0.02 | 0.58 | 67 |
| Upper Bound | | 1.5 | 0.002 | 0.13 | 0.64 | 6.8 | 0.4 | 0.8 | 921 | 0.02 | 0.02 | 1.4 | 0.252 | 0.04 | 0.74 | 77 |
| L2024827-5 OCT TAIL 2017 | | 31.5 | 0.003 | 0.11 | 0.06 | 4.2 | 1.9 | 0.9 | 61.3 | <0.01 | 0.26 | 3.6 | 0.104 | 0.26 | 0.36 | 74 |
| DUP | | 32.1 | 0.004 | 0.11 | <0.05 | 4.2 | 2.1 | 1.0 | 62.5 | <0.01 | 0.26 | 3.3 | 0.106 | 0.24 | 0.35 | 75 |
| Target Range - Lower Bound | | 30.1 | 0.002 | 0.09 | <0.05 | 3.9 | 1.7 | 0.7 | 58.6 | <0.01 | 0.24 | 3.1 | 0.095 | 0.21 | 0.29 | 70 |
| Upper Bound | | 33.5 | 0.005 | 0.13 | 0.10 | 4.5 | 2.3 | 1.2 | 65.2 | 0.02 | 0.28 | 3.8 | 0.115 | 0.29 | 0.42 | 79 |
| L2024827-7-145581 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L2024827-10-145584 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L2027460-5 145589 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

***** See Appendix Page for comments regarding this certificate *****



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 100 - 8081 LOUGHEED HWY.
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Page: 4 - E
 Total # Pages: 4 (A - E)
 Plus Appendix Pages
 Finalized Date: 19-DEC-2017
 Account: APN

Project: L2024827

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| QC CERTIFICATE OF ANALYSIS VA17259183 |
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| Sample Description | Method Analyte Units LOR | ME-MS41 W ppm | ME-MS41 Y ppm | ME-MS41 Zn ppm | ME-MS41 Zr ppm |
|----------------------------|--------------------------|---------------|---------------|----------------|----------------|
| | | 0.05 | 0.05 | 2 | 0.5 |
| DUPLICATES | | | | | |
| ORIGINAL | | 0.15 | 7.42 | 65 | 17.5 |
| DUP | | 0.15 | 7.37 | 66 | 17.7 |
| Target Range - Lower Bound | | 0.09 | 6.98 | 60 | 15.8 |
| Upper Bound | | 0.21 | 7.81 | 71 | 19.4 |
| L2024827-5 OCT TAIL 2017 | | 0.10 | 6.12 | 116 | 1.2 |
| DUP | | 0.08 | 6.26 | 117 | 1.2 |
| Target Range - Lower Bound | | <0.05 | 5.83 | 109 | 0.6 |
| Upper Bound | | 0.10 | 6.55 | 124 | 1.8 |
| L2024827-7-145581 | | | | | |
| DUP | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| L2024827-10-145584 | | | | | |
| DUP | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| L2027460-5 145589 | | | | | |
| DUP | | | | | |
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| Upper Bound | | | | | |



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Page: Appendix 1
 Total # Appendix Pages: 1
 Finalized Date: 19-DEC-2017
 Account: APN

Project: L2024827

QC CERTIFICATE OF ANALYSIS VA17259183

| CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | | |
|-----------------------------|---|----------|---------|--------|---------|----------|-----------|--------|--------|----------|---------|----------|--------|--------|--------|--|--|
| | ANALYTICAL COMMENTS | | | | | | | | | | | | | | | | |
| Applies to Method: | Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41 | | | | | | | | | | | | | | | | |
| | LABORATORY ADDRESSES | | | | | | | | | | | | | | | | |
| Applies to Method: | Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada. | | | | | | | | | | | | | | | | |
| | <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">C-IR07</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> </tr> <tr> <td>OA-ELE07</td> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> </tr> <tr> <td>S-CAL06a</td> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> </tr> <tr> <td>SPL-21</td> <td>WEI-21</td> <td></td> <td></td> </tr> </table> | C-GAS05 | C-IR07 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | |
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 | | | | | | | | | | | | | | |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | | | | | | | | | | | | | | |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 | | | | | | | | | | | | | | |
| SPL-21 | WEI-21 | | | | | | | | | | | | | | | | |



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2024827-COFC

COC Number: **17-33**

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| Report To Contact and company name below will appear on the final report Company: Minto Explorations Ltd. Contact: Minto Environment - Coordinator Phone: 1-604-759-4659 Company address below will appear on the final report Street: 2100-510 West Georgia St. City/Province: Vancouver, British Columbia Postal Code: V6B 0M3 | | Report Format / Distribution Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: minto_environment@mintomine.com Email 2: Email 3: | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">PRIORITY (Business Days)</td> <td>4 day [P4] <input type="checkbox"/></td> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">EMERGENCY</td> <td>1 Business day [E1] <input type="checkbox"/></td> </tr> <tr> <td>3 day [P3] <input type="checkbox"/></td> <td>Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/></td> </tr> <tr> <td>2 day [P2] <input type="checkbox"/></td> <td></td> </tr> </table> | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | 3 day [P3] <input type="checkbox"/> | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Company: Minto Explorations Ltd. Contact: Ruth Cayetano | | Invoice Distribution Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: ap@mintomine.com Email 2: | | Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Metals- Aqua regia digestion (ICP)</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Paste pH</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">% Inorganic Carbonate</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Carbon/Sulphur (Leco)</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">AP - determination by % sulphide sulphur</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Modified NP - (MEND 1991)</td> <td colspan="10" rowspan="10" style="text-align: center; vertical-align: middle;">Number of Containers</td> </tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> </table> | | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Project Information ALS Account # / Quote #: Job #: PO / AFE: TBD LSD: | | Oil and Gas Required Fields (client use) AFE/Cost Center: PO# Major/Minor Code: Routing Code: Requisitioner: Location: | | ALS Lab Work Order # (lab use only) ALS Contact: Sampler: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) Sample Identification and/or Coordinates (This description will appear on the report) | | Date (dd-mmm-yy) | | Time (hh:mm) | | Sample Type | | <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table> | | R | R | R | R | R | R | | | | | | | | | | | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | | X | X | X | X | X | X | | | | | | | | | | | | | | | |
| R | R | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input type="checkbox"/> INITIAL COOLER TEMPERATURES °C: 3.0 FINAL COOLER TEMPERATURES °C: 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) Released by: Date: Time: | | INITIAL SHIPMENT RECEPTION (lab use only) Received by: EIFF Date: 20 NOV 2017 Time: 16:22 | | FINAL SHIPMENT RECEPTION (lab use only) Received by: Cade Date: Nov 22 Time: 11:30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.
 OCTOBER 2015 FROXT



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-NOV-17
Report Date: 12-JAN-18 18:39 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2027460
Project P.O. #: 228594
Job Reference:
C of C Numbers: 17-34
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2027460-1 WASTE 05-NOV-17 145585 | L2027460-2 WASTE 02-NOV-17 145586 | L2027460-3 WASTE 02-NOV-17 145587 | L2027460-4 WASTE 06-NOV-17 145588 | L2027460-5 WASTE 06-NOV-17 145589 | |
|---|--|--|--|--|--|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.6 | 8.4 | 8.1 | 8.5 | 8.6 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.66 | 0.35 | 0.15 | 0.62 | 0.70 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 1 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 9.7 | 0.6 | 0.3 | 4.4 | 10.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 38 | 32 | 12 | 39 | 46 |
| | NNP (tCaCO3/1Kt) | 28 | 31 | 12 | 35 | 35 |
| | Ratio (NP/MPA) (Unity) | 3.92 | 51.20 | 38.40 | 8.91 | 4.33 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | 0.02 | <0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | 0.02 | 0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.31 | <0.01 | <0.01 | 0.14 | 0.34 |
| | Total Sulfur (combustion) (%) | 0.31 | 0.02 | 0.01 | 0.14 | 0.34 |
| Total Metals | Aluminum (Al) (%) | 0.66 | 0.95 | 1.08 | 0.54 | 0.90 |
| | Antimony (Sb) (ppm) | <0.05 | 0.36 | 0.12 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 3.1 | 6.1 | 4.1 | 1.6 | 1.3 |
| | Barium (Ba) (ppm) | 210 | 240 | 170 | 90 | 310 |
| | Beryllium (Be) (ppm) | 0.34 | 0.38 | 0.32 | 0.35 | 0.43 |
| | Bismuth (Bi) (ppm) | 0.06 | 0.18 | 0.65 | 0.05 | 0.10 |
| | Boron (B) (ppm) | 10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.19 | 0.21 | 0.10 | 0.11 | 0.13 |
| | Calcium (Ca) (%) | 1.19 | 1.40 | 0.49 | 1.39 | 1.38 |
| | Cerium (Ce) (ppm) | 25.7 | 25.1 | 21.0 | 24.9 | 32.7 |
| | Cesium (Cs) (ppm) | 0.30 | 0.60 | 0.52 | 0.35 | 0.51 |
| | Chromium (Cr) (ppm) | 3 | 20 | 8 | 3 | 3 |
| | Cobalt (Co) (ppm) | 8.8 | 7.4 | 6.4 | 7.3 | 11.7 |
| | Copper (Cu) (ppm) | 1330 | 304 | 8790 | 1490 | 2030 |
| | Gallium (Ga) (ppm) | 3.57 | 3.78 | 5.16 | 3.39 | 4.70 |
| | Germanium (Ge) (ppm) | <0.05 | 0.05 | 0.05 | <0.05 | 0.06 |
| | Gold (Au) (ppm) | <0.02 | <0.02 | 0.13 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.05 | 0.22 | 0.12 | 0.03 | 0.05 |
| | Indium (In) (ppm) | 0.064 | 0.022 | 0.114 | 0.069 | 0.096 |
| | Iron (Fe) (%) | 2.63 | 2.14 | 2.40 | 2.35 | 3.33 |
| | Lanthanum (La) (ppm) | 14.0 | 13.1 | 10.2 | 14.1 | 17.5 |
| | Lead (Pb) (ppm) | 5.6 | 4.5 | 5.4 | 5.2 | 5.3 |
| | Lithium (Li) (ppm) | 2.5 | 7.0 | 5.2 | 2.0 | 3.1 |
| | Magnesium (Mg) (%) | 0.52 | 0.47 | 0.40 | 0.32 | 0.72 |
| | Manganese (Mn) (ppm) | 698 | 421 | 301 | 574 | 1040 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2027460-6 WASTE 11-NOV-17 145590 | L2027460-7 WASTE 13-NOV-17 145591 | L2027460-8 WASTE 05-NOV-17 145592 | L2027460-9 WASTE 17-NOV-17 145593 | L2027460-10 WASTE 14-NOV-17 145594 |
|---|--|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.0 | 8.6 | 8.3 | 7.7 | 8.3 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.35 | 0.44 | 0.38 | 0.34 | 0.09 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 1 |
| | MPA (tCaCO3/1Kt) | 1.6 | 3.8 | 0.6 | 1.9 | 1.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 31 | 33 | 35 | 28 | 11 |
| | NNP (tCaCO3/1Kt) | 29 | 29 | 34 | 26 | 10 |
| | Ratio (NP/MPA) (Unity) | 19.84 | 8.80 | 56.00 | 14.93 | 8.80 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | <0.01 | 0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | 0.01 | 0.01 | 0.02 | 0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.05 | 0.11 | 0.01 | 0.04 | 0.03 |
| | Total Sulfur (combustion) (%) | 0.05 | 0.12 | 0.02 | 0.06 | 0.04 |
| Total Metals | Aluminum (Al) (%) | 1.47 | 1.07 | 0.93 | 1.30 | 0.83 |
| | Antimony (Sb) (ppm) | 0.67 | <0.05 | 0.44 | 0.57 | <0.05 |
| | Arsenic (As) (ppm) | 8.7 | 1.1 | 5.9 | 7.5 | 3.1 |
| | Barium (Ba) (ppm) | 320 | 250 | 230 | 280 | 160 |
| | Beryllium (Be) (ppm) | 0.64 | 0.37 | 0.35 | 0.51 | 0.29 |
| | Bismuth (Bi) (ppm) | 0.19 | 0.19 | 0.10 | 0.15 | 0.27 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.33 | 0.29 | 0.21 | 0.30 | 0.52 |
| | Calcium (Ca) (%) | 1.43 | 1.12 | 1.54 | 1.39 | 0.41 |
| | Cerium (Ce) (ppm) | 33.9 | 32.2 | 25.1 | 29.8 | 29.5 |
| | Cesium (Cs) (ppm) | 1.23 | 0.63 | 0.61 | 0.80 | 0.46 |
| | Chromium (Cr) (ppm) | 33 | 5 | 22 | 29 | 4 |
| | Cobalt (Co) (ppm) | 11.5 | 7.5 | 7.2 | 9.8 | 7.9 |
| | Copper (Cu) (ppm) | 258 | 2200 | 76.1 | 107.0 | 5220 |
| | Gallium (Ga) (ppm) | 4.84 | 5.45 | 3.31 | 4.33 | 4.29 |
| | Germanium (Ge) (ppm) | 0.05 | 0.06 | <0.05 | 0.06 | 0.05 |
| | Gold (Au) (ppm) | <0.02 | 0.03 | 0.03 | <0.02 | 0.07 |
| | Hafnium (Hf) (ppm) | 0.28 | 0.06 | 0.24 | 0.28 | 0.06 |
| | Indium (In) (ppm) | 0.030 | 0.057 | 0.017 | 0.024 | 0.099 |
| | Iron (Fe) (%) | 2.72 | 2.93 | 1.99 | 2.43 | 2.39 |
| | Lanthanum (La) (ppm) | 17.4 | 17.8 | 13.3 | 15.2 | 16.4 |
| | Lead (Pb) (ppm) | 7.9 | 3.9 | 4.7 | 6.6 | 6.6 |
| | Lithium (Li) (ppm) | 11.2 | 3.9 | 6.7 | 9.5 | 3.4 |
| | Magnesium (Mg) (%) | 0.73 | 0.61 | 0.49 | 0.61 | 0.31 |
| | Manganese (Mn) (ppm) | 595 | 753 | 403 | 487 | 657 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2027460-1 WASTE 05-NOV-17 145585 | L2027460-2 WASTE 02-NOV-17 145586 | L2027460-3 WASTE 02-NOV-17 145587 | L2027460-4 WASTE 06-NOV-17 145588 | L2027460-5 WASTE 06-NOV-17 145589 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | 0.04 | 0.04 | 0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | 22.6 | 1.05 | 2.70 | 13.65 | 28.7 |
| | Nickel (Ni) (ppm) | 2.3 | 16.1 | 5.8 | 2.1 | 2.7 |
| | Niobium (Nb) (ppm) | 0.15 | 0.35 | 0.56 | 0.06 | 0.27 |
| | Phosphorus (P) (ppm) | 870 | 770 | 820 | 660 | 890 |
| | Potassium (K) (%) | 0.32 | 0.21 | 0.49 | 0.17 | 0.48 |
| | Rhenium (Re) (ppm) | 0.040 | 0.001 | 0.001 | 0.049 | 0.044 |
| | Rubidium (Rb) (ppm) | 16.2 | 11.7 | 29.3 | 9.2 | 25.0 |
| | Scandium (Sc) (ppm) | 5.0 | 5.0 | 5.4 | 3.8 | 5.4 |
| | Selenium (Se) (ppm) | 1.2 | 0.3 | 1.1 | 0.9 | 1.5 |
| | Silver (Ag) (ppm) | 0.23 | 0.10 | 0.93 | 0.30 | 0.36 |
| | Sodium (Na) (%) | 0.05 | 0.06 | 0.05 | 0.05 | 0.05 |
| | Strontium (Sr) (ppm) | 86.9 | 69.5 | 32.8 | 65.0 | 109.0 |
| | Sulfur (S) (%) | 0.30 | <0.01 | <0.01 | 0.14 | 0.33 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.03 | 0.02 | 0.13 | 0.04 | 0.06 |
| | Thallium (Tl) (ppm) | 0.11 | 0.11 | 0.27 | 0.06 | 0.18 |
| | Thorium (Th) (ppm) | 3.8 | 3.0 | 5.7 | 3.3 | 3.2 |
| | Tin (Sn) (ppm) | 0.8 | 0.5 | 0.8 | 0.8 | 1.0 |
| | Titanium (Ti) (%) | 0.036 | 0.075 | 0.099 | 0.008 | 0.060 |
| | Tungsten (W) (ppm) | 0.24 | 0.45 | 0.28 | 0.12 | 0.21 |
| | Uranium (U) (ppm) | 0.88 | 0.48 | 0.42 | 0.40 | 0.46 |
| | Vanadium (V) (ppm) | 55 | 46 | 59 | 44 | 67 |
| | Yttrium (Y) (ppm) | 9.95 | 9.17 | 9.23 | 7.89 | 10.10 |
| | Zinc (Zn) (ppm) | 71 | 51 | 68 | 60 | 101 |
| | Zirconium (Zr) (ppm) | 1.6 | 6.7 | 4.0 | 1.1 | 1.6 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 2.4 | 1.3 | 0.6 | 2.3 | 2.6 |
| Miscellaneous | Carbon (C) (%) | 0.79 | 0.48 | 0.19 | 0.73 | 0.82 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2027460-6 | L2027460-7 | L2027460-8 | L2027460-9 | L2027460-10 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|-------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 11-NOV-17 | 13-NOV-17 | 05-NOV-17 | 17-NOV-17 | 14-NOV-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 145590 | 145591 | 145592 | 145593 | 145594 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.06 | 0.01 | 0.03 | 0.05 | 0.01 |
| | Molybdenum (Mo) (ppm) | | 1.66 | 15.70 | 1.32 | 1.12 | 7.50 |
| | Nickel (Ni) (ppm) | | 29.6 | 2.5 | 16.7 | 23.5 | 2.5 |
| | Niobium (Nb) (ppm) | | 0.80 | 0.32 | 0.30 | 1.15 | 0.18 |
| | Phosphorus (P) (ppm) | | 830 | 810 | 770 | 820 | 860 |
| | Potassium (K) (%) | | 0.23 | 0.67 | 0.15 | 0.17 | 0.44 |
| | Rhenium (Re) (ppm) | | 0.001 | 0.025 | 0.001 | 0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | | 14.1 | 34.7 | 8.4 | 10.7 | 25.4 |
| | Scandium (Sc) (ppm) | | 6.0 | 6.5 | 4.4 | 5.6 | 5.5 |
| | Selenium (Se) (ppm) | | 0.5 | 1.5 | 0.2 | 0.4 | 1.6 |
| | Silver (Ag) (ppm) | | 0.14 | 0.52 | 0.07 | 0.10 | 0.77 |
| | Sodium (Na) (%) | | 0.06 | 0.06 | 0.06 | 0.05 | 0.05 |
| | Strontium (Sr) (ppm) | | 76.5 | 58.2 | 74.8 | 75.7 | 34.5 |
| | Sulfur (S) (%) | | 0.03 | 0.11 | 0.01 | 0.05 | 0.04 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.03 | 0.07 | 0.01 | 0.02 | 0.12 |
| | Thallium (Tl) (ppm) | | 0.15 | 0.28 | 0.09 | 0.12 | 0.21 |
| | Thorium (Th) (ppm) | | 4.6 | 5.1 | 3.3 | 3.8 | 5.6 |
| | Tin (Sn) (ppm) | | 0.6 | 0.8 | 0.4 | 0.5 | 0.9 |
| | Titanium (Ti) (%) | | 0.073 | 0.100 | 0.071 | 0.086 | 0.063 |
| | Tungsten (W) (ppm) | | 0.36 | 0.48 | 0.43 | 0.33 | 0.56 |
| | Uranium (U) (ppm) | | 0.90 | 0.33 | 0.53 | 0.83 | 0.40 |
| | Vanadium (V) (ppm) | | 56 | 70 | 44 | 53 | 58 |
| | Yttrium (Y) (ppm) | | 11.10 | 9.11 | 8.65 | 10.20 | 10.15 |
| | Zinc (Zn) (ppm) | | 74 | 82 | 43 | 59 | 79 |
| | Zirconium (Zr) (ppm) | | 9.2 | 1.4 | 7.2 | 9.4 | 1.5 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 1.3 | 1.6 | 1.4 | 1.3 | 0.3 |
| Miscellaneous | Carbon (C) (%) | | 0.89 | 0.50 | 0.55 | 1.23 | 0.11 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-34

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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CERTIFICATE VA17263693

Project: L2027460

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 28-NOV-2017.

The following have access to data associated with this certificate:

| | |
|------------------|-------------|
| ALSEV DATASUBLET | SHANE STACK |
|------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17263693

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm |
|--------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|
| L2027460-1 145585 | | 1.06 | 2 | 9.7 | 28 | 38 | 3.92 | 8.6 | 0.31 | 0.31 | 0.66 | 2.4 | <0.01 | 0.79 | 0.01 | 0.23 |
| L2027460-2 145586 | | 1.08 | 2 | 0.6 | 31 | 32 | 51.20 | 8.4 | 0.02 | <0.01 | 0.35 | 1.3 | 0.02 | 0.48 | 0.02 | 0.10 |
| L2027460-3 145587 | | 1.12 | 1 | 0.3 | 12 | 12 | 38.40 | 8.1 | 0.01 | <0.01 | 0.15 | 0.6 | 0.01 | 0.19 | <0.01 | 0.93 |
| L2027460-4 145588 | | 1.12 | 2 | 4.4 | 35 | 39 | 8.91 | 8.5 | 0.14 | 0.14 | 0.62 | 2.3 | <0.01 | 0.73 | 0.01 | 0.30 |
| L2027460-5 145589 | | 1.12 | 2 | 10.6 | 35 | 46 | 4.33 | 8.6 | 0.34 | 0.34 | 0.70 | 2.6 | <0.01 | 0.82 | <0.01 | 0.36 |
| L2027460-6 145590 | | 1.14 | 2 | 1.6 | 29 | 31 | 19.84 | 8.0 | 0.05 | 0.05 | 0.35 | 1.3 | <0.01 | 0.89 | 0.01 | 0.14 |
| L2027460-7 145591 | | 1.12 | 2 | 3.8 | 29 | 33 | 8.80 | 8.6 | 0.12 | 0.11 | 0.44 | 1.6 | 0.01 | 0.50 | <0.01 | 0.52 |
| L2027460-8 145592 | | 1.12 | 2 | 0.6 | 34 | 35 | 56.00 | 8.3 | 0.02 | 0.01 | 0.38 | 1.4 | 0.01 | 0.55 | 0.01 | 0.07 |
| L2027460-9 145593 | | 1.10 | 2 | 1.9 | 26 | 28 | 14.93 | 7.7 | 0.06 | 0.04 | 0.34 | 1.3 | 0.02 | 1.23 | 0.01 | 0.10 |
| L2027460-10 145594 | | 1.12 | 1 | 1.3 | 10 | 11 | 8.80 | 8.3 | 0.04 | 0.03 | 0.09 | 0.3 | 0.01 | 0.11 | <0.01 | 0.77 |

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CERTIFICATE OF ANALYSIS VA17263693

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe |
| Units | | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % |
| LOR | | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 |
| L2027460-1 145585 | | 0.66 | 3.1 | <0.02 | 10 | 210 | 0.34 | 0.06 | 1.19 | 0.19 | 25.7 | 8.8 | 3 | 0.30 | 1330 | 2.63 |
| L2027460-2 145586 | | 0.95 | 6.1 | <0.02 | <10 | 240 | 0.38 | 0.18 | 1.40 | 0.21 | 25.1 | 7.4 | 20 | 0.60 | 304 | 2.14 |
| L2027460-3 145587 | | 1.08 | 4.1 | 0.13 | <10 | 170 | 0.32 | 0.65 | 0.49 | 0.10 | 21.0 | 6.4 | 8 | 0.52 | 8790 | 2.40 |
| L2027460-4 145588 | | 0.54 | 1.6 | <0.02 | <10 | 90 | 0.35 | 0.05 | 1.39 | 0.11 | 24.9 | 7.3 | 3 | 0.35 | 1490 | 2.35 |
| L2027460-5 145589 | | 0.90 | 1.3 | <0.02 | <10 | 310 | 0.43 | 0.10 | 1.38 | 0.13 | 32.7 | 11.7 | 3 | 0.51 | 2030 | 3.33 |
| L2027460-6 145590 | | 1.47 | 8.7 | <0.02 | <10 | 320 | 0.64 | 0.19 | 1.43 | 0.33 | 33.9 | 11.5 | 33 | 1.23 | 258 | 2.72 |
| L2027460-7 145591 | | 1.07 | 1.1 | 0.03 | <10 | 250 | 0.37 | 0.19 | 1.12 | 0.29 | 32.2 | 7.5 | 5 | 0.63 | 2200 | 2.93 |
| L2027460-8 145592 | | 0.93 | 5.9 | 0.03 | <10 | 230 | 0.35 | 0.10 | 1.54 | 0.21 | 25.1 | 7.2 | 22 | 0.61 | 76.1 | 1.99 |
| L2027460-9 145593 | | 1.30 | 7.5 | <0.02 | <10 | 280 | 0.51 | 0.15 | 1.39 | 0.30 | 29.8 | 9.8 | 29 | 0.80 | 107.0 | 2.43 |
| L2027460-10 145594 | | 0.83 | 3.1 | 0.07 | <10 | 160 | 0.29 | 0.27 | 0.41 | 0.52 | 29.5 | 7.9 | 4 | 0.46 | 5220 | 2.39 |

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CERTIFICATE OF ANALYSIS VA17263693

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P |
| Units | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm |
| LOR | | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 |
| L2027460-1 145585 | | 3.57 | <0.05 | 0.05 | 0.01 | 0.064 | 0.32 | 14.0 | 2.5 | 0.52 | 698 | 22.6 | 0.05 | 0.15 | 2.3 | 870 |
| L2027460-2 145586 | | 3.78 | 0.05 | 0.22 | 0.04 | 0.022 | 0.21 | 13.1 | 7.0 | 0.47 | 421 | 1.05 | 0.06 | 0.35 | 16.1 | 770 |
| L2027460-3 145587 | | 5.16 | 0.05 | 0.12 | 0.04 | 0.114 | 0.49 | 10.2 | 5.2 | 0.40 | 301 | 2.70 | 0.05 | 0.56 | 5.8 | 820 |
| L2027460-4 145588 | | 3.39 | <0.05 | 0.03 | 0.01 | 0.069 | 0.17 | 14.1 | 2.0 | 0.32 | 574 | 13.65 | 0.05 | 0.06 | 2.1 | 660 |
| L2027460-5 145589 | | 4.70 | 0.06 | 0.05 | 0.01 | 0.096 | 0.48 | 17.5 | 3.1 | 0.72 | 1040 | 28.7 | 0.05 | 0.27 | 2.7 | 890 |
| L2027460-6 145590 | | 4.84 | 0.05 | 0.28 | 0.06 | 0.030 | 0.23 | 17.4 | 11.2 | 0.73 | 595 | 1.66 | 0.06 | 0.80 | 29.6 | 830 |
| L2027460-7 145591 | | 5.45 | 0.06 | 0.06 | 0.01 | 0.057 | 0.67 | 17.8 | 3.9 | 0.61 | 753 | 15.70 | 0.06 | 0.32 | 2.5 | 810 |
| L2027460-8 145592 | | 3.31 | <0.05 | 0.24 | 0.03 | 0.017 | 0.15 | 13.3 | 6.7 | 0.49 | 403 | 1.32 | 0.06 | 0.30 | 16.7 | 770 |
| L2027460-9 145593 | | 4.33 | 0.06 | 0.28 | 0.05 | 0.024 | 0.17 | 15.2 | 9.5 | 0.61 | 487 | 1.12 | 0.05 | 1.15 | 23.5 | 820 |
| L2027460-10 145594 | | 4.29 | 0.05 | 0.06 | 0.01 | 0.099 | 0.44 | 16.4 | 3.4 | 0.31 | 657 | 7.50 | 0.05 | 0.18 | 2.5 | 860 |

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CERTIFICATE OF ANALYSIS VA17263693

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U |
| Units | | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm |
| LOR | | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 |
| L2027460-1 145585 | | 5.6 | 16.2 | 0.040 | 0.30 | <0.05 | 5.0 | 1.2 | 0.8 | 86.9 | <0.01 | 0.03 | 3.8 | 0.036 | 0.11 | 0.88 |
| L2027460-2 145586 | | 4.5 | 11.7 | 0.001 | <0.01 | 0.36 | 5.0 | 0.3 | 0.5 | 69.5 | <0.01 | 0.02 | 3.0 | 0.075 | 0.11 | 0.48 |
| L2027460-3 145587 | | 5.4 | 29.3 | 0.001 | <0.01 | 0.12 | 5.4 | 1.1 | 0.8 | 32.8 | <0.01 | 0.13 | 5.7 | 0.099 | 0.27 | 0.42 |
| L2027460-4 145588 | | 5.2 | 9.2 | 0.049 | 0.14 | <0.05 | 3.8 | 0.9 | 0.8 | 65.0 | <0.01 | 0.04 | 3.3 | 0.008 | 0.06 | 0.40 |
| L2027460-5 145589 | | 5.3 | 25.0 | 0.044 | 0.33 | <0.05 | 5.4 | 1.5 | 1.0 | 109.0 | <0.01 | 0.06 | 3.2 | 0.060 | 0.18 | 0.46 |
| L2027460-6 145590 | | 7.9 | 14.1 | 0.001 | 0.03 | 0.67 | 6.0 | 0.5 | 0.6 | 76.5 | <0.01 | 0.03 | 4.6 | 0.073 | 0.15 | 0.90 |
| L2027460-7 145591 | | 3.9 | 34.7 | 0.025 | 0.11 | <0.05 | 6.5 | 1.5 | 0.8 | 58.2 | <0.01 | 0.07 | 5.1 | 0.100 | 0.28 | 0.33 |
| L2027460-8 145592 | | 4.7 | 8.4 | 0.001 | 0.01 | 0.44 | 4.4 | 0.2 | 0.4 | 74.8 | <0.01 | 0.01 | 3.3 | 0.071 | 0.09 | 0.53 |
| L2027460-9 145593 | | 6.6 | 10.7 | 0.001 | 0.05 | 0.57 | 5.6 | 0.4 | 0.5 | 75.7 | <0.01 | 0.02 | 3.8 | 0.086 | 0.12 | 0.83 |
| L2027460-10 145594 | | 6.6 | 25.4 | 0.001 | 0.04 | <0.05 | 5.5 | 1.6 | 0.9 | 34.5 | <0.01 | 0.12 | 5.6 | 0.063 | 0.21 | 0.40 |

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CERTIFICATE OF ANALYSIS VA17263693

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------|---------|---------|---------|---------|---------|---------|
| | Analyte | V | W | Y | Zn | Zr |
| | Units | ppm | ppm | ppm | ppm | ppm |
| | LOR | 1 | 0.05 | 0.05 | 2 | 0.5 |
| L2027460-1 145585 | | 55 | 0.24 | 9.95 | 71 | 1.6 |
| L2027460-2 145586 | | 46 | 0.45 | 9.17 | 51 | 6.7 |
| L2027460-3 145587 | | 59 | 0.28 | 9.23 | 68 | 4.0 |
| L2027460-4 145588 | | 44 | 0.12 | 7.89 | 60 | 1.1 |
| L2027460-5 145589 | | 67 | 0.21 | 10.10 | 101 | 1.6 |
| L2027460-6 145590 | | 56 | 0.36 | 11.10 | 74 | 9.2 |
| L2027460-7 145591 | | 70 | 0.48 | 9.11 | 82 | 1.4 |
| L2027460-8 145592 | | 44 | 0.43 | 8.65 | 43 | 7.2 |
| L2027460-9 145593 | | 53 | 0.33 | 10.20 | 59 | 9.4 |
| L2027460-10 145594 | | 58 | 0.56 | 10.15 | 79 | 1.5 |



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CERTIFICATE OF ANALYSIS VA17263693

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
 ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



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QC CERTIFICATE VA17263693

Project: L2027460

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 28-NOV-2017.

The following have access to data associated with this certificate:

| | |
|------------------|-------------|
| ALSEV DATASUBLET | SHANE STACK |
|------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA17263693

| Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % | |
|----------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|---------------------------------|-------------------------|------------------|--------------------|-------------------|---------------------|--------------------|------------------|-------------------|----------------------|--------------------|--|
| Sample Description | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.3 | | | | | | | | | | |
| Upper Bound | | | | | | 6.7 | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | 0.53 | 1.9 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.42 | 1.5 | | | | | | |
| Upper Bound | | | | | | | | | 0.64 | 2.4 | | | | | | |
| DS-1 | | | | | | | 2.67 | | | | | 3.12 | | | | |
| Target Range - Lower Bound | | | | | | | 2.51 | | | | | 3.01 | | | | |
| Upper Bound | | | | | | | 2.71 | | | | | 3.25 | | | | |
| GS313-8 | | | | | | | 1.29 | | | | | 0.95 | | | | |
| Target Range - Lower Bound | | | | | | | 1.19 | | | | | 0.90 | | | | |
| Upper Bound | | | | | | | 1.29 | | | | | 0.98 | | | | |
| KZK-1 | 2 | 25.0 | 32 | 57 | 2.28 | | | | | | | | | | | |
| KZK-1 | 2 | 25.0 | 32 | 57 | 2.28 | | | | | | | | | | | |
| Target Range - Lower Bound | <1 | 22.9 | 30 | 54 | 2.18 | | | | | | | | | | | |
| Upper Bound | >4 | 27.1 | 38 | 64 | 2.53 | | | | | | | | | | | |
| MRGeo08 | | | | | | | | | | | | | | 4.39 | 2.69 | |
| Target Range - Lower Bound | | | | | | | | | | | | | | 4.00 | 2.44 | |
| Upper Bound | | | | | | | | | | | | | | 4.92 | 3.00 | |
| OREAS 905 | | | | | | | | | | | | | | 0.50 | 0.84 | |
| Target Range - Lower Bound | | | | | | | | | | | | | | 0.45 | 0.73 | |
| Upper Bound | | | | | | | | | | | | | | 0.58 | 0.91 | |
| SY-4 | | | | | | | | | 0.86 | 3.2 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.84 | 3.0 | | | | | | |
| Upper Bound | | | | | | | | | 1.08 | 4.0 | | | | | | |
| UTS-1 | | | | | | | | | | | | | 0.86 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.83 | | | |
| Upper Bound | | | | | | | | | | | | | 0.93 | | | |
| UTS-1 | | | | | | | | | | | 0.80 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | 0.81 | | | | | |
| Upper Bound | | | | | | | | | | | 0.95 | | | | | |
| UTS-4 | | | | | | | | | | | | | 1.76 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 1.64 | | | |
| Upper Bound | | | | | | | | | | | | | 1.84 | | | |
| UTS-4 | | | | | | | | | | | 1.74 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | 1.61 | | | | | |
| Upper Bound | | | | | | | | | | | 1.87 | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17263693

| Method Analyte Units LOR | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm |
|----------------------------|----------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|
| Sample Description | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 32.3 | <0.02 | <10 | 440 | 0.81 | 0.64 | 1.08 | 2.25 | 73.7 | 19.6 | 89 | 10.80 | 630 | 3.55 | 9.33 |
| Target Range - Lower Bound | 29.6 | <0.02 | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 | 3.22 | 8.73 |
| Upper Bound | 36.4 | 0.04 | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 | 3.96 | 10.80 |
| OREAS 905 | 32.1 | 0.39 | <10 | 240 | 0.92 | 5.28 | 0.33 | 0.34 | 78.8 | 14.1 | 17 | 1.26 | 1540 | 3.34 | 6.16 |
| Target Range - Lower Bound | 28.4 | 0.33 | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 | 3.14 | 5.74 |
| Upper Bound | 35.0 | 0.45 | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 | 3.86 | 7.12 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17263693

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sample Description | Ge ppm | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 0.11 | 0.75 | 0.06 | 0.160 | 1.27 | 37.0 | 30.6 | 1.14 | 408 | 14.15 | 0.35 | 0.82 | 696 | 970 | 1060 |
| Target Range - Lower Bound | 0.07 | 0.64 | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 | 900 | 959 |
| Upper Bound | 0.29 | 0.83 | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 | 1130 | 1175 |
| OREAS 905 | 0.08 | 1.20 | 0.02 | 0.576 | 0.33 | 39.3 | 4.9 | 0.15 | 336 | 2.90 | 0.10 | 0.34 | 8.9 | 230 | 15.8 |
| Target Range - Lower Bound | <0.05 | 1.08 | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 | | 15.2 |
| Upper Bound | 0.22 | 1.36 | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 | | 19.0 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17263693

| Method Analyte Units LOR | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm |
|----------------------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|
| Sample Description | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | 143.0 | 0.009 | 0.29 | 3.16 | 7.1 | 0.7 | 3.4 | 79.9 | 0.01 | 0.03 | 21.8 | 0.373 | 0.81 | 5.34 | 98 |
| Target Range - Lower Bound | 132.0 | 0.006 | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 | 4.93 | 90 |
| Upper Bound | 162.0 | 0.010 | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 | 6.13 | 112 |
| OREAS 905 | 19.9 | <0.001 | 0.05 | 1.05 | 1.8 | 2.4 | 1.3 | 12.8 | <0.01 | 0.07 | 8.2 | 0.021 | 0.12 | 2.21 | 5 |
| Target Range - Lower Bound | 17.3 | <0.001 | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 | 2.08 | 4 |
| Upper Bound | 21.3 | 0.002 | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 | 2.66 | 8 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA17263693

| Sample Description | Method Analyte Units LOR | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|-----------------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| STANDARDS | | | | | |
| Buffer pH6 | | | | | |
| Buffer pH6 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| CO-ASSAY | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| DS-1 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| GS313-8 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| KZK-1 | | | | | |
| KZK-1 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| MGeo08 | | 2.82 | 19.75 | 762 | 22.5 |
| Target Range - Lower Bound | | 2.44 | 17.50 | 708 | 18.1 |
| Upper Bound | | 3.42 | 21.5 | 870 | 25.7 |
| OREAS 905 | | 0.61 | 7.17 | 65 | 47.3 |
| Target Range - Lower Bound | | 0.44 | 6.32 | 58 | 39.9 |
| Upper Bound | | 0.76 | 7.84 | 76 | 55.1 |
| SY-4 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| UTS-1 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| UTS-1 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| UTS-4 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| UTS-4 | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |

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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 3 - A
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 Plus Appendix Pages
 Finalized Date: 17-DEC-2017
 Account: APN

Project: L2027460

QC CERTIFICATE OF ANALYSIS VA17263693

| Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % |
|----------------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|--------------|
| Sample Description | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | <0.05 | <0.2 | | | | | |
| BLANK | | | | | | | | | <0.05 | <0.2 | | | | | |
| Target Range - Lower Bound | | | | | | | | | <0.05 | <0.2 | | | | | |
| Upper Bound | | | | | | | | | 0.10 | 0.4 | | | | | |
| BLANK | | | | | | | | | | | | | | <0.01 | <0.01 |
| Target Range - Lower Bound | | | | | | | | | | | | | | <0.01 | <0.01 |
| Upper Bound | | | | | | | | | | | | | | 0.02 | 0.02 |
| BLANK | | | | | | 6.0 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.5 | | | | | | | | | |
| Upper Bound | | | | | | 6.9 | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | <0.01 | <0.01 |
| Target Range - Lower Bound | | | | | | | | | | | | | | <0.01 | <0.01 |
| Upper Bound | | | | | | | | | | | | | | 0.02 | 0.02 |
| BLANK | | | | | | | | | | | <0.01 | | | | |
| Target Range - Lower Bound | | | | | | | | | | | <0.01 | | | | |
| Upper Bound | | | | | | | | | | | 0.02 | | | | |
| BLANK | | | | | | | 0.01 | | | | | | | <0.01 | <0.01 |
| Target Range - Lower Bound | | | | | | | <0.01 | | | | | | | <0.01 | <0.01 |
| Upper Bound | | | | | | | 0.02 | | | | | | | 0.02 | 0.02 |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | 0.05 | 1.84 |
| DUP | | | | | | | | | | | | | | 0.05 | 1.98 |
| Target Range - Lower Bound | | | | | | | | | | | | | | 0.04 | 1.80 |
| Upper Bound | | | | | | | | | | | | | | 0.06 | 2.02 |
| L2027460-5 145589 | | | | | | 8.6 | | | 0.70 | 2.6 | | | | | |
| DUP | | | | | | 8.6 | | | 0.70 | 2.6 | | | | | |
| Target Range - Lower Bound | | | | | | 8.1 | | | 0.62 | 2.3 | | | | | |
| Upper Bound | | | | | | 9.1 | | | 0.79 | 2.9 | | | | | |
| L2027460-10 145594 | 1 | 1.3 | 10 | 11 | 8.80 | | 0.04 | 0.03 | 0.09 | 0.3 | 0.01 | 0.11 | <0.01 | | |
| DUP | 1 | 1.3 | 10 | 11 | 8.80 | | 0.04 | 0.03 | 0.09 | 0.3 | 0.01 | 0.12 | <0.01 | | |
| Target Range - Lower Bound | <1 | 0.9 | 9 | 9 | 8.35 | | 0.03 | 0.02 | <0.05 | <0.2 | <0.01 | 0.10 | <0.01 | | |
| Upper Bound | 2 | 1.7 | 12 | 13 | 9.25 | | 0.05 | 0.04 | 0.10 | 0.4 | 0.02 | 0.13 | 0.02 | | |

***** See Appendix Page for comments regarding this certificate *****



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Project: L2027460

QC CERTIFICATE OF ANALYSIS VA17263693

| Method Analyte Units LOR | ME-MS41 As ppm | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm |
|----------------------------|----------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|
| Sample Description | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 |
| Target Range - Lower Bound | <0.1 | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 |
| Upper Bound | 0.2 | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | 19.0 | <0.02 | <10 | 50 | 0.24 | 0.14 | 0.08 | 0.02 | 73.3 | 4.5 | 20 | 0.25 | 14.6 | 4.41 | 5.22 |
| DUP | 20.0 | <0.02 | <10 | 50 | 0.23 | 0.15 | 0.08 | 0.03 | 81.8 | 4.6 | 22 | 0.28 | 15.0 | 4.73 | 5.50 |
| Target Range - Lower Bound | 18.4 | <0.02 | <10 | 40 | 0.17 | 0.13 | 0.07 | <0.01 | 73.7 | 4.2 | 19 | 0.20 | 14.1 | 4.33 | 5.04 |
| Upper Bound | 20.6 | 0.04 | 20 | 60 | 0.30 | 0.16 | 0.09 | 0.04 | 81.4 | 4.9 | 23 | 0.33 | 15.5 | 4.81 | 5.68 |
| L2027460-5 145589 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L2027460-10 145594 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

***** See Appendix Page for comments regarding this certificate *****



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Project: L2027460

QC CERTIFICATE OF ANALYSIS VA17263693

| Sample Description | Method Analyte Units LOR | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 | ME-MS41 Hg ppm 0.01 | ME-MS41 In ppm 0.005 | ME-MS41 K % 0.01 | ME-MS41 La ppm 0.2 | ME-MS41 Li ppm 0.1 | ME-MS41 Mg % 0.01 | ME-MS41 Mn ppm 5 | ME-MS41 Mo ppm 0.05 | ME-MS41 Na % 0.01 | ME-MS41 Nb ppm 0.05 | ME-MS41 Ni ppm 0.2 | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 |
|----------------------------|-----------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|---------------------------|-----------------------------|-----------------------------|----------------------------|---------------------------|------------------------------|----------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | 0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 |
| Target Range - Lower Bound | | <0.05 | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 |
| Upper Bound | | 0.10 | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 0.08 | 0.38 | 0.01 | 0.017 | 0.16 | 35.9 | 8.9 | 0.68 | 749 | 4.32 | 0.01 | <0.05 | 16.5 | 570 | 5.0 |
| DUP | | 0.07 | 0.29 | 0.01 | 0.018 | 0.17 | 39.9 | 7.8 | 0.73 | 800 | 4.70 | 0.01 | <0.05 | 16.7 | 600 | 5.3 |
| Target Range - Lower Bound | | <0.05 | 0.30 | <0.01 | 0.012 | 0.15 | 35.8 | 7.8 | 0.66 | 731 | 4.23 | <0.01 | <0.05 | 15.6 | 550 | 4.7 |
| Upper Bound | | 0.10 | 0.37 | 0.02 | 0.023 | 0.18 | 40.0 | 8.9 | 0.75 | 818 | 4.79 | 0.02 | 0.10 | 17.6 | 620 | 5.6 |
| L2027460-5 145589 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L2027460-10 145594 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17263693

| Sample Description | Method Analyte Units LOR | ME-MS41 Rb ppm | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm |
|----------------------------|--------------------------|----------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 |
| BLANK | | <0.1 | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 |
| Target Range - Lower Bound | | 0.2 | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| ORIGINAL | | 6.8 | <0.001 | 0.02 | 0.26 | 1.6 | <0.2 | 0.2 | 7.2 | <0.01 | 0.02 | 9.3 | <0.005 | 0.07 | 1.78 | 22 |
| DUP | | 7.4 | <0.001 | 0.02 | 0.28 | 1.6 | 0.3 | 0.2 | 7.8 | <0.01 | 0.01 | 10.0 | <0.005 | 0.08 | 1.94 | 24 |
| Target Range - Lower Bound | | 6.6 | <0.001 | <0.01 | 0.20 | 1.4 | <0.2 | <0.2 | 6.9 | <0.01 | <0.01 | 9.0 | <0.005 | 0.05 | 1.72 | 21 |
| Upper Bound | | 7.6 | 0.002 | 0.03 | 0.34 | 1.8 | 0.4 | 0.4 | 8.1 | 0.02 | 0.02 | 10.3 | 0.010 | 0.10 | 2.00 | 25 |
| L2027460-5 145589 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| L2027460-10 145594 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17263693

| Sample Description | Method Analyte Units LOR | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|-----------------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| BLANKS | | | | | |
| BLANK | | | | | |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| BLANK | | <0.05 | <0.05 | <2 | <0.5 |
| Target Range - Lower Bound | | <0.05 | <0.05 | <2 | <0.5 |
| Upper Bound | | 0.10 | 0.10 | 4 | 1.0 |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| BLANK | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| DUPLICATES | | | | | |
| ORIGINAL | | <0.05 | 5.06 | 77 | 17.5 |
| DUP | | <0.05 | 5.43 | 83 | 12.5 |
| Target Range - Lower Bound | | <0.05 | 4.93 | 74 | 13.4 |
| Upper Bound | | 0.10 | 5.56 | 86 | 16.6 |
| L2027460-5 145589 | | | | | |
| DUP | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |
| L2027460-10 145594 | | | | | |
| DUP | | | | | |
| Target Range - Lower Bound | | | | | |
| Upper Bound | | | | | |



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QC CERTIFICATE OF ANALYSIS VA17263693

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



Chain of Custody (COC) / Analytical Request Form



COC Number: 18-17-34

Canada Toll Free: 1 800 668 9878

L2027460-COFC

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| Report To Contact and company name below will appear on the final report Company: Minto Explorations Ltd. Contact: Minto Environment - Coordinator Phone: 1-604-759-4659 Company address below will appear on the final report Street: 2100-510 West Georgia St. City/Province: Vancouver, British Columbia Postal Code: V6B 0M3 | | Report Format / Distribution Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: minto_environment@mintomine.com Email 2: Email 3: | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply 4 day [P4] <input type="checkbox"/> 3 day [P3] <input type="checkbox"/> 2 day [P2] <input type="checkbox"/> EMERGENCY 1 Business day [E1] <input type="checkbox"/> Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|-----------------------------|--|--|--|---|-----------------------------|--|--|--|----------------------|-----------------------|-----------------------------|--|---------------------------|----------------------|---|--|--|--|-----------|---|---|---|---|---|---|--|--|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--------|-----------|--|-------|---|---|---|---|---|---|--|--|--------|-----------|--|-------|---|---|---|---|---|---|--|
| Invoice To Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Company: Minto Explorations Ltd. Contact: Ruth Cayetano | | Invoice Distribution Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: ap@mintomine.com Email 2: Project Information ALS Account # / Quote #: Job #: PO / AFE: TBD LSD: ALS Lab Work Order # (lab use only): | | Analysis Request Indicate Filtered (F) Preserved (P) or Filtered and Preserved (F/P) below <table border="1"> <tr> <th>Total Metals- Aqua regia digestion (ICP)</th> <th>Paste pH</th> <th>% Inorganic Carbonate</th> <th>Total Carbon/Sulphur (Leco)</th> <th>AP - determination by % sulphide sulphur</th> <th>Modified NP - (MEND 1991)</th> <th>Number of Containers</th> </tr> <tr> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td></td> </tr> </table> | | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | R | R | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R | R | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oil and Gas Required Fields (client use) AFE/Cost Center: PO# Major/Minor Code: Routing Code: Requisitioner: Location: | | ALS Contact: Sampler: | | <table border="1"> <thead> <tr> <th>ALS Sample # (lab use only)</th> <th>Sample Identification and/or Coordinates (This description will appear on the report)</th> <th>Date (dd-mmm-yy)</th> <th>Time (hh:mm)</th> <th>Sample Type</th> <th>Total Metals- Aqua regia digestion (ICP)</th> <th>Paste pH</th> <th>% Inorganic Carbonate</th> <th>Total Carbon/Sulphur (Leco)</th> <th>AP - determination by % sulphide sulphur</th> <th>Modified NP - (MEND 1991)</th> <th>Number of Containers</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td>Composite</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td></td> </tr> <tr> <td></td> <td>145585</td> <td>05-NOV-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>145586</td> <td>02-NOV-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>145587</td> <td>02-NOV-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>145588</td> <td>06-NOV-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>145589</td> <td>06-NOV-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>145590</td> <td>11-NOV-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>145591</td> <td>13-NOV-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>145592</td> <td>05-NOV-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>145593</td> <td>17-NOV-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> <tr> <td></td> <td>145594</td> <td>14-NOV-17</td> <td></td> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td> </tr> </tbody> </table> | | ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | | Composite | R | R | R | R | R | R | | | 145585 | 05-NOV-17 | | WASTE | X | X | X | X | X | X | | | 145586 | 02-NOV-17 | | WASTE | X | X | X | X | X | X | | | 145587 | 02-NOV-17 | | WASTE | X | X | X | X | X | X | | | 145588 | 06-NOV-17 | | WASTE | X | X | X | X | X | X | | | 145589 | 06-NOV-17 | | WASTE | X | X | X | X | X | X | | | 145590 | 11-NOV-17 | | WASTE | X | X | X | X | X | X | | | 145591 | 13-NOV-17 | | WASTE | X | X | X | X | X | X | | | 145592 | 05-NOV-17 | | WASTE | X | X | X | X | X | X | | | 145593 | 17-NOV-17 | | WASTE | X | X | X | X | X | X | | | 145594 | 14-NOV-17 | | WASTE | X | X | X | X | X | X | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | Composite | R | R | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145585 | 05-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145586 | 02-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145587 | 02-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145588 | 06-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145589 | 06-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145590 | 11-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145591 | 13-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145592 | 05-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145593 | 17-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145594 | 14-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | SAMPLE CONDITION AS RECEIVED (lab use only) Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> Cooling Initiated <input checked="" type="checkbox"/> INITIAL COOLER TEMPERATURES °C: 5.0 FINAL COOLER TEMPERATURES °C: 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) Released by: Date: Time: | | INITIAL SHIPMENT RECEPTION (lab use only) Received by: Date: Time: | | FINAL SHIPMENT RECEPTION (lab use only) Received by: Date: Time: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy
 1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 08-DEC-17
Report Date: 17-JAN-18 15:19 (MT)
Version: FINAL REV. 2

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2032841
Project P.O. #: PO#228594
Job Reference:
C of C Numbers: 17-35
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2032841-1 Waste 09-NOV-17 145596 | L2032841-2 Waste 19-NOV-17 145595 | L2032841-3 Waste 07-NOV-17 144248 | L2032841-4 Waste 07-NOV-17 144249 | L2032841-5 Waste 07-NOV-17 144250 |
|---|--|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.1 | 8.5 | 8.2 | 8.5 | 8.7 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.39 | 0.24 | 0.28 | 0.26 | 0.38 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.9 | 1.6 | 20.9 | 5.0 | 23.1 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 35 | 22 | 22 | 23 | 30 |
| | NNP (tCaCO3/1Kt) | 34 | 20 | 1 | 18 | 7 |
| | Ratio (NP/MPA) (Unity) | 37.33 | 14.08 | 1.05 | 4.60 | 1.30 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | 0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.03 | 0.05 | 0.66 | 0.16 | 0.74 |
| | Total Sulfur (combustion) (%) | 0.03 | 0.05 | 0.67 | 0.16 | 0.74 |
| Total Metals | Aluminum (Al) (%) | 0.99 | 0.85 | 1.15 | 1.31 | 1.11 |
| | Antimony (Sb) (ppm) | 0.48 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 6.8 | 1.6 | 0.4 | 0.4 | 0.7 |
| | Barium (Ba) (ppm) | 250 | 240 | 200 | 280 | 240 |
| | Beryllium (Be) (ppm) | 0.39 | 0.25 | 0.22 | 0.21 | 0.23 |
| | Bismuth (Bi) (ppm) | 0.08 | 0.08 | 0.53 | 0.09 | 0.46 |
| | Boron (B) (ppm) | <10 | 10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.23 | 0.23 | 0.42 | 0.09 | 0.19 |
| | Calcium (Ca) (%) | 1.56 | 0.82 | 0.83 | 0.90 | 1.04 |
| | Cerium (Ce) (ppm) | 24.3 | 28.3 | 15.00 | 21.8 | 25.0 |
| | Cesium (Cs) (ppm) | 0.71 | 0.37 | 0.36 | 0.43 | 0.34 |
| | Chromium (Cr) (ppm) | 25 | 4 | 6 | 7 | 6 |
| | Cobalt (Co) (ppm) | 7.5 | 7.1 | 7.2 | 6.5 | 8.1 |
| | Copper (Cu) (ppm) | 37.1 | 2360 | 4990 | 859 | 3350 |
| | Gallium (Ga) (ppm) | 3.41 | 4.24 | 6.12 | 6.20 | 5.90 |
| | Germanium (Ge) (ppm) | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 |
| | Gold (Au) (ppm) | <0.02 | 0.02 | 0.10 | 0.02 | 0.07 |
| | Hafnium (Hf) (ppm) | 0.24 | 0.06 | 0.05 | 0.04 | 0.03 |
| | Indium (In) (ppm) | 0.017 | 0.085 | 0.090 | 0.031 | 0.069 |
| | Iron (Fe) (%) | 2.01 | 2.33 | 3.38 | 2.60 | 3.25 |
| | Lanthanum (La) (ppm) | 12.3 | 16.0 | 7.7 | 11.7 | 13.5 |
| | Lead (Pb) (ppm) | 4.7 | 3.6 | 3.3 | 2.5 | 4.4 |
| | Lithium (Li) (ppm) | 6.8 | 3.1 | 5.1 | 6.1 | 5.6 |
| | Magnesium (Mg) (%) | 0.53 | 0.31 | 0.63 | 0.71 | 0.65 |
| | Manganese (Mn) (ppm) | 409 | 573 | 483 | 482 | 536 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2032841-6 Waste 07-NOV-17 144850 | L2032841-7 Waste 07-NOV-17 144848 | L2032841-8 Waste 07-NOV-17 144849 | L2032841-9 Waste 07-NOV-17 144598 | L2032841-10 Waste 07-NOV-17 144599 |
|---|--|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.8 | 8.8 | 8.0 | 8.8 | 8.8 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.30 | 0.25 | 0.27 | 0.34 | 0.42 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 13.1 | 20.3 | 43.1 | 10.9 | 10.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 25 | 20 | 22 | 29 | 35 |
| | NNP (tCaCO3/1Kt) | 12 | 0 | -21 | 18 | 24 |
| | Ratio (NP/MPA) (Unity) | 1.90 | 0.98 | 0.51 | 2.65 | 3.29 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | 0.31 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | 0.02 | 0.33 | 0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.42 | 0.63 | 1.05 | 0.34 | 0.34 |
| | Total Sulfur (combustion) (%) | 0.42 | 0.65 | 1.38 | 0.35 | 0.34 |
| Total Metals | Aluminum (Al) (%) | 1.05 | 1.14 | 1.12 | 1.27 | 1.19 |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 0.5 | 0.6 | 0.5 | 0.7 | 0.5 |
| | Barium (Ba) (ppm) | 190 | 230 | 180 | 270 | 260 |
| | Beryllium (Be) (ppm) | 0.20 | 0.30 | 0.19 | 0.19 | 0.19 |
| | Bismuth (Bi) (ppm) | 0.14 | 0.46 | 0.67 | 0.29 | 0.14 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.13 | 0.20 | 0.88 | 0.14 | 0.10 |
| | Calcium (Ca) (%) | 0.90 | 0.74 | 1.20 | 1.08 | 1.29 |
| | Cerium (Ce) (ppm) | 17.50 | 18.50 | 21.2 | 22.5 | 22.3 |
| | Cesium (Cs) (ppm) | 0.27 | 0.28 | 0.43 | 0.46 | 0.38 |
| | Chromium (Cr) (ppm) | 7 | 7 | 7 | 7 | 7 |
| | Cobalt (Co) (ppm) | 6.5 | 10.7 | 8.0 | 7.1 | 8.0 |
| | Copper (Cu) (ppm) | 2210 | 3440 | >10000 | 2350 | 1500 |
| | Gallium (Ga) (ppm) | 5.21 | 6.12 | 5.89 | 6.43 | 5.55 |
| | Germanium (Ge) (ppm) | 0.06 | 0.06 | 0.07 | 0.06 | 0.06 |
| | Gold (Au) (ppm) | 0.08 | 0.14 | 0.33 | 0.07 | 0.03 |
| | Hafnium (Hf) (ppm) | 0.04 | 0.05 | 0.04 | 0.04 | 0.04 |
| | Indium (In) (ppm) | 0.060 | 0.055 | 0.159 | 0.052 | 0.036 |
| | Iron (Fe) (%) | 2.31 | 3.15 | 3.43 | 3.08 | 2.50 |
| | Lanthanum (La) (ppm) | 9.1 | 9.6 | 11.5 | 11.7 | 11.9 |
| | Lead (Pb) (ppm) | 3.2 | 3.7 | 3.2 | 2.8 | 2.8 |
| | Lithium (Li) (ppm) | 5.2 | 5.7 | 4.8 | 5.3 | 5.2 |
| | Magnesium (Mg) (%) | 0.57 | 0.60 | 0.64 | 0.69 | 0.64 |
| | Manganese (Mn) (ppm) | 435 | 482 | 471 | 484 | 433 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2032841-1 Waste 09-NOV-17 145596 | L2032841-2 Waste 19-NOV-17 145595 | L2032841-3 Waste 07-NOV-17 144248 | L2032841-4 Waste 07-NOV-17 144249 | L2032841-5 Waste 07-NOV-17 144250 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.04 | <0.01 | <0.01 | <0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | 1.41 | 9.68 | 29.9 | 6.96 | 12.45 |
| | Nickel (Ni) (ppm) | 18.6 | 2.3 | 2.0 | 2.0 | 2.3 |
| | Niobium (Nb) (ppm) | 0.53 | 0.21 | 0.22 | 0.22 | 0.16 |
| | Phosphorus (P) (ppm) | 840 | 680 | 610 | 700 | 730 |
| | Potassium (K) (%) | 0.16 | 0.42 | 0.58 | 0.66 | 0.52 |
| | Rhenium (Re) (ppm) | <0.001 | 0.007 | 0.046 | 0.004 | 0.036 |
| | Rubidium (Rb) (ppm) | 9.0 | 21.5 | 26.8 | 30.1 | 25.0 |
| | Scandium (Sc) (ppm) | 4.9 | 4.8 | 2.7 | 4.1 | 3.6 |
| | Selenium (Se) (ppm) | 0.5 | 0.9 | 3.6 | 1.1 | 2.9 |
| | Silver (Ag) (ppm) | 0.06 | 0.36 | 1.31 | 0.24 | 1.01 |
| | Sodium (Na) (%) | 0.05 | 0.05 | 0.06 | 0.08 | 0.06 |
| | Strontium (Sr) (ppm) | 77.5 | 55.6 | 51.6 | 62.1 | 63.3 |
| | Sulfur (S) (%) | 0.04 | 0.07 | 0.66 | 0.17 | 0.74 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.01 | 0.07 | 0.22 | 0.04 | 0.18 |
| | Thallium (Tl) (ppm) | 0.10 | 0.17 | 0.19 | 0.20 | 0.18 |
| | Thorium (Th) (ppm) | 3.2 | 3.5 | 2.3 | 3.4 | 3.2 |
| | Tin (Sn) (ppm) | 0.4 | 0.9 | 0.9 | 0.7 | 0.9 |
| | Titanium (Ti) (%) | 0.074 | 0.060 | 0.095 | 0.117 | 0.086 |
| | Tungsten (W) (ppm) | 0.41 | 0.29 | <0.05 | <0.05 | <0.05 |
| | Uranium (U) (ppm) | 0.57 | 0.39 | 0.18 | 0.32 | 0.24 |
| | Vanadium (V) (ppm) | 47 | 61 | 54 | 56 | 61 |
| | Yttrium (Y) (ppm) | 8.79 | 8.28 | 5.63 | 5.84 | 6.43 |
| | Zinc (Zn) (ppm) | 47 | 69 | 84 | 76 | 84 |
| | Zirconium (Zr) (ppm) | 8.1 | 1.6 | 1.1 | 1.0 | 1.0 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.4 | 0.9 | 1.0 | 1.0 | 1.4 |
| Miscellaneous | Carbon (C) (%) | 0.64 | 0.29 | 0.30 | 0.27 | 0.41 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L2032841-6 Waste 07-NOV-17 144850 | L2032841-7 Waste 07-NOV-17 144848 | L2032841-8 Waste 07-NOV-17 144849 | L2032841-9 Waste 07-NOV-17 144598 | L2032841-10 Waste 07-NOV-17 144599 |
|------------------------|--------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | 0.01 | 0.02 | <0.01 | <0.01 | |
| | Molybdenum (Mo) (ppm) | 2.88 | 5.80 | 7.17 | 17.95 | 21.0 | |
| | Nickel (Ni) (ppm) | 1.6 | 3.1 | 2.1 | 2.1 | 1.9 | |
| | Niobium (Nb) (ppm) | 0.14 | 0.21 | 0.34 | 0.27 | 0.18 | |
| | Phosphorus (P) (ppm) | 590 | 610 | 690 | 1210 | 620 | |
| | Potassium (K) (%) | 0.42 | 0.46 | 0.58 | 0.71 | 0.58 | |
| | Rhenium (Re) (ppm) | 0.019 | 0.016 | 0.024 | 0.039 | 0.040 | |
| | Rubidium (Rb) (ppm) | 18.8 | 21.6 | 27.3 | 34.4 | 27.7 | |
| | Scandium (Sc) (ppm) | 2.6 | 3.8 | 3.4 | 3.9 | 3.1 | |
| | Selenium (Se) (ppm) | 2.0 | 3.4 | 7.8 | 2.2 | 1.4 | |
| | Silver (Ag) (ppm) | 0.58 | 1.17 | 3.27 | 0.66 | 0.44 | |
| | Sodium (Na) (%) | 0.07 | 0.08 | 0.06 | 0.08 | 0.07 | |
| | Strontium (Sr) (ppm) | 53.9 | 51.9 | 76.7 | 66.7 | 55.9 | |
| | Sulfur (S) (%) | 0.41 | 0.64 | 1.39 | 0.36 | 0.36 | |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| | Tellurium (Te) (ppm) | 0.12 | 0.22 | 0.80 | 0.16 | 0.06 | |
| | Thallium (Tl) (ppm) | 0.13 | 0.15 | 0.21 | 0.24 | 0.21 | |
| | Thorium (Th) (ppm) | 2.8 | 2.3 | 3.8 | 3.0 | 2.3 | |
| | Tin (Sn) (ppm) | 0.7 | 0.8 | 1.0 | 0.9 | 0.8 | |
| | Titanium (Ti) (%) | 0.066 | 0.077 | 0.105 | 0.127 | 0.098 | |
| | Tungsten (W) (ppm) | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | |
| | Uranium (U) (ppm) | 0.35 | 0.28 | 0.36 | 0.34 | 0.26 | |
| | Vanadium (V) (ppm) | 43 | 51 | 57 | 61 | 51 | |
| | Yttrium (Y) (ppm) | 5.62 | 5.81 | 6.32 | 9.43 | 6.44 | |
| | Zinc (Zn) (ppm) | 65 | 74 | 95 | 72 | 61 | |
| | Zirconium (Zr) (ppm) | 0.9 | 1.2 | 1.0 | 1.1 | 1.0 | |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.1 | 0.9 | 1.0 | 1.2 | 1.5 | |
| Miscellaneous | Carbon (C) (%) | 0.32 | 0.28 | 0.31 | 0.37 | 0.46 | |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-35

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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CERTIFICATE VA17276191

Project: L2032841

This report is for 10 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 12-DEC-2017.

The following have access to data associated with this certificate:

| | | |
|------------------|-------------|--|
| ALSEV DATASUBLET | SHANE STACK | |
|------------------|-------------|--|

| SAMPLE PREPARATION | |
|---------------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|------------------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| ME-OG46 | Ore Grade Elements - AquaRegia | ICP-AES |
| Cu-OG46 | Ore Grade Cu - Aqua Regia | ICP-AES |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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Project: L2032841

CERTIFICATE OF ANALYSIS VA17276191

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm |
|--------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|
| L2032841-1 145596 | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 |
| L2032841-2 145595 | | 1.08 | 2 | 0.9 | 34 | 35 | 37.33 | 8.1 | 0.03 | 0.03 | 0.39 | 1.4 | <0.01 | 0.64 | <0.01 | 0.06 |
| L2032841-3 144248 | | 1.10 | 2 | 1.6 | 20 | 22 | 14.08 | 8.5 | 0.05 | 0.05 | 0.24 | 0.9 | <0.01 | 0.29 | <0.01 | 0.36 |
| L2032841-4 144249 | | 1.12 | 2 | 20.9 | 1 | 22 | 1.05 | 8.2 | 0.67 | 0.66 | 0.28 | 1.0 | 0.01 | 0.30 | <0.01 | 1.31 |
| L2032841-5 144250 | | 1.10 | 2 | 5.0 | 18 | 23 | 4.60 | 8.5 | 0.16 | 0.16 | 0.26 | 1.0 | <0.01 | 0.27 | 0.02 | 0.24 |
| L2032841-6 144850 | | 1.24 | 2 | 23.1 | 7 | 30 | 1.30 | 8.7 | 0.74 | 0.74 | 0.38 | 1.4 | <0.01 | 0.41 | <0.01 | 1.01 |
| L2032841-7 144848 | | 1.18 | 2 | 13.1 | 12 | 25 | 1.90 | 8.8 | 0.42 | 0.42 | 0.30 | 1.1 | <0.01 | 0.32 | <0.01 | 0.58 |
| L2032841-8 144849 | | 1.10 | 2 | 20.3 | 0 | 20 | 0.98 | 8.8 | 0.65 | 0.63 | 0.25 | 0.9 | 0.02 | 0.28 | <0.01 | 1.17 |
| L2032841-9 144598 | | 1.18 | 2 | 43.1 | -21 | 22 | 0.51 | 8.0 | 1.38 | 1.05 | 0.27 | 1.0 | 0.33 | 0.31 | 0.31 | 3.27 |
| L2032841-10 144599 | | 1.18 | 2 | 10.9 | 18 | 29 | 2.65 | 8.8 | 0.35 | 0.34 | 0.34 | 1.2 | 0.01 | 0.37 | <0.01 | 0.66 |
| | | 1.12 | 2 | 10.6 | 24 | 35 | 3.29 | 8.8 | 0.34 | 0.34 | 0.42 | 1.5 | <0.01 | 0.46 | <0.01 | 0.44 |

***** See Appendix Page for comments regarding this certificate *****



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Project: L2032841

CERTIFICATE OF ANALYSIS VA17276191

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe |
| | Units | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % |
| | LOR | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 |
| L2032841-1 145596 | | 0.99 | 6.8 | <0.02 | <10 | 250 | 0.39 | 0.08 | 1.56 | 0.23 | 24.3 | 7.5 | 25 | 0.71 | 37.1 | 2.01 |
| L2032841-2 145595 | | 0.85 | 1.6 | 0.02 | 10 | 240 | 0.25 | 0.08 | 0.82 | 0.23 | 28.3 | 7.1 | 4 | 0.37 | 2360 | 2.33 |
| L2032841-3 144248 | | 1.15 | 0.4 | 0.10 | <10 | 200 | 0.22 | 0.53 | 0.83 | 0.42 | 15.00 | 7.2 | 6 | 0.36 | 4990 | 3.38 |
| L2032841-4 144249 | | 1.31 | 0.4 | 0.02 | <10 | 280 | 0.21 | 0.09 | 0.90 | 0.09 | 21.8 | 6.5 | 7 | 0.43 | 859 | 2.60 |
| L2032841-5 144250 | | 1.11 | 0.7 | 0.07 | <10 | 240 | 0.23 | 0.46 | 1.04 | 0.19 | 25.0 | 8.1 | 6 | 0.34 | 3350 | 3.25 |
| L2032841-6 144850 | | 1.05 | 0.5 | 0.08 | <10 | 190 | 0.20 | 0.14 | 0.90 | 0.13 | 17.50 | 6.5 | 7 | 0.27 | 2210 | 2.31 |
| L2032841-7 144848 | | 1.14 | 0.6 | 0.14 | <10 | 230 | 0.30 | 0.46 | 0.74 | 0.20 | 18.50 | 10.7 | 7 | 0.28 | 3440 | 3.15 |
| L2032841-8 144849 | | 1.12 | 0.5 | 0.33 | <10 | 180 | 0.19 | 0.67 | 1.20 | 0.88 | 21.2 | 8.0 | 7 | 0.43 | >10000 | 3.43 |
| L2032841-9 144598 | | 1.27 | 0.7 | 0.07 | <10 | 270 | 0.19 | 0.29 | 1.08 | 0.14 | 22.5 | 7.1 | 7 | 0.46 | 2350 | 3.08 |
| L2032841-10 144599 | | 1.19 | 0.5 | 0.03 | <10 | 260 | 0.19 | 0.14 | 1.29 | 0.10 | 22.3 | 8.0 | 7 | 0.38 | 1500 | 2.50 |

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CERTIFICATE OF ANALYSIS VA17276191

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P |
| Units | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm |
| LOR | | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 |
| L2032841-1 145596 | | 3.41 | 0.05 | 0.24 | 0.04 | 0.017 | 0.16 | 12.3 | 6.8 | 0.53 | 409 | 1.41 | 0.05 | 0.53 | 18.6 | 840 |
| L2032841-2 145595 | | 4.24 | 0.05 | 0.06 | <0.01 | 0.085 | 0.42 | 16.0 | 3.1 | 0.31 | 573 | 9.68 | 0.05 | 0.21 | 2.3 | 680 |
| L2032841-3 144248 | | 6.12 | 0.05 | 0.05 | <0.01 | 0.090 | 0.58 | 7.7 | 5.1 | 0.63 | 483 | 29.9 | 0.06 | 0.22 | 2.0 | 610 |
| L2032841-4 144249 | | 6.20 | 0.06 | 0.04 | <0.01 | 0.031 | 0.66 | 11.7 | 6.1 | 0.71 | 482 | 6.96 | 0.08 | 0.22 | 2.0 | 700 |
| L2032841-5 144250 | | 5.90 | 0.06 | 0.03 | 0.01 | 0.069 | 0.52 | 13.5 | 5.6 | 0.65 | 536 | 12.45 | 0.06 | 0.16 | 2.3 | 730 |
| L2032841-6 144850 | | 5.21 | 0.06 | 0.04 | 0.01 | 0.060 | 0.42 | 9.1 | 5.2 | 0.57 | 435 | 2.88 | 0.07 | 0.14 | 1.6 | 590 |
| L2032841-7 144848 | | 6.12 | 0.06 | 0.05 | 0.01 | 0.055 | 0.46 | 9.6 | 5.7 | 0.60 | 482 | 5.80 | 0.08 | 0.21 | 3.1 | 610 |
| L2032841-8 144849 | | 5.89 | 0.07 | 0.04 | 0.02 | 0.159 | 0.58 | 11.5 | 4.8 | 0.64 | 471 | 7.17 | 0.06 | 0.34 | 2.1 | 690 |
| L2032841-9 144598 | | 6.43 | 0.06 | 0.04 | <0.01 | 0.052 | 0.71 | 11.7 | 5.3 | 0.69 | 484 | 17.95 | 0.08 | 0.27 | 2.1 | 1210 |
| L2032841-10 144599 | | 5.55 | 0.06 | 0.04 | <0.01 | 0.036 | 0.58 | 11.9 | 5.2 | 0.64 | 433 | 21.0 | 0.07 | 0.18 | 1.9 | 620 |

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CERTIFICATE OF ANALYSIS VA17276191

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U |
| Units | | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm |
| LOR | | 0.2 | 0.1 | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 |
| L2032841-1 145596 | | 4.7 | 9.0 | <0.001 | 0.04 | 0.48 | 4.9 | 0.5 | 0.4 | 77.5 | <0.01 | 0.01 | 3.2 | 0.074 | 0.10 | 0.57 |
| L2032841-2 145595 | | 3.6 | 21.5 | 0.007 | 0.07 | <0.05 | 4.8 | 0.9 | 0.9 | 55.6 | <0.01 | 0.07 | 3.5 | 0.060 | 0.17 | 0.39 |
| L2032841-3 144248 | | 3.3 | 26.8 | 0.046 | 0.66 | <0.05 | 2.7 | 3.6 | 0.9 | 51.6 | <0.01 | 0.22 | 2.3 | 0.095 | 0.19 | 0.18 |
| L2032841-4 144249 | | 2.5 | 30.1 | 0.004 | 0.17 | <0.05 | 4.1 | 1.1 | 0.7 | 62.1 | <0.01 | 0.04 | 3.4 | 0.117 | 0.20 | 0.32 |
| L2032841-5 144250 | | 4.4 | 25.0 | 0.036 | 0.74 | <0.05 | 3.6 | 2.9 | 0.9 | 63.3 | <0.01 | 0.18 | 3.2 | 0.086 | 0.18 | 0.24 |
| L2032841-6 144850 | | 3.2 | 18.8 | 0.019 | 0.41 | <0.05 | 2.6 | 2.0 | 0.7 | 53.9 | <0.01 | 0.12 | 2.8 | 0.066 | 0.13 | 0.35 |
| L2032841-7 144848 | | 3.7 | 21.6 | 0.016 | 0.64 | <0.05 | 3.8 | 3.4 | 0.8 | 51.9 | <0.01 | 0.22 | 2.3 | 0.077 | 0.15 | 0.28 |
| L2032841-8 144849 | | 3.2 | 27.3 | 0.024 | 1.39 | <0.05 | 3.4 | 7.8 | 1.0 | 76.7 | <0.01 | 0.80 | 3.8 | 0.105 | 0.21 | 0.36 |
| L2032841-9 144598 | | 2.8 | 34.4 | 0.039 | 0.36 | <0.05 | 3.9 | 2.2 | 0.9 | 66.7 | <0.01 | 0.16 | 3.0 | 0.127 | 0.24 | 0.34 |
| L2032841-10 144599 | | 2.8 | 27.7 | 0.040 | 0.36 | <0.05 | 3.1 | 1.4 | 0.8 | 55.9 | <0.01 | 0.06 | 2.3 | 0.098 | 0.21 | 0.26 |

***** See Appendix Page for comments regarding this certificate *****



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 2103 Dollarton Hwy
 North Vancouver BC V7H 0A7
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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 2 - E
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 9-JAN-2018
 Account: APN

Project: L2032841

| |
|---|
| CERTIFICATE OF ANALYSIS VA17276191 |
|---|

| Sample Description | Method Analyte Units LOR | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 | Cu-OG46 Cu % 0.001 |
|--------------------|-----------------------------------|--------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|-----------------------------|
| L2032841-1 145596 | | 47 | 0.41 | 8.79 | 47 | 8.1 | |
| L2032841-2 145595 | | 61 | 0.29 | 8.28 | 69 | 1.6 | |
| L2032841-3 144248 | | 54 | <0.05 | 5.63 | 84 | 1.1 | |
| L2032841-4 144249 | | 56 | <0.05 | 5.84 | 76 | 1.0 | |
| L2032841-5 144250 | | 61 | <0.05 | 6.43 | 84 | 1.0 | |
| L2032841-6 144850 | | 43 | <0.05 | 5.62 | 65 | 0.9 | |
| L2032841-7 144848 | | 51 | <0.05 | 5.81 | 74 | 1.2 | |
| L2032841-8 144849 | | 57 | <0.05 | 6.32 | 95 | 1.0 | 1.105 |
| L2032841-9 144598 | | 61 | <0.05 | 9.43 | 72 | 1.1 | |
| L2032841-10 144599 | | 51 | <0.05 | 6.44 | 61 | 1.0 | |



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To: ALS ENVIRONMENTAL
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 9-JAN-2018
Account: APN

Project: L2032841

CERTIFICATE OF ANALYSIS VA17276191

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|---------|----------|-----------|
| C-GAS05 | C-IR07 | Cu-OG46 | LOG-22 |
| ME-MS41 | ME-OG46 | OA-ELE07 | OA-VOL08m |
| PUL-31 | PUL-QC | S-CAL06a | S-GRA06 |
| S-GRA06a | S-IR08 | SPL-21 | WEI-21 |



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| Report To | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | |
|--|---|--|--------------|------------------|--|-------------------------------------|-----------------------|-----------------------------|--|---|---------------|--|-------|-------|--|--|--|----------------------|--|--|
| Contact and company name below will appear on the final report | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | |
| Contact: | Minto Environment - Coordinator | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Phone: | 1-604-759-4659 | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: _____ | | | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 3 | | | Analysis Request | | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Total Metals - Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leop) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | | | | | | | | | | |
| | Copy of invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Email 2 | | | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | |
| Project Information | | AFB/Cost Center: | | | | | | | | | PO# | | | | | | | Number of Containers | | |
| ALS Account # / Quote #: | | Major/Minor Code: | | | | | | | | | Routing Code: | | | | | | | | | |
| Job #: | | Requisitioner: | | | | | | | | | Location: | | | | | | | | | |
| PO / AFE: TBD | | ALS Contact: | | | | | | | | | Sampler: | | | | | | | | | |
| LSD: | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | |
| | 145595 | | | 19-NOV-17 | | Composite | R | R | R | R | R | R | | | | | | | | |
| | 145596 | | | 9-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 145595 | | | 19-NOV-17 | | WASTE | F | P | X | X | X | X | | | | | | | | |
| | 144248 | | | 07-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 144249 | | | 07-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 144250 | | | 07-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 144850 | | | 07-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 144848 | | | 07-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 144849 | | | 07-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 144598 | | | 07-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| | 144599 | | | 07-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | |
| Drinking Water (DW) Samples ¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> | | | | | SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> | | | | | Ice Cubes <input type="checkbox"/> | | | | | Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | |
| Released by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 PRINT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 13-DEC-17
Report Date: 19-JAN-18 16:47 (MT)
Version: FINAL REV. 2

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2035058
Project P.O. #: PO#228594
Job Reference:
C of C Numbers: 17-36
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2035058-2 Waste 07-NOV-17 144600 | L2035058-3 Waste 24-NOV-17 146676 | L2035058-4 Waste 24-NOV-17 146677 | L2035058-5 Waste 24-NOV-17 146678 | L2035058-6 Waste 23-NOV-17 145597 |
|---|--|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.4 | 8.5 | 8.3 | 8.6 | 7.9 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.52 | <0.05 | <0.05 | <0.05 | 0.26 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 1 | 1 | 1 | 2 |
| | MPA (tCaCO3/1Kt) | 9.7 | 0.6 | 0.6 | 0.3 | 2.2 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 48 | 10 | 8 | 8 | 32 |
| | NNP (tCaCO3/1Kt) | 38 | 9 | 7 | 8 | 30 |
| | Ratio (NP/MPA) (Unity) | 4.95 | 16.00 | 12.80 | 25.60 | 14.63 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.02 | 0.01 | <0.01 | 0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | 0.03 | 0.01 | 0.02 | 0.04 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.31 | <0.01 | 0.01 | <0.01 | 0.03 |
| | Total Sulfur (combustion) (%) | 0.31 | 0.02 | 0.02 | 0.01 | 0.07 |
| Total Metals | Aluminum (Al) (%) | 0.98 | 1.15 | 1.02 | 1.04 | 1.22 |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | <0.05 | <0.05 | 0.53 |
| | Arsenic (As) (ppm) | 0.6 | 1.8 | 1.0 | 0.3 | 6.2 |
| | Barium (Ba) (ppm) | 240 | 390 | 220 | 320 | 310 |
| | Beryllium (Be) (ppm) | 0.22 | 0.28 | 0.26 | 0.27 | 0.39 |
| | Bismuth (Bi) (ppm) | 0.10 | 0.01 | 0.08 | 0.01 | 0.12 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.15 | 0.12 | 0.19 | 0.05 | 0.29 |
| | Calcium (Ca) (%) | 1.69 | 0.29 | 0.27 | 0.28 | 1.18 |
| | Cerium (Ce) (ppm) | 29.9 | 26.9 | 33.0 | 24.8 | 25.9 |
| | Cesium (Cs) (ppm) | 0.25 | 0.63 | 0.57 | 0.41 | 0.82 |
| | Chromium (Cr) (ppm) | 5 | 4 | 3 | 4 | 24 |
| | Cobalt (Co) (ppm) | 6.5 | 6.2 | 6.7 | 5.5 | 8.9 |
| | Copper (Cu) (ppm) | 1510 | 407 | 2470 | 65.3 | 976 |
| | Gallium (Ga) (ppm) | 4.85 | 5.67 | 5.39 | 5.04 | 4.65 |
| | Germanium (Ge) (ppm) | 0.10 | 0.10 | 0.10 | 0.12 | 0.10 |
| | Gold (Au) (ppm) | 0.04 | <0.02 | 0.02 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.06 | 0.06 | 0.06 | 0.08 | 0.26 |
| | Indium (In) (ppm) | 0.046 | 0.034 | 0.087 | 0.029 | 0.034 |
| | Iron (Fe) (%) | 2.20 | 2.43 | 2.53 | 1.99 | 2.44 |
| | Lanthanum (La) (ppm) | 16.8 | 14.7 | 18.2 | 12.6 | 13.3 |
| | Lead (Pb) (ppm) | 2.9 | 2.8 | 4.2 | 1.4 | 5.2 |
| | Lithium (Li) (ppm) | 4.8 | 5.0 | 4.3 | 5.1 | 7.9 |
| | Magnesium (Mg) (%) | 0.49 | 0.42 | 0.41 | 0.45 | 0.63 |
| | Manganese (Mn) (ppm) | 440 | 527 | 551 | 598 | 490 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2035058-7 Waste 26-NOV-17 145598 | L2035058-8 Waste 26-NOV-17 145599 | L2035058-9 Waste 26-NOV-17 145600 | L2035058-10 Waste 25-NOV-17 146679 | L2035058-11 TAILS 20-NOV-17 NOV TAL 2017 | |
|---|--|--|--|---|---|-------|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.2 | 8.4 | 8.3 | 8.4 | 7.9 |
| Organic / Inorganic Carbon | Carbon (C) (%) | <0.05 | <0.05 | <0.05 | 0.11 | 0.22 |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | 1 | 1 | 1 | 2 |
| | MPA (tCaCO3/1Kt) | 0.6 | 0.6 | 0.3 | 2.2 | 3.4 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 8 | 9 | 5 | 13 | 27 |
| | NNP (tCaCO3/1Kt) | 7 | 8 | 5 | 11 | 24 |
| | Ratio (NP/MPA) (Unity) | 12.80 | 14.40 | 16.00 | 5.94 | 7.85 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.02 | 0.01 | <0.01 | 0.01 | 0.05 |
| | Sulfate Sulfur (HCl leach) (%) | 0.04 | 0.02 | 0.01 | 0.02 | 0.05 |
| | Sulfide Sulfur (T minus HCl leach) (%) | <0.01 | <0.01 | <0.01 | 0.05 | 0.06 |
| | Total Sulfur (combustion) (%) | 0.02 | 0.02 | 0.01 | 0.07 | 0.11 |
| Total Metals | Aluminum (Al) (%) | 1.18 | 0.96 | 0.66 | 0.82 | 1.32 |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 1.5 | 0.6 | 0.9 | 0.9 | 0.8 |
| | Barium (Ba) (ppm) | 260 | 290 | 210 | 220 | 250 |
| | Beryllium (Be) (ppm) | 0.27 | 0.26 | 0.20 | 0.21 | 0.28 |
| | Bismuth (Bi) (ppm) | 0.09 | <0.01 | 0.01 | 0.12 | 0.25 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.35 | 0.05 | 0.23 | 0.25 | 0.26 |
| | Calcium (Ca) (%) | 0.22 | 0.32 | 0.10 | 0.47 | 0.87 |
| | Cerium (Ce) (ppm) | 26.2 | 26.9 | 9.15 | 24.1 | 24.9 |
| | Cesium (Cs) (ppm) | 0.58 | 0.31 | 0.27 | 0.41 | 0.53 |
| | Chromium (Cr) (ppm) | 4 | 6 | 4 | 4 | 8 |
| | Cobalt (Co) (ppm) | 9.8 | 5.7 | 5.9 | 5.9 | 7.3 |
| | Copper (Cu) (ppm) | 4420 | 306 | 1830 | 2650 | 1970 |
| | Gallium (Ga) (ppm) | 6.71 | 4.91 | 3.64 | 4.20 | 8.43 |
| | Germanium (Ge) (ppm) | 0.12 | 0.11 | 0.06 | 0.09 | 0.11 |
| | Gold (Au) (ppm) | 0.04 | <0.02 | <0.02 | 0.05 | 0.07 |
| | Hafnium (Hf) (ppm) | 0.07 | 0.11 | 0.05 | 0.07 | 0.06 |
| | Indium (In) (ppm) | 0.074 | 0.029 | 0.027 | 0.058 | 0.084 |
| | Iron (Fe) (%) | 2.61 | 2.06 | 1.56 | 2.27 | 3.81 |
| | Lanthanum (La) (ppm) | 14.9 | 14.2 | 5.2 | 14.0 | 13.7 |
| | Lead (Pb) (ppm) | 2.8 | 1.7 | 2.3 | 3.1 | 3.7 |
| | Lithium (Li) (ppm) | 4.7 | 5.3 | 2.6 | 3.0 | 6.0 |
| | Magnesium (Mg) (%) | 0.53 | 0.42 | 0.20 | 0.33 | 0.71 |
| | Manganese (Mn) (ppm) | 397 | 499 | 259 | 525 | 612 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID Description Sampled Date Sampled Time Client ID | L2035058-2 Waste 07-NOV-17 144600 | L2035058-3 Waste 24-NOV-17 146676 | L2035058-4 Waste 24-NOV-17 146677 | L2035058-5 Waste 24-NOV-17 146678 | L2035058-6 Waste 23-NOV-17 145597 |
|------------------------|--------------------------|---|--|--|--|--|--|
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | <0.01 | 0.01 | 0.01 | 0.01 | 0.04 |
| | Molybdenum (Mo) (ppm) | 8.81 | 1.35 | 5.14 | 0.81 | 0.81 | 1.42 |
| | Nickel (Ni) (ppm) | 1.6 | 2.4 | 2.5 | 2.6 | 2.6 | 20.0 |
| | Niobium (Nb) (ppm) | 0.21 | 0.33 | 0.28 | 0.22 | 0.22 | 0.78 |
| | Phosphorus (P) (ppm) | 600 | 670 | 880 | 620 | 620 | 860 |
| | Potassium (K) (%) | 0.41 | 0.66 | 0.60 | 0.57 | 0.57 | 0.23 |
| | Rhenium (Re) (ppm) | 0.024 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | 19.5 | 32.9 | 32.5 | 25.7 | 25.7 | 11.9 |
| | Scandium (Sc) (ppm) | 3.3 | 8.0 | 6.3 | 5.4 | 5.4 | 4.9 |
| | Selenium (Se) (ppm) | 1.4 | 0.2 | 0.8 | 0.2 | 0.2 | 0.7 |
| | Silver (Ag) (ppm) | 0.40 | 0.04 | 0.20 | 0.02 | 0.02 | 0.27 |
| | Sodium (Na) (%) | 0.05 | 0.07 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Strontium (Sr) (ppm) | 98.2 | 28.8 | 38.1 | 28.1 | 28.1 | 54.6 |
| | Sulfur (S) (%) | 0.35 | 0.01 | 0.02 | 0.01 | 0.01 | 0.07 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.06 | 0.01 | 0.06 | <0.01 | <0.01 | 0.06 |
| | Thallium (Tl) (ppm) | 0.13 | 0.22 | 0.29 | 0.17 | 0.17 | 0.12 |
| | Thorium (Th) (ppm) | 3.1 | 3.5 | 5.7 | 2.8 | 2.8 | 3.4 |
| | Tin (Sn) (ppm) | 0.6 | 0.8 | 1.2 | 0.7 | 0.7 | 0.5 |
| | Titanium (Ti) (%) | 0.065 | 0.102 | 0.094 | 0.085 | 0.085 | 0.081 |
| | Tungsten (W) (ppm) | 0.22 | 0.79 | 0.20 | 0.55 | 0.55 | 0.56 |
| | Uranium (U) (ppm) | 0.62 | 0.17 | 0.35 | 0.15 | 0.15 | 0.67 |
| | Vanadium (V) (ppm) | 40 | 57 | 70 | 44 | 44 | 53 |
| | Yttrium (Y) (ppm) | 6.52 | 8.83 | 10.50 | 11.95 | 11.95 | 9.18 |
| | Zinc (Zn) (ppm) | 59 | 69 | 82 | 54 | 54 | 67 |
| | Zirconium (Zr) (ppm) | 1.4 | 1.4 | 1.4 | 1.3 | 1.3 | 7.2 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.9 | <0.2 | <0.2 | <0.2 | <0.2 | 1.0 |
| Miscellaneous | Carbon (C) (%) | 0.58 | 0.04 | 0.05 | 0.05 | 0.05 | 0.74 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2035058-7 Waste 26-NOV-17 145598 | L2035058-8 Waste 26-NOV-17 145599 | L2035058-9 Waste 26-NOV-17 145600 | L2035058-10 Waste 25-NOV-17 146679 | L2035058-11 TAILS 20-NOV-17 NOV TAL 2017 |
|---|--------------------------|--|--|--|---|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.02 | 0.01 | 0.02 | 0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | 3.49 | 0.68 | 2.53 | 9.44 | 3.97 |
| | Nickel (Ni) (ppm) | 6.9 | 7.2 | 2.9 | 2.4 | 3.4 |
| | Niobium (Nb) (ppm) | 0.40 | 0.18 | 0.30 | 0.22 | 0.28 |
| | Phosphorus (P) (ppm) | 780 | 660 | 230 | 700 | 820 |
| | Potassium (K) (%) | 0.77 | 0.49 | 0.35 | 0.49 | 0.66 |
| | Rhenium (Re) (ppm) | <0.001 | <0.001 | <0.001 | 0.003 | 0.007 |
| | Rubidium (Rb) (ppm) | 39.4 | 25.9 | 16.3 | 24.7 | 34.3 |
| | Scandium (Sc) (ppm) | 7.3 | 5.5 | 2.7 | 5.0 | 4.6 |
| | Selenium (Se) (ppm) | 0.8 | <0.2 | 0.4 | 1.3 | 1.5 |
| | Silver (Ag) (ppm) | 0.44 | 0.08 | 0.18 | 0.42 | 0.72 |
| | Sodium (Na) (%) | 0.04 | 0.06 | 0.05 | 0.05 | 0.06 |
| | Strontium (Sr) (ppm) | 43.9 | 30.6 | 28.8 | 35.1 | 66.6 |
| | Sulfur (S) (%) | 0.01 | 0.01 | 0.01 | 0.06 | 0.12 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.10 | <0.01 | 0.03 | 0.04 | 0.19 |
| | Thallium (Tl) (ppm) | 0.31 | 0.15 | 0.12 | 0.17 | 0.25 |
| | Thorium (Th) (ppm) | 3.1 | 2.2 | 0.7 | 3.7 | 3.5 |
| | Tin (Sn) (ppm) | 1.5 | 0.6 | 0.5 | 0.6 | 1.2 |
| | Titanium (Ti) (%) | 0.128 | 0.084 | 0.054 | 0.072 | 0.118 |
| | Tungsten (W) (ppm) | 1.15 | 0.68 | 0.93 | 0.54 | 0.25 |
| | Uranium (U) (ppm) | 0.33 | 0.16 | 0.20 | 0.26 | 0.37 |
| | Vanadium (V) (ppm) | 84 | 45 | 35 | 52 | 71 |
| | Yttrium (Y) (ppm) | 8.68 | 8.89 | 4.94 | 7.21 | 6.86 |
| | Zinc (Zn) (ppm) | 65 | 66 | 45 | 71 | 113 |
| | Zirconium (Zr) (ppm) | 1.7 | 2.2 | 1.4 | 1.6 | 1.2 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | <0.2 | <0.2 | <0.2 | 0.4 | 0.8 |
| Miscellaneous | Carbon (C) (%) | 0.08 | 0.05 | 0.06 | 0.14 | 0.25 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-36

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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CERTIFICATE VA17278855

Project: L2035058

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 15-DEC-2017.

The following have access to data associated with this certificate:

| | | |
|---|------------------|----------------------------|
| ALSE VANCOUVER WEBTRIEVE SHANE STACK | ALSEV DATASUBLET | SOFTWARE DEVELOPMENT GROUP |
|---|------------------|----------------------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-QC | Pulverizing QC Test |
| SPL-21 | Split sample - riffle splitter |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08 | Basic Acid Base Accounting | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA17278855

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08 FIZZ RAT Unity | OA-VOL08 MPA tCaCO3/1Kt | OA-VOL08 NNP tCaCO3/1Kt | OA-VOL08 NP tCaCO3/1Kt | OA-VOL08 Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|--------------------|--------------------------|---------------------|-------------------------|-------------------------|-------------------------|------------------------|--------------------------|-------------------|------------|--------------|-------------|---------------|--------------|----------------|--------------|----------------|
| L2035058-2 144600 | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.1 |
| L2035058-3 146676 | | 1.08 | 2 | 9.7 | 38 | 48 | 4.95 | 8.4 | 0.31 | 0.31 | 0.52 | 1.9 | <0.01 | 0.40 | 0.98 | 0.6 |
| L2035058-4 146677 | | 1.02 | 1 | 0.6 | 9 | 10 | 16.00 | 8.5 | 0.02 | <0.01 | <0.05 | <0.2 | 0.03 | 0.04 | 1.15 | 1.8 |
| L2035058-5 146678 | | 1.06 | 1 | 0.6 | 7 | 8 | 12.80 | 8.3 | 0.02 | 0.01 | <0.05 | <0.2 | 0.01 | 0.20 | 1.02 | 1.0 |
| L2035058-6 145597 | | 1.12 | 1 | 0.3 | 8 | 8 | 25.60 | 8.6 | 0.01 | <0.01 | <0.05 | <0.2 | 0.02 | 0.02 | 1.04 | 0.3 |
| L2035058-7 145598 | | 1.10 | 2 | 2.2 | 30 | 32 | 14.63 | 7.9 | 0.07 | 0.03 | 0.26 | 1.0 | 0.04 | 0.27 | 1.22 | 6.2 |
| L2035058-8 145599 | | 1.10 | 1 | 0.6 | 7 | 8 | 12.80 | 8.2 | 0.02 | <0.01 | <0.05 | <0.2 | 0.04 | 0.44 | 1.18 | 1.5 |
| L2035058-9 145600 | | 1.10 | 1 | 0.6 | 8 | 9 | 14.40 | 8.4 | 0.02 | <0.01 | <0.05 | <0.2 | 0.02 | 0.08 | 0.96 | 0.6 |
| L2035058-10 146679 | | 0.94 | 1 | 0.3 | 5 | 5 | 16.00 | 8.3 | 0.01 | <0.01 | <0.05 | <0.2 | 0.01 | 0.18 | 0.66 | 0.9 |
| L2035058-11 | | 1.10 | 1 | 2.2 | 11 | 13 | 5.94 | 8.4 | 0.07 | 0.05 | 0.11 | 0.4 | 0.02 | 0.42 | 0.82 | 0.9 |
| | | 0.90 | 2 | 3.4 | 24 | 27 | 7.85 | 7.9 | 0.11 | 0.06 | 0.22 | 0.8 | 0.05 | 0.72 | 1.32 | 0.8 |

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CERTIFICATE OF ANALYSIS VA17278855

| Sample Description | Method Analyte Units LOR | ME-MS41 Au ppm 0.02 | ME-MS41 B ppm 10 | ME-MS41 Ba ppm 10 | ME-MS41 Be ppm 0.05 | ME-MS41 Bi ppm 0.01 | ME-MS41 Ca % 0.01 | ME-MS41 Cd ppm 0.01 | ME-MS41 Ce ppm 0.02 | ME-MS41 Co ppm 0.1 | ME-MS41 Cr ppm 1 | ME-MS41 Cs ppm 0.05 | ME-MS41 Cu ppm 0.2 | ME-MS41 Fe % 0.01 | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 |
|--------------------|-----------------------------------|------------------------------|---------------------------|----------------------------|------------------------------|------------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|---------------------------|------------------------------|-----------------------------|----------------------------|------------------------------|------------------------------|
| L2035058-2 144600 | | 0.04 | <10 | 240 | 0.22 | 0.10 | 1.69 | 0.15 | 29.9 | 6.5 | 5 | 0.25 | 1510 | 2.20 | 4.85 | 0.10 |
| L2035058-3 146676 | | <0.02 | <10 | 390 | 0.28 | 0.01 | 0.29 | 0.12 | 26.9 | 6.2 | 4 | 0.63 | 407 | 2.43 | 5.67 | 0.10 |
| L2035058-4 146677 | | 0.02 | <10 | 220 | 0.26 | 0.08 | 0.27 | 0.19 | 33.0 | 6.7 | 3 | 0.57 | 2470 | 2.53 | 5.39 | 0.10 |
| L2035058-5 146678 | | <0.02 | <10 | 320 | 0.27 | 0.01 | 0.28 | 0.05 | 24.8 | 5.5 | 4 | 0.41 | 65.3 | 1.99 | 5.04 | 0.12 |
| L2035058-6 145597 | | <0.02 | <10 | 310 | 0.39 | 0.12 | 1.18 | 0.29 | 25.9 | 8.9 | 24 | 0.82 | 976 | 2.44 | 4.65 | 0.10 |
| L2035058-7 145598 | | 0.04 | <10 | 260 | 0.27 | 0.09 | 0.22 | 0.35 | 26.2 | 9.8 | 4 | 0.58 | 4420 | 2.61 | 6.71 | 0.12 |
| L2035058-8 145599 | | <0.02 | <10 | 290 | 0.26 | <0.01 | 0.32 | 0.05 | 26.9 | 5.7 | 6 | 0.31 | 306 | 2.06 | 4.91 | 0.11 |
| L2035058-9 145600 | | <0.02 | <10 | 210 | 0.20 | 0.01 | 0.10 | 0.23 | 9.15 | 5.9 | 4 | 0.27 | 1830 | 1.56 | 3.64 | 0.06 |
| L2035058-10 146679 | | 0.05 | <10 | 220 | 0.21 | 0.12 | 0.47 | 0.25 | 24.1 | 5.9 | 4 | 0.41 | 2650 | 2.27 | 4.20 | 0.09 |
| L2035058-11 | | 0.07 | <10 | 250 | 0.28 | 0.25 | 0.87 | 0.26 | 24.9 | 7.3 | 8 | 0.53 | 1970 | 3.81 | 8.43 | 0.11 |



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CERTIFICATE OF ANALYSIS VA17278855

| Sample Description | Method Analyte Units LOR | ME-MS41 Hf ppm 0.02 | ME-MS41 Hg ppm 0.01 | ME-MS41 In ppm 0.005 | ME-MS41 K % 0.01 | ME-MS41 La ppm 0.2 | ME-MS41 Li ppm 0.1 | ME-MS41 Mg % 0.01 | ME-MS41 Mn ppm 5 | ME-MS41 Mo ppm 0.05 | ME-MS41 Na % 0.01 | ME-MS41 Nb ppm 0.05 | ME-MS41 Ni ppm 0.2 | ME-MS41 P ppm 10 | ME-MS41 Pb ppm 0.2 | ME-MS41 Rb ppm 0.1 |
|--------------------|-----------------------------------|------------------------------|------------------------------|-------------------------------|---------------------------|-----------------------------|-----------------------------|----------------------------|---------------------------|------------------------------|----------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|-----------------------------|
| L2035058-2 144600 | | 0.06 | 0.01 | 0.046 | 0.41 | 16.8 | 4.8 | 0.49 | 440 | 8.81 | 0.05 | 0.21 | 1.6 | 600 | 2.9 | 19.5 |
| L2035058-3 146676 | | 0.06 | <0.01 | 0.034 | 0.66 | 14.7 | 5.0 | 0.42 | 527 | 1.35 | 0.07 | 0.33 | 2.4 | 670 | 2.8 | 32.9 |
| L2035058-4 146677 | | 0.06 | 0.01 | 0.087 | 0.60 | 18.2 | 4.3 | 0.41 | 551 | 5.14 | 0.05 | 0.28 | 2.5 | 880 | 4.2 | 32.5 |
| L2035058-5 146678 | | 0.08 | 0.01 | 0.029 | 0.57 | 12.6 | 5.1 | 0.45 | 598 | 0.81 | 0.05 | 0.22 | 2.6 | 620 | 1.4 | 25.7 |
| L2035058-6 145597 | | 0.26 | 0.04 | 0.034 | 0.23 | 13.3 | 7.9 | 0.63 | 490 | 1.42 | 0.05 | 0.78 | 20.0 | 860 | 5.2 | 11.9 |
| L2035058-7 145598 | | 0.07 | 0.02 | 0.074 | 0.77 | 14.9 | 4.7 | 0.53 | 397 | 3.49 | 0.04 | 0.40 | 6.9 | 780 | 2.8 | 39.4 |
| L2035058-8 145599 | | 0.11 | 0.01 | 0.029 | 0.49 | 14.2 | 5.3 | 0.42 | 499 | 0.68 | 0.06 | 0.18 | 7.2 | 660 | 1.7 | 25.9 |
| L2035058-9 145600 | | 0.05 | 0.02 | 0.027 | 0.35 | 5.2 | 2.6 | 0.20 | 259 | 2.53 | 0.05 | 0.30 | 2.9 | 230 | 2.3 | 16.3 |
| L2035058-10 146679 | | 0.07 | 0.01 | 0.058 | 0.49 | 14.0 | 3.0 | 0.33 | 525 | 9.44 | 0.05 | 0.22 | 2.4 | 700 | 3.1 | 24.7 |
| L2035058-11 | | 0.06 | 0.01 | 0.084 | 0.66 | 13.7 | 6.0 | 0.71 | 612 | 3.97 | 0.06 | 0.28 | 3.4 | 820 | 3.7 | 34.3 |



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CERTIFICATE OF ANALYSIS VA17278855

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U | V | W |
| | Units | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm |
| | LOR | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| L2035058-2 144600 | | 0.024 | 0.35 | <0.05 | 3.3 | 1.4 | 0.6 | 98.2 | <0.01 | 0.06 | 3.1 | 0.065 | 0.13 | 0.62 | 40 | 0.22 |
| L2035058-3 146676 | | <0.001 | 0.01 | <0.05 | 8.0 | 0.2 | 0.8 | 28.8 | <0.01 | 0.01 | 3.5 | 0.102 | 0.22 | 0.17 | 57 | 0.79 |
| L2035058-4 146677 | | <0.001 | 0.02 | <0.05 | 6.3 | 0.8 | 1.2 | 38.1 | <0.01 | 0.06 | 5.7 | 0.094 | 0.29 | 0.35 | 70 | 0.20 |
| L2035058-5 146678 | | <0.001 | 0.01 | <0.05 | 5.4 | 0.2 | 0.7 | 28.1 | <0.01 | <0.01 | 2.8 | 0.085 | 0.17 | 0.15 | 44 | 0.55 |
| L2035058-6 145597 | | 0.001 | 0.07 | 0.53 | 4.9 | 0.7 | 0.5 | 54.6 | <0.01 | 0.06 | 3.4 | 0.081 | 0.12 | 0.67 | 53 | 0.56 |
| L2035058-7 145598 | | <0.001 | 0.01 | <0.05 | 7.3 | 0.8 | 1.5 | 43.9 | <0.01 | 0.10 | 3.1 | 0.128 | 0.31 | 0.33 | 84 | 1.15 |
| L2035058-8 145599 | | <0.001 | 0.01 | <0.05 | 5.5 | <0.2 | 0.6 | 30.6 | <0.01 | <0.01 | 2.2 | 0.084 | 0.15 | 0.16 | 45 | 0.68 |
| L2035058-9 145600 | | <0.001 | 0.01 | <0.05 | 2.7 | 0.4 | 0.5 | 28.8 | <0.01 | 0.03 | 0.7 | 0.054 | 0.12 | 0.20 | 35 | 0.93 |
| L2035058-10 146679 | | 0.003 | 0.06 | <0.05 | 5.0 | 1.3 | 0.6 | 35.1 | <0.01 | 0.04 | 3.7 | 0.072 | 0.17 | 0.26 | 52 | 0.54 |
| L2035058-11 | | 0.007 | 0.12 | <0.05 | 4.6 | 1.5 | 1.2 | 66.6 | <0.01 | 0.19 | 3.5 | 0.118 | 0.25 | 0.37 | 71 | 0.25 |

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CERTIFICATE OF ANALYSIS VA17278855

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|--------------------|-----------------------------------|-----------------------------|---------------------------|-----------------------------|
| L2035058-2 144600 | | 6.52 | 59 | 1.4 |
| L2035058-3 146676 | | 8.83 | 69 | 1.4 |
| L2035058-4 146677 | | 10.50 | 82 | 1.4 |
| L2035058-5 146678 | | 11.95 | 54 | 1.3 |
| L2035058-6 145597 | | 9.18 | 67 | 7.2 |
| L2035058-7 145598 | | 8.68 | 65 | 1.7 |
| L2035058-8 145599 | | 8.89 | 66 | 2.2 |
| L2035058-9 145600 | | 4.94 | 45 | 1.4 |
| L2035058-10 146679 | | 7.21 | 71 | 1.6 |
| L2035058-11 | | 6.86 | 113 | 1.2 |
| | | | | |



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CERTIFICATE OF ANALYSIS VA17278855

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|--------|---------|----------|
| C-GAS05 | LOG-22 | ME-MS41 | OA-ELE07 |
| OA-VOL08 | PUL-31 | PUL-QC | S-CAL06a |
| S-GRA06a | S-IR08 | SPL-21 | WEI-21 |



ALS Canada Ltd.
 2103 Dollarton Hwy
 North Vancouver BC V7H 0A7
 Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
 www.alsglobal.com/geochemistry

To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Page: 1
 Total # Pages: 2 (A)
 Plus Appendix Pages
 Finalized Date: 18-JAN-2018
 Account: APN

CERTIFICATE VA18008315

Project: L2035058

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 12-JAN-2018.

The following have access to data associated with this certificate:

| | | |
|---|------------------|----------------------------|
| ALSE VANCOUVER WEBTRIEVE SHANE STACK | ALSEV DATASUBLET | SOFTWARE DEVELOPMENT GROUP |
|---|------------------|----------------------------|

| SAMPLE PREPARATION | |
|--------------------|-------------------------------|
| ALS CODE | DESCRIPTION |
| FND-02 | Find Sample for Addn Analysis |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|------------|
| ALS CODE | DESCRIPTION | INSTRUMENT |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 2 - A
 Total # Pages: 2 (A)
 Plus Appendix Pages
 Finalized Date: 18-JAN-2018
 Account: APN

Project: L2035058

| |
|---|
| CERTIFICATE OF ANALYSIS VA18008315 |
|---|

| Sample Description | Method Analyte Units LOR | C-IR07 C % | S-GRA06 S % |
|--------------------|-----------------------------------|------------------|-------------------|
| L2035058-2 144600 | | 0.58 | 0.02 |
| L2035058-3 146676 | | 0.04 | 0.01 |
| L2035058-4 146677 | | 0.05 | <0.01 |
| L2035058-5 146678 | | 0.05 | 0.01 |
| L2035058-6 145597 | | 0.74 | <0.01 |
| L2035058-7 145598 | | 0.08 | 0.02 |
| L2035058-8 145599 | | 0.05 | 0.01 |
| L2035058-9 145600 | | 0.06 | <0.01 |
| L2035058-10 146679 | | 0.14 | 0.01 |
| L2035058-11 | | 0.25 | 0.05 |

**** See Appendix Page for comments regarding this certificate ****



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To: ALS ENVIRONMENTAL
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 18-JAN-2018
Account: APN

Project: L2035058

CERTIFICATE OF ANALYSIS VA18008315

CERTIFICATE COMMENTS

LABORATORY ADDRESSES

Applies to Method:

Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.
C-IR07 FND-02 S-GRA06



www.alsglobal.com

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|--|-----------------------------|--|---|-------------------|--------------------------|-------------------------------------|-----------|---|-------------------------------------|--|--|-------------------------------------|--|--|-----------------------|-----------------------------|--|---------------------------|---------------------------|---|--|---|--|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">PRIORITY (Business days)</td> <td style="width: 60%;">4 day [P4] <input type="checkbox"/></td> <td style="width: 20%;">EMERGENCY</td> </tr> <tr> <td></td> <td>3 day [P3] <input type="checkbox"/></td> <td>1 Business day [E1] <input type="checkbox"/></td> </tr> <tr> <td></td> <td>2 day [P2] <input type="checkbox"/></td> <td>Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/></td> </tr> </table> | | PRIORITY (Business days) | 4 day [P4] <input type="checkbox"/> | EMERGENCY | | 3 day [P3] <input type="checkbox"/> | 1 Business day [E1] <input type="checkbox"/> | | 2 day [P2] <input type="checkbox"/> | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | Date and Time Required for all E&P TATs: _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PRIORITY (Business days) | 4 day [P4] <input type="checkbox"/> | EMERGENCY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 day [P3] <input type="checkbox"/> | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 day [P2] <input type="checkbox"/> | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 1 or Fax: minto_environment@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 2 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To: Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Invoice Distribution | | | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Metals- Aqua regia digestion (ICP)</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Paste pH</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">% Inorganic Carbonate</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Carbon/Sulphur (Leco)</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">AP - determination by % sulphide sulphur</td> <td rowspan="10" style="writing-mode: vertical-rl; transform: rotate(180deg);">Modified NP - (MEND 1991)</td> <td colspan="10" style="text-align: center;">Number of Containers</td> </tr> <tr> <td colspan="10" style="text-align: center;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="10"></td> </tr> </table> </td> </tr> </table> | | | | | | | | | | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | | | | | | | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="10"></td> </tr> </table> | | | | | | | | | | | | | | | | | | | |
| Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | | | | | | | | | | | | | | | | | Modified NP - (MEND 1991) | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="10"></td> </tr> </table> | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | | | Company: Minto Explorations Ltd. | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | Contact: Ruth Cayetano | | Email 1 or Fax: ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | ALS Account # / Quote #: | | AFE/Cost Center: _____ PO# _____ | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | Job #: | | Major/Minor Code: _____ Routing Code: _____ | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | PO / AFE: TBD | | Requisitioner: _____ | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | LSD: | | Location: _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 144600 | | | 21-NOV-17 | | Composite | R | R | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146676 | | | 24-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146677 | | | 24-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146678 | | | 24-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145597 | | | 23-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145598 | | | 26-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145599 | | | 26-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 145600 | | | 26-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146679 | | | 25-NOV-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | NOV. TAL 2017 | | | NOV-2017 | | TAILS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | | | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | INITIAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | 5.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | 12.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: JOBY | | Date: DEC. 12/17 | Time: | Received by: EHF | | Date: 13 DEC 2017 | Time: 16:45 | Received by: TP | | Date: Dec 14 | Time: 16:15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 28-DEC-17
Report Date: 08-FEB-18 15:06 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2039797
Project P.O. #: PO#228594
Job Reference:
C of C Numbers: 17-38
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2039797-1 WASTE 17-DEC-17 146698 | L2039797-2 WASTE 17-DEC-17 146699 | L2039797-3 WASTE 17-DEC-17 146700 | L2039797-4 WASTE 08-DEC-17 146685 | L2039797-5 WASTE 06-DEC-17 146684 |
|-------------------------------|---|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.3 | 8.6 | 8.6 | 8.5 | 8.4 |
| Organic / Inorganic Carbon | Carbon (C) (%) | <0.05 | <0.05 | 0.07 | 0.22 | 0.29 |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | 1 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.3 | 0.3 | 0.3 | 0.6 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 6 | 9 | 12 | 23 | 30 |
| | NNP (tCaCO3/1Kt) | 6 | 9 | 12 | 22 | 30 |
| | Ratio (NP/MPA) (Unity) | 19.20 | 28.80 | 38.40 | 36.80 | 96.00 |
| | Sulfate Sulfur (carbonate leach) (%) | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 |
| | Total Sulfur (combustion) (%) | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 |
| Total Metals | Aluminum (Al) (%) | 0.74 | 0.96 | 1.03 | 0.79 | 0.92 |
| | Antimony (Sb) (ppm) | <0.05 | <0.05 | 0.05 | 0.28 | 0.36 |
| | Arsenic (As) (ppm) | 1.9 | 1.1 | 2.1 | 5.0 | 5.1 |
| | Barium (Ba) (ppm) | 220 | 200 | 150 | 230 | 220 |
| | Beryllium (Be) (ppm) | 0.28 | 0.20 | 0.21 | 0.30 | 0.30 |
| | Bismuth (Bi) (ppm) | 0.18 | 0.03 | 0.09 | 0.05 | 0.10 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.25 | 0.11 | 0.11 | 0.21 | 0.20 |
| | Calcium (Ca) (%) | 0.25 | 0.38 | 0.46 | 0.95 | 1.20 |
| | Cerium (Ce) (ppm) | 29.8 | 26.3 | 27.6 | 23.6 | 26.8 |
| | Cesium (Cs) (ppm) | 0.40 | 0.28 | 0.27 | 0.58 | 0.70 |
| | Chromium (Cr) (ppm) | 4 | 4 | 4 | 16 | 19 |
| | Cobalt (Co) (ppm) | 6.6 | 5.1 | 5.3 | 6.3 | 6.8 |
| | Copper (Cu) (ppm) | 3310 | 230 | 1650 | 433 | 2200 |
| | Gallium (Ga) (ppm) | 4.52 | 5.44 | 6.02 | 3.33 | 3.91 |
| | Germanium (Ge) (ppm) | 0.05 | 0.05 | 0.05 | <0.05 | 0.05 |
| | Gold (Au) (ppm) | 0.07 | <0.02 | 0.02 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.04 | 0.05 | 0.03 | 0.18 | 0.22 |
| | Indium (In) (ppm) | 0.058 | 0.029 | 0.024 | 0.029 | 0.041 |
| | Iron (Fe) (%) | 2.33 | 1.98 | 2.05 | 1.95 | 1.98 |
| | Lanthanum (La) (ppm) | 15.8 | 13.2 | 14.7 | 12.6 | 13.8 |
| | Lead (Pb) (ppm) | 3.8 | 2.7 | 3.3 | 4.3 | 5.1 |
| | Lithium (Li) (ppm) | 2.5 | 4.9 | 5.7 | 4.2 | 5.0 |
| | Magnesium (Mg) (%) | 0.26 | 0.45 | 0.55 | 0.40 | 0.49 |
| | Manganese (Mn) (ppm) | 670 | 577 | 521 | 419 | 424 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2039797-6 WASTE 11-DEC-17 146686 | L2039797-7 WASTE 11-DEC-17 146687 | L2039797-8 WASTE 10-DEC-17 146688 | L2039797-9 WASTE 10-DEC-17 146689 |
|-----------------------------------|---|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | 8.4 | 8.6 | 8.8 | 9.1 |
| Organic / Inorganic Carbon | Carbon (C) (%) | <0.05 | 0.16 | 0.56 | 0.23 |
| Acid Base Accounting | FIZZ RATING (Unity) | 1 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.3 | 0.3 | 3.8 | 0.6 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 6 | 20 | 44 | 21 |
| | NNP (tCaCO3/1Kt) | 6 | 20 | 40 | 20 |
| | Ratio (NP/MPA) (Unity) | 19.20 | 64.00 | 11.73 | 33.60 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.01 | 0.01 | 0.12 | 0.02 |
| | Total Sulfur (combustion) (%) | 0.01 | 0.01 | 0.12 | 0.02 |
| Total Metals | Aluminum (Al) (%) | 0.77 | 1.00 | 0.70 | 0.99 |
| | Antimony (Sb) (ppm) | <0.05 | 0.22 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | 0.8 | 3.9 | 0.9 | 0.6 |
| | Barium (Ba) (ppm) | 110 | 230 | 170 | 270 |
| | Beryllium (Be) (ppm) | 0.25 | 0.27 | 0.23 | 0.21 |
| | Bismuth (Bi) (ppm) | 0.03 | 0.03 | 0.18 | 0.03 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.12 | 0.12 | 0.17 | 0.05 |
| | Calcium (Ca) (%) | 0.27 | 0.88 | 1.45 | 0.82 |
| | Cerium (Ce) (ppm) | 24.5 | 23.5 | 21.8 | 25.9 |
| | Cesium (Cs) (ppm) | 0.24 | 0.54 | 0.48 | 0.55 |
| | Chromium (Cr) (ppm) | 3 | 12 | 4 | 5 |
| | Cobalt (Co) (ppm) | 5.4 | 6.2 | 5.4 | 5.3 |
| | Copper (Cu) (ppm) | 813 | 50.7 | 2030 | 155.0 |
| | Gallium (Ga) (ppm) | 4.78 | 4.56 | 3.87 | 5.24 |
| | Germanium (Ge) (ppm) | <0.05 | 0.05 | 0.05 | 0.05 |
| | Gold (Au) (ppm) | <0.02 | <0.02 | 0.05 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.04 | 0.16 | 0.05 | 0.04 |
| | Indium (In) (ppm) | 0.064 | 0.021 | 0.049 | 0.025 |
| | Iron (Fe) (%) | 1.94 | 2.00 | 2.16 | 2.14 |
| | Lanthanum (La) (ppm) | 13.1 | 12.3 | 11.8 | 13.8 |
| | Lead (Pb) (ppm) | 5.4 | 3.0 | 2.9 | 2.7 |
| | Lithium (Li) (ppm) | 4.1 | 5.9 | 2.7 | 4.8 |
| | Magnesium (Mg) (%) | 0.29 | 0.51 | 0.54 | 0.59 |
| | Manganese (Mn) (ppm) | 493 | 519 | 571 | 541 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2039797-1 | L2039797-2 | L2039797-3 | L2039797-4 | L2039797-5 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|------------|
| | | Description | WASTE | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 17-DEC-17 | 17-DEC-17 | 17-DEC-17 | 08-DEC-17 | 06-DEC-17 |
| | | Sampled Time | | | | | |
| | | Client ID | 146698 | 146699 | 146700 | 146685 | 146684 |
| Grouping | Analyte | | | | | | |
| SOIL | | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.01 | <0.01 | <0.01 | 0.02 | 0.02 |
| | Molybdenum (Mo) (ppm) | | 1.59 | 0.93 | 0.62 | 1.60 | 1.16 |
| | Nickel (Ni) (ppm) | | 8.7 | 3.5 | 5.1 | 12.7 | 14.2 |
| | Niobium (Nb) (ppm) | | 0.20 | 0.17 | 0.14 | 0.33 | 0.37 |
| | Phosphorus (P) (ppm) | | 690 | 540 | 590 | 710 | 770 |
| | Potassium (K) (%) | | 0.38 | 0.39 | 0.29 | 0.21 | 0.22 |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | | 21.4 | 19.5 | 15.5 | 12.4 | 13.8 |
| | Scandium (Sc) (ppm) | | 4.0 | 4.7 | 3.4 | 4.6 | 4.6 |
| | Selenium (Se) (ppm) | | 0.7 | <0.2 | 0.2 | 0.6 | 0.7 |
| | Silver (Ag) (ppm) | | 0.48 | 0.09 | 0.31 | 0.07 | 0.28 |
| | Sodium (Na) (%) | | 0.03 | 0.05 | 0.05 | 0.04 | 0.04 |
| | Strontium (Sr) (ppm) | | 18.7 | 30.4 | 33.3 | 52.8 | 61.0 |
| | Sulfur (S) (%) | | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| | Tellurium (Te) (ppm) | | 0.25 | 0.02 | 0.06 | 0.01 | 0.04 |
| | Thallium (Tl) (ppm) | | 0.13 | 0.10 | 0.09 | 0.10 | 0.12 |
| | Thorium (Th) (ppm) | | 3.6 | 2.9 | 3.4 | 3.6 | 3.6 |
| | Tin (Sn) (ppm) | | 0.6 | 0.6 | 0.4 | 0.5 | 0.6 |
| | Titanium (Ti) (%) | | 0.060 | 0.057 | 0.043 | 0.057 | 0.071 |
| | Tungsten (W) (ppm) | | 0.40 | 0.51 | 0.34 | 0.40 | 0.36 |
| | Uranium (U) (ppm) | | 0.32 | 0.14 | 0.15 | 0.40 | 0.49 |
| | Vanadium (V) (ppm) | | 55 | 42 | 40 | 44 | 49 |
| | Yttrium (Y) (ppm) | | 8.58 | 9.43 | 5.93 | 9.68 | 9.60 |
| | Zinc (Zn) (ppm) | | 81 | 69 | 79 | 50 | 53 |
| | Zirconium (Zr) (ppm) | | 1.0 | 0.6 | 0.6 | 5.2 | 6.6 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | <0.2 | <0.2 | 0.2 | 0.8 | 1.1 |
| Miscellaneous | Carbon (C) (%) | | 0.07 | 0.07 | 0.11 | 0.37 | 0.49 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2039797-6 | L2039797-7 | L2039797-8 | L2039797-9 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|
| | | Description | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 11-DEC-17 | 11-DEC-17 | 10-DEC-17 | 10-DEC-17 |
| | | Sampled Time | | | | |
| | | Client ID | 146686 | 146687 | 146688 | 146689 |
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | <0.01 | 0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | | 5.18 | 0.79 | 2.52 | 1.09 |
| | Nickel (Ni) (ppm) | | 1.9 | 8.9 | 2.3 | 2.4 |
| | Niobium (Nb) (ppm) | | 0.13 | 0.31 | 0.18 | 0.18 |
| | Phosphorus (P) (ppm) | | 650 | 750 | 580 | 550 |
| | Potassium (K) (%) | | 0.21 | 0.33 | 0.36 | 0.58 |
| | Rhenium (Re) (ppm) | | <0.001 | <0.001 | 0.003 | 0.002 |
| | Rubidium (Rb) (ppm) | | 10.0 | 18.0 | 18.1 | 29.4 |
| | Scandium (Sc) (ppm) | | 4.3 | 4.2 | 3.6 | 3.6 |
| | Selenium (Se) (ppm) | | 0.3 | 0.3 | 1.5 | 0.2 |
| | Silver (Ag) (ppm) | | 0.08 | 0.03 | 0.71 | 0.07 |
| | Sodium (Na) (%) | | 0.04 | 0.05 | 0.04 | 0.06 |
| | Strontium (Sr) (ppm) | | 21.7 | 48.7 | 79.2 | 56.7 |
| | Sulfur (S) (%) | | 0.01 | 0.02 | 0.13 | 0.03 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.02 | 0.01 | 0.14 | <0.01 |
| | Thallium (Tl) (ppm) | | 0.06 | 0.12 | 0.11 | 0.18 |
| | Thorium (Th) (ppm) | | 2.8 | 3.0 | 2.7 | 3.0 |
| | Tin (Sn) (ppm) | | 0.7 | 0.5 | 0.5 | 0.5 |
| | Titanium (Ti) (%) | | 0.020 | 0.084 | 0.055 | 0.098 |
| | Tungsten (W) (ppm) | | 0.12 | 0.38 | 0.42 | 0.50 |
| | Uranium (U) (ppm) | | 0.22 | 0.35 | 0.30 | 0.20 |
| | Vanadium (V) (ppm) | | 39 | 45 | 45 | 49 |
| | Yttrium (Y) (ppm) | | 9.63 | 9.29 | 7.18 | 7.61 |
| | Zinc (Zn) (ppm) | | 67 | 54 | 73 | 65 |
| | Zirconium (Zr) (ppm) | | 0.8 | 4.3 | 1.2 | 0.7 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | <0.2 | 0.6 | 2.1 | 0.9 |
| Miscellaneous | Carbon (C) (%) | | 0.03 | 0.28 | 0.66 | 0.30 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-38

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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CERTIFICATE VA18001253

Project: L2039797
 P.O. No.: ALSM-CW16-102-APN
 This report is for 9 Other samples submitted to our lab in Vancouver, BC, Canada on 2-JAN-2018.
 The following have access to data associated with this certificate:

| | | |
|------------------|-------------|--|
| ALSEV DATASUBLET | SHANE STACK | |
|------------------|-------------|--|

| SAMPLE PREPARATION | |
|---------------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|------------------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm |
|--------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|
| | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 |
| L2039797-1 146698 | | 0.88 | 1 | 0.3 | 6 | 6 | 19.20 | 8.3 | 0.01 | 0.01 | <0.05 | <0.2 | <0.01 | 0.07 | 0.01 | 0.48 |
| L2039797-2 146699 | | 1.20 | 1 | 0.3 | 9 | 9 | 28.80 | 8.6 | 0.01 | 0.01 | <0.05 | <0.2 | <0.01 | 0.07 | <0.01 | 0.09 |
| L2039797-3 146700 | | 1.16 | 2 | 0.3 | 12 | 12 | 38.40 | 8.6 | 0.01 | 0.01 | 0.07 | 0.2 | <0.01 | 0.11 | <0.01 | 0.31 |
| L2039797-4 146685 | | 1.12 | 2 | 0.6 | 22 | 23 | 36.80 | 8.5 | 0.02 | 0.02 | 0.22 | 0.8 | <0.01 | 0.37 | <0.01 | 0.07 |
| L2039797-5 146684 | | 1.08 | 2 | 0.3 | 30 | 30 | 96.00 | 8.4 | 0.01 | 0.01 | 0.29 | 1.1 | <0.01 | 0.49 | <0.01 | 0.28 |
| L2039797-6 146686 | | 1.06 | 1 | 0.3 | 6 | 6 | 19.20 | 8.4 | 0.01 | 0.01 | <0.05 | <0.2 | <0.01 | 0.03 | <0.01 | 0.08 |
| L2039797-7 146687 | | 1.10 | 2 | 0.3 | 20 | 20 | 64.00 | 8.6 | 0.01 | 0.01 | 0.16 | 0.6 | <0.01 | 0.28 | <0.01 | 0.03 |
| L2039797-8 146688 | | 1.04 | 2 | 3.8 | 40 | 44 | 11.73 | 8.8 | 0.12 | 0.12 | 0.56 | 2.1 | <0.01 | 0.66 | <0.01 | 0.71 |
| L2039797-9 146689 | | 1.08 | 2 | 0.6 | 20 | 21 | 33.60 | 9.1 | 0.02 | 0.02 | 0.23 | 0.9 | <0.01 | 0.30 | <0.01 | 0.07 |



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CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | Analyte | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu |
| Units | | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm |
| LOR | | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 |
| L2039797-1 146698 | | 0.74 | 1.9 | 0.07 | <10 | 220 | 0.28 | 0.18 | 0.25 | 0.25 | 29.8 | 6.6 | 4 | 0.40 | 3310 |
| L2039797-2 146699 | | 0.96 | 1.1 | <0.02 | <10 | 200 | 0.20 | 0.03 | 0.38 | 0.11 | 26.3 | 5.1 | 4 | 0.28 | 230 |
| L2039797-3 146700 | | 1.03 | 2.1 | 0.02 | <10 | 150 | 0.21 | 0.09 | 0.46 | 0.11 | 27.6 | 5.3 | 4 | 0.27 | 1650 |
| L2039797-4 146685 | | 0.79 | 5.0 | <0.02 | <10 | 230 | 0.30 | 0.05 | 0.95 | 0.21 | 23.6 | 6.3 | 16 | 0.58 | 433 |
| L2039797-5 146684 | | 0.92 | 5.1 | <0.02 | <10 | 220 | 0.30 | 0.10 | 1.20 | 0.20 | 26.8 | 6.8 | 19 | 0.70 | 2200 |
| L2039797-6 146686 | | 0.77 | 0.8 | <0.02 | <10 | 110 | 0.25 | 0.03 | 0.27 | 0.12 | 24.5 | 5.4 | 3 | 0.24 | 813 |
| L2039797-7 146687 | | 1.00 | 3.9 | <0.02 | <10 | 230 | 0.27 | 0.03 | 0.88 | 0.12 | 23.5 | 6.2 | 12 | 0.54 | 50.7 |
| L2039797-8 146688 | | 0.70 | 0.9 | 0.05 | <10 | 170 | 0.23 | 0.18 | 1.45 | 0.17 | 21.8 | 5.4 | 4 | 0.48 | 2030 |
| L2039797-9 146689 | | 0.99 | 0.6 | <0.02 | <10 | 270 | 0.21 | 0.03 | 0.82 | 0.05 | 25.9 | 5.3 | 5 | 0.55 | 155.0 |

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CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | Analyte | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P |
| Units | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm |
| LOR | | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 |
| L2039797-1 146698 | | 4.52 | 0.05 | 0.04 | 0.01 | 0.058 | 0.38 | 15.8 | 2.5 | 0.26 | 670 | 1.59 | 0.03 | 0.20 | 8.7 | 690 |
| L2039797-2 146699 | | 5.44 | 0.05 | 0.05 | <0.01 | 0.029 | 0.39 | 13.2 | 4.9 | 0.45 | 577 | 0.93 | 0.05 | 0.17 | 3.5 | 540 |
| L2039797-3 146700 | | 6.02 | 0.05 | 0.03 | <0.01 | 0.024 | 0.29 | 14.7 | 5.7 | 0.55 | 521 | 0.62 | 0.05 | 0.14 | 5.1 | 590 |
| L2039797-4 146685 | | 3.33 | <0.05 | 0.18 | 0.02 | 0.029 | 0.21 | 12.6 | 4.2 | 0.40 | 419 | 1.60 | 0.04 | 0.33 | 12.7 | 710 |
| L2039797-5 146684 | | 3.91 | 0.05 | 0.22 | 0.02 | 0.041 | 0.22 | 13.8 | 5.0 | 0.49 | 424 | 1.16 | 0.04 | 0.37 | 14.2 | 770 |
| L2039797-6 146686 | | 4.78 | <0.05 | 0.04 | <0.01 | 0.064 | 0.21 | 13.1 | 4.1 | 0.29 | 493 | 5.18 | 0.04 | 0.13 | 1.9 | 650 |
| L2039797-7 146687 | | 4.56 | 0.05 | 0.16 | 0.01 | 0.021 | 0.33 | 12.3 | 5.9 | 0.51 | 519 | 0.79 | 0.05 | 0.31 | 8.9 | 750 |
| L2039797-8 146688 | | 3.87 | 0.05 | 0.05 | <0.01 | 0.049 | 0.36 | 11.8 | 2.7 | 0.54 | 571 | 2.52 | 0.04 | 0.18 | 2.3 | 580 |
| L2039797-9 146689 | | 5.24 | 0.05 | 0.04 | <0.01 | 0.025 | 0.58 | 13.8 | 4.8 | 0.59 | 541 | 1.09 | 0.06 | 0.18 | 2.4 | 550 |

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CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|-----------------------------------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-----------|----------|
| | | Pb ppm | Rb ppm | Re ppm | S % | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm |
| L2039797-1 146698 | | 3.8 | 21.4 | <0.001 | 0.01 | <0.05 | 4.0 | 0.7 | 0.6 | 18.7 | <0.01 | 0.25 | 3.6 | 0.060 | 0.13 | 0.32 |
| L2039797-2 146699 | | 2.7 | 19.5 | <0.001 | 0.01 | <0.05 | 4.7 | <0.2 | 0.6 | 30.4 | <0.01 | 0.02 | 2.9 | 0.057 | 0.10 | 0.14 |
| L2039797-3 146700 | | 3.3 | 15.5 | <0.001 | 0.02 | 0.05 | 3.4 | 0.2 | 0.4 | 33.3 | <0.01 | 0.06 | 3.4 | 0.043 | 0.09 | 0.15 |
| L2039797-4 146685 | | 4.3 | 12.4 | <0.001 | 0.02 | 0.28 | 4.6 | 0.6 | 0.5 | 52.8 | <0.01 | 0.01 | 3.6 | 0.057 | 0.10 | 0.40 |
| L2039797-5 146684 | | 5.1 | 13.8 | 0.001 | 0.02 | 0.36 | 4.6 | 0.7 | 0.6 | 61.0 | 0.01 | 0.04 | 3.6 | 0.071 | 0.12 | 0.49 |
| L2039797-6 146686 | | 5.4 | 10.0 | <0.001 | 0.01 | <0.05 | 4.3 | 0.3 | 0.7 | 21.7 | <0.01 | 0.02 | 2.8 | 0.020 | 0.06 | 0.22 |
| L2039797-7 146687 | | 3.0 | 18.0 | <0.001 | 0.02 | 0.22 | 4.2 | 0.3 | 0.5 | 48.7 | <0.01 | 0.01 | 3.0 | 0.084 | 0.12 | 0.35 |
| L2039797-8 146688 | | 2.9 | 18.1 | 0.003 | 0.13 | <0.05 | 3.6 | 1.5 | 0.5 | 79.2 | <0.01 | 0.14 | 2.7 | 0.055 | 0.11 | 0.30 |
| L2039797-9 146689 | | 2.7 | 29.4 | 0.002 | 0.03 | <0.05 | 3.6 | 0.2 | 0.5 | 56.7 | <0.01 | <0.01 | 3.0 | 0.098 | 0.18 | 0.20 |

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CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------|---------|---------|---------|---------|---------|---------|
| | Analyte | V | W | Y | Zn | Zr |
| | Units | ppm | ppm | ppm | ppm | ppm |
| | LOR | 1 | 0.05 | 0.05 | 2 | 0.5 |
| L2039797-1 146698 | | 55 | 0.40 | 8.58 | 81 | 1.0 |
| L2039797-2 146699 | | 42 | 0.51 | 9.43 | 69 | 0.6 |
| L2039797-3 146700 | | 40 | 0.34 | 5.93 | 79 | 0.6 |
| L2039797-4 146685 | | 44 | 0.40 | 9.68 | 50 | 5.2 |
| L2039797-5 146684 | | 49 | 0.36 | 9.60 | 53 | 6.6 |
| L2039797-6 146686 | | 39 | 0.12 | 9.63 | 67 | 0.8 |
| L2039797-7 146687 | | 45 | 0.38 | 9.29 | 54 | 4.3 |
| L2039797-8 146688 | | 45 | 0.42 | 7.18 | 73 | 1.2 |
| L2039797-9 146689 | | 49 | 0.50 | 7.61 | 65 | 0.7 |



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CERTIFICATE OF ANALYSIS VA18001253

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|--------|----------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | S-CAL06a |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



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QC CERTIFICATE VA18001253

Project: L2039797
 P.O. No.: ALSM-CW16-102-APN
 This report is for 9 Other samples submitted to our lab in Vancouver, BC, Canada on 2-JAN-2018.
 The following have access to data associated with this certificate:

| | |
|------------------|-------------|
| ALSEV DATASUBLET | SHANE STACK |
|------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA18001253

| Method Analyte Units LOR | OA-VOL08m FIZZ RAT | OA-VOL08m MPA | OA-VOL08m NNP | OA-VOL08m NP | OA-VOL08m Ratio (N) | OA-ELE07 pH | S-IR08 S | C-GAS05 C | C-GAS05 CO2 | S-GRA06a S | C-IR07 C | S-GRA06 S | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As |
|----------------------------|--------------------|---------------|---------------|--------------|---------------------|-------------|----------|-----------|-------------|------------|----------|-----------|------------|------------|------------|
| Sample Description | Unity | tCaCO3/1Kt | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | % | ppm | % | ppm |
| | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.3 | | | | | | | | | |
| Upper Bound | | | | | | 6.7 | | | | | | | | | |
| GS310-10 | | | | | | | 0.27 | | | | 1.10 | | | | |
| Target Range - Lower Bound | | | | | | | 0.25 | | | | 1.03 | | | | |
| Upper Bound | | | | | | | 0.29 | | | | 1.13 | | | | |
| KZK-1 | 2 | 25.0 | 31 | 56 | 2.24 | | | | | | | | | | |
| KZK-1 | 2 | 25.0 | 31 | 56 | 2.24 | | | | | | | | | | |
| Target Range - Lower Bound | <1 | 22.9 | 30 | 54 | 2.18 | | | | | | | | | | |
| Upper Bound | >4 | 27.1 | 38 | 64 | 2.53 | | | | | | | | | | |
| MA-1b | | | | | | | 1.17 | | | | 2.43 | | | | |
| Target Range - Lower Bound | | | | | | | 1.12 | | | | 2.34 | | | | |
| Upper Bound | | | | | | | 1.22 | | | | 2.54 | | | | |
| MA-3a | | | | | | | | 2.39 | 8.8 | | | | | | |
| Target Range - Lower Bound | | | | | | | | 2.31 | 8.4 | | | | | | |
| Upper Bound | | | | | | | | 2.77 | 10.2 | | | | | | |
| OGGeo08 | | | | | | | | | | | | | 19.20 | 2.14 | 119.0 |
| Target Range - Lower Bound | | | | | | | | | | | | | 18.15 | 2.05 | 107.0 |
| Upper Bound | | | | | | | | | | | | | 22.2 | 2.53 | 131.0 |
| OREAS 920 | | | | | | | | | | | | | 0.10 | 2.27 | 4.7 |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.07 | 2.18 | 3.8 |
| Upper Bound | | | | | | | | | | | | | 0.12 | 2.68 | 4.9 |
| SY-4 | | | | | | | | 0.87 | 3.2 | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.84 | 3.0 | | | | | | |
| Upper Bound | | | | | | | | 1.08 | 4.0 | | | | | | |
| UTS-1 | | | | | | | | | | | | | 0.85 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.83 | | |
| Upper Bound | | | | | | | | | | | | | 0.93 | | |
| UTS-1 | | | | | | | | | | 0.82 | | | | | |
| Target Range - Lower Bound | | | | | | | | | | 0.81 | | | | | |
| Upper Bound | | | | | | | | | | 0.95 | | | | | |
| UTS-4 | | | | | | | | | | | | | 1.71 | | |
| UTS-4 | | | | | | | | | | | | | 1.71 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 1.64 | | |
| Upper Bound | | | | | | | | | | | | | 1.84 | | |

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| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Au ppm | B ppm | Ba ppm | Be ppm | Bi ppm | Ca % | Cd ppm | Ce ppm | Co ppm | Cr ppm | Cs ppm | Cu ppm | Fe % | Ga ppm | Ge ppm | |
| | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | 0.07 | <10 | 60 | 0.80 | 9.93 | 0.87 | 18.05 | 58.5 | 95.8 | 79 | 9.46 | 8040 | 4.89 | 8.69 | 0.13 | |
| Target Range - Lower Bound | 0.03 | <10 | 60 | 0.61 | 9.44 | 0.82 | 16.75 | 56.7 | 87.2 | 75 | 8.68 | 7800 | 4.51 | 8.05 | 0.21 | |
| Upper Bound | 0.11 | 30 | 110 | 0.89 | 11.55 | 1.02 | 20.5 | 69.3 | 107.0 | 93 | 10.70 | 8980 | 5.53 | 9.95 | 0.45 | |
| OREAS 920 | <0.02 | <10 | 70 | 0.64 | 0.62 | 0.30 | 0.06 | 71.9 | 14.0 | 40 | 1.93 | 105.0 | 3.44 | 6.76 | 0.06 | |
| Target Range - Lower Bound | <0.02 | <10 | 50 | 0.59 | 0.60 | 0.28 | 0.04 | 64.8 | 13.4 | 37 | 1.84 | 102.0 | 3.26 | 6.12 | <0.05 | |
| Upper Bound | 0.04 | 20 | 110 | 0.87 | 0.76 | 0.37 | 0.09 | 79.2 | 16.6 | 48 | 2.36 | 118.0 | 4.00 | 7.60 | 0.22 | |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA18001253

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | |
| | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| OGGeo08 | 0.84 | 0.47 | 1.395 | 1.00 | 28.6 | 31.5 | 0.91 | 380 | 862 | 0.28 | 1.00 | 8530 | 770 | 6860 | 118.5 | |
| Target Range - Lower Bound | 0.72 | 0.41 | 1.335 | 0.94 | 27.7 | 28.4 | 0.84 | 350 | 811 | 0.26 | 0.97 | 7760 | 700 | 6520 | 109.5 | |
| Upper Bound | 0.92 | 0.57 | 1.645 | 1.18 | 34.3 | 35.0 | 1.05 | 438 | 991 | 0.34 | 1.29 | 9480 | 880 | 7970 | 134.5 | |
| OREAS 920 | 0.56 | <0.01 | 0.032 | 0.38 | 35.8 | 16.3 | 1.01 | 493 | 0.33 | 0.02 | 0.32 | 36.0 | 680 | 21.6 | 22.9 | |
| Target Range - Lower Bound | 0.53 | <0.01 | 0.019 | 0.39 | 33.3 | 19.0 | 0.98 | 472 | 0.29 | <0.01 | 0.31 | 34.4 | | 19.2 | 22.2 | |
| Upper Bound | 0.69 | 0.02 | 0.043 | 0.50 | 41.1 | 23.4 | 1.22 | 588 | 0.53 | 0.02 | 0.55 | 42.4 | | 23.9 | 27.4 | |
| SY-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA18001253

| Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Tl % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|----------------------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS310-10 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-1b | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-3a | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| OGGeo08 | 1.345 | 2.65 | 18.00 | 6.2 | 9.1 | 12.1 | 60.9 | <0.01 | 0.14 | 16.7 | 0.300 | 1.39 | 4.72 | 77 | 2.76 |
| Target Range - Lower Bound | 1.295 | 2.51 | 17.70 | 6.0 | 9.7 | 12.0 | 59.6 | <0.01 | 0.14 | 15.6 | 0.279 | 1.14 | 4.45 | 70 | 2.58 |
| Upper Bound | 1.585 | 3.09 | 24.1 | 7.6 | 12.3 | 15.1 | 73.2 | 0.03 | 0.20 | 19.6 | 0.353 | 1.58 | 5.55 | 88 | 3.60 |
| OREAS 920 | <0.001 | 0.04 | 0.60 | 2.5 | 0.2 | 1.0 | 16.1 | 0.01 | 0.02 | 16.3 | 0.112 | 0.14 | 2.09 | 24 | 0.40 |
| Target Range - Lower Bound | <0.001 | <0.01 | 0.45 | 2.5 | <0.2 | 0.7 | 15.0 | <0.01 | <0.01 | 13.6 | 0.106 | 0.07 | 1.89 | 23 | 0.31 |
| Upper Bound | 0.002 | 0.05 | 0.77 | 3.3 | 0.7 | 1.7 | 18.8 | 0.02 | 0.04 | 17.0 | 0.140 | 0.18 | 2.42 | 30 | 0.61 |
| SY-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

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Project: L2039797

QC CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|--------------------------|--------------------|------------------|--------------------|
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS310-10 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-1b | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-3a | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| OGGeo08 | | 17.10 | 6760 | 23.2 |
| Target Range - Lower Bound | | 15.35 | 6500 | 19.5 |
| Upper Bound | | 18.85 | 7950 | 27.5 |
| OREAS 920 | | 17.70 | 100 | 19.7 |
| Target Range - Lower Bound | | 16.85 | 93 | 17.6 |
| Upper Bound | | 20.7 | 119 | 25.0 |
| SY-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

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QC CERTIFICATE OF ANALYSIS VA18001253

| Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm | |
|----------------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|-------------|---------------|--------------|------------|-------------|----------------|--------------|----------------|--|
| Sample Description | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1 | |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | <0.05 | <0.2 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.05 | <0.2 | | | | | | | |
| Upper Bound | | | | | | | | 0.10 | 0.4 | | | | | | | |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 | |
| Upper Bound | | | | | | | | | | | | | 0.02 | 0.02 | 0.2 | |
| BLANK | | | | | | 6.0 | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.5 | | | | | | | | | | |
| Upper Bound | | | | | | 6.9 | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | <0.01 | | | |
| BLANK | | | | | | | | | | | | | <0.01 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | | | |
| Upper Bound | | | | | | | | | | | | | 0.02 | | | |
| BLANK | | | | | | | | | | <0.01 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | <0.01 | | | | | | |
| Upper Bound | | | | | | | | | | 0.02 | | | | | | |
| BLANK | | | | | | | <0.01 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | <0.01 | | | | | | | | | |
| Upper Bound | | | | | | | 0.02 | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L2039797-1 146698 | | | | | | | | | | | | | 0.01 | | | |
| DUP | | | | | | | | | | | | | <0.01 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | | | |
| Upper Bound | | | | | | | | | | | | | 0.02 | | | |
| L2039797-6 146686 | | | | | | | 0.01 | | | | | | 0.03 | | | |
| DUP | | | | | | | 0.01 | | | | | | 0.04 | | | |
| Target Range - Lower Bound | | | | | | | <0.01 | | | | | | 0.02 | | | |
| Upper Bound | | | | | | | 0.02 | | | | | | 0.05 | | | |
| L2039797-8 146688 | 2 | 3.8 | 40 | 44 | 11.73 | | | | | | | | | | | |
| DUP | 2 | 3.8 | 39 | 43 | 11.47 | | | | | | | | | | | |
| Target Range - Lower Bound | <1 | 3.3 | 37 | 40 | 11.01 | | | | | | | | | | | |
| Upper Bound | 3 | 4.3 | 42 | 47 | 12.19 | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method Analyte Units LOR | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm | |
|--------------------|----------------------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|--|
| | | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 | |
| BLANKS | | | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | 0.06 | <0.2 | <0.01 | <0.05 | <0.05 | |
| | Upper Bound | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | | |
| L2039797-1 146698 | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| L2039797-6 146686 | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |
| L2039797-8 146688 | Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method Analyte Units LOR | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm |
|--------------------|----------------------------|----------------|----------------|----------------|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|---------------|----------------|----------------|
| | | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 |
| BLANKS | | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | 0.05 | <0.2 | <10 | 0.3 | <0.1 |
| | Upper Bound | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| BLANK | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L2039797-1 146698 | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| L2039797-6 146686 | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |
| L2039797-8 146688 | Target Range - Lower Bound | | | | | | | | | | | | | | | |
| | Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA18001253

| Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|----------------------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|---------------|---------------|---------------|
| Sample Description | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.001 | 0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Target Range - Lower Bound | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Upper Bound | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| L2039797-1 146698 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L2039797-6 146686 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L2039797-8 146688 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|-----------------------------------|-----------------------------|---------------------------|-----------------------------|
| BLANKS | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | <0.05 | <2 | <0.5 |
| Target Range - Lower Bound | | <0.05 | <2 | <0.5 |
| Upper Bound | | 0.10 | 4 | 1.0 |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DUPLICATES | | | | |
| L2039797-1 146698 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L2039797-6 146686 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L2039797-8 146688 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |



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QC CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|-------------|---------------|--------------|------------|-------------|----------------|--------------|----------------|
| | | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L2039797-9 146689 | | | | | | | | | 0.23 | 0.9 | | | | 0.07 | 0.99 | 0.6 |
| DUP | | | | | | | | | 0.23 | 0.9 | | | | 0.06 | 1.00 | 0.8 |
| Target Range - Lower Bound | | | | | | | | | 0.17 | 0.7 | | | | 0.05 | 0.94 | 0.6 |
| Upper Bound | | | | | | | | | 0.29 | 1.1 | | | | 0.08 | 1.05 | 0.8 |
| L2041640-1 146693 | | | | | | | 8.8 | | | | <0.01 | | <0.01 | | | |
| DUP | | | | | | | 8.8 | | | | <0.01 | | <0.01 | | | |
| Target Range - Lower Bound | | | | | | | 8.3 | | | | <0.01 | | <0.01 | | | |
| Upper Bound | | | | | | | 9.3 | | | | 0.02 | | 0.02 | | | |

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QC CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method Analyte Units LOR | ME-MS41 Au ppm 0.02 | ME-MS41 B ppm 10 | ME-MS41 Ba ppm 10 | ME-MS41 Be ppm 0.05 | ME-MS41 Bi ppm 0.01 | ME-MS41 Ca % 0.01 | ME-MS41 Cd ppm 0.01 | ME-MS41 Ce ppm 0.02 | ME-MS41 Co ppm 0.1 | ME-MS41 Cr ppm 1 | ME-MS41 Cs ppm 0.05 | ME-MS41 Cu ppm 0.2 | ME-MS41 Fe % 0.01 | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 |
|----------------------------|-----------------------------------|------------------------------|---------------------------|----------------------------|------------------------------|------------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|---------------------------|------------------------------|-----------------------------|----------------------------|------------------------------|------------------------------|
| DUPLICATES | | | | | | | | | | | | | | | | |
| L2039797-9 146689 | | <0.02 | <10 | 270 | 0.21 | 0.03 | 0.82 | 0.05 | 25.9 | 5.3 | 5 | 0.55 | 155.0 | 2.14 | 5.24 | 0.05 |
| DUP | | <0.02 | <10 | 270 | 0.27 | 0.02 | 0.83 | 0.06 | 26.2 | 5.7 | 5 | 0.54 | 155.5 | 2.16 | 5.19 | 0.07 |
| Target Range - Lower Bound | | <0.02 | <10 | 240 | 0.18 | <0.01 | 0.77 | 0.04 | 24.7 | 5.1 | 4 | 0.47 | 149.5 | 2.03 | 4.90 | <0.05 |
| Upper Bound | | 0.04 | 20 | 300 | 0.30 | 0.04 | 0.88 | 0.07 | 27.4 | 5.9 | 6 | 0.62 | 161.0 | 2.27 | 5.53 | 0.10 |
| L2041640-1 146693 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method | Analyte | Units | LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | | | |
|----------------------------|--------|---------|-------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|-----|------|
| | | | | | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P | Pb | Rb |
| | | | | | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm |
| | | | | | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 |
| DUPLICATES | | | | | | | | | | | | | | | | | | | |
| L2039797-9 146689 | | | | | 0.04 | <0.01 | 0.025 | 0.58 | 13.8 | 4.8 | 0.59 | 541 | 1.09 | 0.06 | 0.18 | 2.4 | 550 | 2.7 | 29.4 |
| DUP | | | | | 0.04 | <0.01 | 0.024 | 0.60 | 14.0 | 5.7 | 0.60 | 547 | 0.99 | 0.06 | 0.18 | 2.5 | 540 | 2.5 | 29.1 |
| Target Range - Lower Bound | | | | | <0.02 | <0.01 | 0.018 | 0.55 | 13.0 | 4.9 | 0.56 | 512 | 0.94 | 0.05 | 0.12 | 2.1 | 510 | 2.3 | 27.7 |
| Upper Bound | | | | | 0.06 | 0.02 | 0.031 | 0.63 | 14.8 | 5.6 | 0.63 | 576 | 1.14 | 0.07 | 0.24 | 2.8 | 580 | 2.9 | 30.8 |
| L2041640-1 146693 | | | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | | | |

***** See Appendix Page for comments regarding this certificate *****



ALS Canada Ltd.
 2103 Dollarton Hwy
 North Vancouver BC V7H 0A7
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To: ALS ENVIRONMENTAL
 100 - 8081 LOUGHEED HWY.
 BURNABY BC V5A 1W9

Page: 4 - D
 Total # Pages: 4 (A - E)
 Plus Appendix Pages
 Finalized Date: 30-JAN-2018
 Account: APN

Project: L2039797

QC CERTIFICATE OF ANALYSIS VA18001253

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti | Tl | U | V | W |
| Units | | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm |
| LOR | | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L2039797-9 146689 | | 0.002 | 0.03 | <0.05 | 3.6 | 0.2 | 0.5 | 56.7 | <0.01 | <0.01 | 3.0 | 0.098 | 0.18 | 0.20 | 49 | 0.50 |
| DUP | | 0.001 | 0.03 | <0.05 | 3.7 | <0.2 | 0.5 | 56.0 | <0.01 | 0.01 | 3.2 | 0.098 | 0.19 | 0.19 | 50 | 0.56 |
| Target Range - Lower Bound | | <0.001 | 0.02 | <0.05 | 3.4 | <0.2 | 0.3 | 53.3 | <0.01 | <0.01 | 2.7 | 0.088 | 0.15 | 0.14 | 46 | 0.44 |
| Upper Bound | | 0.002 | 0.04 | 0.10 | 3.9 | 0.4 | 0.7 | 59.4 | 0.02 | 0.02 | 3.5 | 0.108 | 0.22 | 0.25 | 53 | 0.62 |
| L2041640-1 146693 | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |



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Project: L2039797

| |
|--|
| QC CERTIFICATE OF ANALYSIS VA18001253 |
|--|

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|---|-----------------------------------|------------------------------|---------------------------|-----------------------------|
| DUPLICATES | | | | |
| L2039797-9 146689 DUP Target Range - Lower Bound Upper Bound | | 7.61 7.50 7.13 7.98 | 65 65 60 70 | 0.7 0.7 <0.5 1.0 |
| L2041640-1 146693 DUP Target Range - Lower Bound Upper Bound | | | | |
| | | | | |



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Page: Appendix 1
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Project: L2039797

QC CERTIFICATE OF ANALYSIS VA18001253

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|--------|----------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | S-CAL06a |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



Chain of Custody (COC) / Analytical Request Form



COC Number: 15 -

17 - 38

Canada Toll Free: 1 800 668 9878

L2039797-COFC

Page of

www.alsglobal.com

| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|--|-----------------------------|--|--|-------------------------------------|--------|-------|-----------|--|--|--|----------------------|-----------------------|-----------------------------|--|---------------------------|----------------------|--|--|--|--|-----------|---|---|---|---|---|--|--|--|--|--|-------|---|---|---|---|---|--|--|--|--|--|-------|---|---|---|---|---|--|--|--|--|--|-------|---|---|---|---|---|--|--|--|--|--|-------|---|---|---|---|---|--|--|--|--|--|-------|---|---|---|---|---|--|--|--|--|--|-------|---|---|---|---|---|--|--|--|--|--|-------|---|---|---|---|---|--|--|--|--|--|-------|---|---|---|---|---|--|--|--|--|--|
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business days) | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | Analysis Request | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | | <table border="1"> <thead> <tr> <th>Total Metals- Aqua regia digestion (ICP)</th> <th>Paste pH</th> <th>% Inorganic Carbonate</th> <th>Total Carbon/Sulphur (Leco)</th> <th>AP - determination by % sulphide sulphur</th> <th>Modified NP - (MEND 1991)</th> <th colspan="5">Number of Containers</th> </tr> </thead> <tbody> <tr> <td>Composite</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>WASTE</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td> </tr> </tbody> </table> | | | | | | | Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | | Composite | R | R | R | R | R | | | | | | WASTE | X | X | X | X | X | | | | | | WASTE | X | X | X | X | X | | | | | | WASTE | X | X | X | X | X | | | | | | WASTE | X | X | X | X | X | | | | | | WASTE | X | X | X | X | X | | | | | | WASTE | X | X | X | X | X | | | | | | WASTE | X | X | X | X | X | | | | | | WASTE | X | X | X | X | X | | | | | |
| Total Metals- Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | | | | | | | | Modified NP - (MEND 1991) | Number of Containers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Composite | R | R | R | R | | | | | | | | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WASTE | X | X | X | X | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WASTE | X | X | X | X | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WASTE | X | X | X | X | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WASTE | X | X | X | X | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| WASTE | X | X | X | X | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WASTE | X | X | X | X | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WASTE | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | PO# | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | Routing Code: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO / AFE: | TBD | Requisitioner: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | Sampler: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146695 | 17-DEC-17 | | Composite | R | R | R | R | R | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146699 | 17-DEC-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146700 | 17-DEC-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146685 | 08-DEC-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146684 | 06-DEC-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146686 | 11-DEC-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146687 | 11-DEC-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146688 | 10-DEC-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 146689 | 10-DEC-17 | | WASTE | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C: -2.0°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | FINAL COOLER TEMPERATURES °C: 7.9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Released by: | Date: | Time: | Received by: | Date: | Time: | Received by: | Date: | Time: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Kala Sol | Dec 22, 2017 | | (Signature) | DEC 28/17 | 13:35 | PAUL | DEC 29 | 13:10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 28-DEC-17
Report Date: 30-JAN-18 16:08 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2040080
Project P.O. #: PO#228594
Job Reference:
C of C Numbers: 17-37
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2040080-1 WASTE 03-DEC-17 146680 | L2040080-2 WASTE 03-DEC-17 146681 | L2040080-3 WASTE 05-DEC-17 146682 | L2040080-4 WASTE 05-DEC-17 146683 | L2040080-5 WASTE 13-DEC-17 146690 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.3 | 8.6 | 8.7 | 8.5 | 8.9 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | <0.05 | <0.05 | <0.05 | 0.09 | 0.11 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 1 | 1 | 1 | 1 | 1 |
| | MPA (tCaCO3/1Kt) | | | | |
| | <0.3 | 0.6 | <0.3 | <0.3 | <0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 8 | 8 | 6 | 14 | 16 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 8 | 7 | 6 | 14 | 16 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 51.20 | 12.80 | 38.40 | 89.60 | 102.40 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | 0.02 | 0.01 | 0.02 | 0.02 | 0.01 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | <0.01 | 0.01 | 0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | | | | |
| | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 |
| | Total Sulfur (combustion) (%) | | | | |
| | <0.01 | 0.02 | <0.01 | <0.01 | <0.01 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.11 | 0.91 | 1.05 | 1.21 | 1.32 |
| | Antimony (Sb) (ppm) | | | | |
| | 0.05 | <0.05 | <0.05 | 0.18 | <0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 1.1 | 0.6 | 0.7 | 3.2 | 0.7 |
| | Barium (Ba) (ppm) | | | | |
| | 290 | 240 | 360 | 280 | 240 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.34 | 0.27 | 0.21 | 0.36 | 0.29 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.01 | 0.22 | 0.09 | 0.03 | 0.02 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.10 | 0.22 | 0.21 | 0.14 | 0.05 |
| | Calcium (Ca) (%) | | | | |
| | 0.37 | 0.30 | 0.22 | 0.65 | 0.71 |
| | Cerium (Ce) (ppm) | | | | |
| | 29.8 | 22.4 | 10.95 | 27.6 | 31.7 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.33 | 0.40 | 0.43 | 0.46 | 0.36 |
| | Chromium (Cr) (ppm) | | | | |
| | 5 | 5 | 4 | 9 | 5 |
| | Cobalt (Co) (ppm) | | | | |
| | 6.2 | 5.1 | 7.5 | 6.3 | 5.8 |
| | Copper (Cu) (ppm) | | | | |
| | 114.5 | 3010 | 2710 | 444 | 111.5 |
| | Gallium (Ga) (ppm) | | | | |
| | 5.48 | 4.33 | 5.04 | 5.76 | 6.22 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.06 | <0.05 | <0.05 | 0.05 | 0.05 |
| | Gold (Au) (ppm) | | | | |
| | <0.02 | 0.03 | 0.03 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.08 | 0.06 | 0.08 | 0.13 | 0.06 |
| | Indium (In) (ppm) | | | | |
| | 0.034 | 0.040 | 0.039 | 0.031 | 0.017 |
| | Iron (Fe) (%) | | | | |
| | 2.46 | 2.05 | 2.00 | 2.42 | 2.24 |
| | Lanthanum (La) (ppm) | | | | |
| | 16.1 | 12.2 | 5.9 | 14.0 | 16.7 |
| | Lead (Pb) (ppm) | | | | |
| | 3.3 | 3.5 | 3.1 | 4.1 | 3.2 |
| | Lithium (Li) (ppm) | | | | |
| | 6.9 | 3.6 | 4.8 | 9.0 | 7.8 |
| | Magnesium (Mg) (%) | | | | |
| | 0.46 | 0.36 | 0.42 | 0.53 | 0.66 |
| | Manganese (Mn) (ppm) | | | | |
| | 718 | 462 | 417 | 516 | 601 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2040080-6 WASTE 13-DEC-17 146691 | L2040080-7 WASTE 13-DEC-17 146692 | L2040080-8 WASTE 16-DEC-17 146696 | L2040080-9 WASTE 16-DEC-17 146697 |
|---|--|--|--|--|
| Grouping | | | | |
| Analyte | | | | |
| SOIL | | | | |
| Physical Tests | | | | |
| pH (Unity) | 8.6 | 8.6 | 8.7 | 8.7 |
| Organic / Inorganic Carbon | | | | |
| Carbon (C) (%) | 0.43 | 0.26 | 0.05 | 0.11 |
| Acid Base Accounting | | | | |
| FIZZ RATING (Unity) | 2 | 2 | 1 | 1 |
| MPA (tCaCO3/1Kt) | 3.8 | 2.2 | <0.3 | <0.3 |
| Neutralization Potential (NP) (tCaCO3/1Kt) | 35 | 27 | 9 | 15 |
| NNP (tCaCO3/1Kt) | 31 | 25 | 9 | 15 |
| Ratio (NP/MPA) (Unity) | 9.33 | 12.34 | 57.60 | 96.00 |
| Sulfate Sulfur (carbonate leach) (%) | 0.02 | 0.03 | 0.01 | 0.01 |
| Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | 0.02 | 0.02 |
| Sulfide Sulfur (T minus HCl leach) (%) | 0.12 | 0.07 | <0.01 | <0.01 |
| Total Sulfur (combustion) (%) | 0.12 | 0.07 | <0.01 | <0.01 |
| Total Metals | | | | |
| Aluminum (Al) (%) | 0.76 | 1.04 | 1.03 | 1.14 |
| Antimony (Sb) (ppm) | <0.05 | <0.05 | <0.05 | <0.05 |
| Arsenic (As) (ppm) | 0.6 | 0.8 | 0.8 | 0.8 |
| Barium (Ba) (ppm) | 180 | 150 | 260 | 270 |
| Beryllium (Be) (ppm) | 0.24 | 0.28 | 0.19 | 0.26 |
| Bismuth (Bi) (ppm) | 0.24 | 0.06 | 0.15 | 0.34 |
| Boron (B) (ppm) | <10 | <10 | <10 | <10 |
| Cadmium (Cd) (ppm) | 0.18 | 0.19 | 0.15 | 0.15 |
| Calcium (Ca) (%) | 1.35 | 1.05 | 0.36 | 0.58 |
| Cerium (Ce) (ppm) | 14.65 | 47.6 | 23.6 | 21.7 |
| Cesium (Cs) (ppm) | 0.28 | 0.29 | 0.46 | 0.40 |
| Chromium (Cr) (ppm) | 4 | 4 | 5 | 5 |
| Cobalt (Co) (ppm) | 5.1 | 5.7 | 5.1 | 5.7 |
| Copper (Cu) (ppm) | 2050 | 1355 | 2420 | 2630 |
| Gallium (Ga) (ppm) | 4.21 | 5.68 | 5.03 | 6.10 |
| Germanium (Ge) (ppm) | <0.05 | 0.05 | 0.06 | 0.06 |
| Gold (Au) (ppm) | 0.04 | <0.02 | 0.04 | 0.06 |
| Hafnium (Hf) (ppm) | 0.06 | 0.05 | 0.08 | 0.08 |
| Indium (In) (ppm) | 0.061 | 0.061 | 0.051 | 0.054 |
| Iron (Fe) (%) | 2.05 | 2.12 | 2.38 | 2.79 |
| Lanthanum (La) (ppm) | 7.6 | 25.6 | 12.6 | 11.2 |
| Lead (Pb) (ppm) | 4.3 | 5.3 | 3.1 | 2.7 |
| Lithium (Li) (ppm) | 3.8 | 6.1 | 4.2 | 5.2 |
| Magnesium (Mg) (%) | 0.35 | 0.47 | 0.43 | 0.53 |
| Manganese (Mn) (ppm) | 521 | 660 | 521 | 618 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2040080-1 WASTE 03-DEC-17 146680 | L2040080-2 WASTE 03-DEC-17 146681 | L2040080-3 WASTE 05-DEC-17 146682 | L2040080-4 WASTE 05-DEC-17 146683 | L2040080-5 WASTE 13-DEC-17 146690 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 |
| | Molybdenum (Mo) (ppm) | 1.11 | 3.87 | 1.95 | 0.63 | 1.09 |
| | Nickel (Ni) (ppm) | 3.3 | 2.9 | 3.6 | 6.3 | 4.2 |
| | Niobium (Nb) (ppm) | 0.10 | 0.13 | 0.20 | 0.18 | 0.15 |
| | Phosphorus (P) (ppm) | 740 | 640 | 690 | 760 | 630 |
| | Potassium (K) (%) | 0.53 | 0.52 | 0.64 | 0.42 | 0.54 |
| | Rhenium (Re) (ppm) | <0.001 | 0.001 | 0.001 | <0.001 | <0.001 |
| | Rubidium (Rb) (ppm) | 27.4 | 25.1 | 32.4 | 21.7 | 25.6 |
| | Scandium (Sc) (ppm) | 5.0 | 3.4 | 2.5 | 4.6 | 3.5 |
| | Selenium (Se) (ppm) | 0.3 | 0.8 | 0.5 | 0.4 | 0.3 |
| | Silver (Ag) (ppm) | 0.07 | 0.49 | 0.36 | 0.09 | 0.03 |
| | Sodium (Na) (%) | 0.07 | 0.08 | 0.07 | 0.07 | 0.08 |
| | Strontium (Sr) (ppm) | 33.8 | 29.6 | 28.9 | 47.0 | 49.9 |
| | Sulfur (S) (%) | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.02 | 0.14 | 0.13 | 0.03 | 0.02 |
| | Thallium (Tl) (ppm) | 0.16 | 0.16 | 0.19 | 0.13 | 0.17 |
| | Thorium (Th) (ppm) | 3.2 | 2.4 | 0.6 | 3.4 | 4.2 |
| | Tin (Sn) (ppm) | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| | Titanium (Ti) (%) | 0.084 | 0.082 | 0.122 | 0.074 | 0.084 |
| | Tungsten (W) (ppm) | 0.40 | 1.16 | 1.29 | 0.31 | 0.52 |
| | Uranium (U) (ppm) | 0.22 | 0.34 | 0.24 | 0.31 | 0.21 |
| | Vanadium (V) (ppm) | 54 | 49 | 57 | 52 | 48 |
| | Yttrium (Y) (ppm) | 12.15 | 6.89 | 5.82 | 10.25 | 6.69 |
| | Zinc (Zn) (ppm) | 86 | 65 | 75 | 77 | 62 |
| | Zirconium (Zr) (ppm) | 1.3 | 1.1 | 1.6 | 2.9 | 0.8 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | <0.2 | 0.2 | <0.2 | 0.3 | 0.4 |
| Miscellaneous | Carbon (C) (%) | 0.04 | 0.07 | 0.05 | 0.17 | 0.17 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L2040080-6 | L2040080-7 | L2040080-8 | L2040080-9 |
|------------------------|--------------------------|--------------|------------|------------|------------|------------|
| | | Description | WASTE | WASTE | WASTE | WASTE |
| | | Sampled Date | 13-DEC-17 | 13-DEC-17 | 16-DEC-17 | 16-DEC-17 |
| | | Sampled Time | | | | |
| | | Client ID | 146691 | 146692 | 146696 | 146697 |
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | | 0.01 | 0.01 | 0.02 | 0.01 |
| | Molybdenum (Mo) (ppm) | | 4.51 | 5.75 | 1.67 | 1.20 |
| | Nickel (Ni) (ppm) | | 2.3 | 2.5 | 3.3 | 4.6 |
| | Niobium (Nb) (ppm) | | 0.11 | 0.09 | 0.19 | 0.16 |
| | Phosphorus (P) (ppm) | | 570 | 690 | 590 | 540 |
| | Potassium (K) (%) | | 0.26 | 0.29 | 0.59 | 0.59 |
| | Rhenium (Re) (ppm) | | 0.011 | 0.002 | <0.001 | 0.001 |
| | Rubidium (Rb) (ppm) | | 13.1 | 16.0 | 30.2 | 28.6 |
| | Scandium (Sc) (ppm) | | 2.6 | 5.5 | 3.9 | 4.2 |
| | Selenium (Se) (ppm) | | 1.9 | 1.1 | 0.9 | 0.7 |
| | Silver (Ag) (ppm) | | 0.67 | 0.23 | 1.23 | 0.72 |
| | Sodium (Na) (%) | | 0.05 | 0.06 | 0.08 | 0.08 |
| | Strontium (Sr) (ppm) | | 52.9 | 41.6 | 32.3 | 46.3 |
| | Sulfur (S) (%) | | 0.15 | 0.10 | 0.02 | 0.02 |
| | Tantalum (Ta) (ppm) | | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | | 0.11 | 0.04 | 0.14 | 0.23 |
| | Thallium (Tl) (ppm) | | 0.09 | 0.11 | 0.18 | 0.17 |
| | Thorium (Th) (ppm) | | 1.4 | 5.6 | 2.6 | 2.1 |
| | Tin (Sn) (ppm) | | 0.6 | 0.9 | 0.7 | 0.7 |
| | Titanium (Ti) (%) | | 0.029 | 0.037 | 0.101 | 0.100 |
| | Tungsten (W) (ppm) | | 0.38 | 0.15 | 0.48 | 0.57 |
| | Uranium (U) (ppm) | | 0.30 | 0.43 | 0.23 | 0.27 |
| | Vanadium (V) (ppm) | | 38 | 46 | 55 | 63 |
| | Yttrium (Y) (ppm) | | 5.06 | 8.31 | 8.01 | 9.24 |
| | Zinc (Zn) (ppm) | | 58 | 71 | 74 | 88 |
| | Zirconium (Zr) (ppm) | | 1.1 | 0.9 | 1.3 | 1.2 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | | 1.6 | 1.0 | 0.2 | 0.4 |
| Miscellaneous | Carbon (C) (%) | | 0.52 | 0.33 | 0.08 | 0.15 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-37

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Page: 1
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 Plus Appendix Pages
 Finalized Date: 23-JAN-2018
 Account: APN

CERTIFICATE VA18001254

Project: L2040080
 P.O. No.: ALSM-CW16-102-APN
 This report is for 9 Other samples submitted to our lab in Vancouver, BC, Canada on 2-JAN-2018.
 The following have access to data associated with this certificate:

| | |
|------------------|-------------|
| ALSEV DATASUBLET | SHANE STACK |
|------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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Project: L2040080

CERTIFICATE OF ANALYSIS VA18001254

| Sample Description | Method Analyte Units LOR | WEI-21 | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-VOL08m | OA-ELE07 | S-IR08 | S-CAL06a | C-GAS05 | C-GAS05 | S-GRA06a | C-IR07 | S-GRA06 | ME-MS41 |
|--------------------|--------------------------|--------------|----------------|----------------|----------------|---------------|-----------------|----------|--------|----------|---------|---------|----------|--------|---------|---------|
| | | Recvd Wt. kg | FIZZ RAT Unity | MPA tCaCO3/1Kt | NNP tCaCO3/1Kt | NP tCaCO3/1Kt | Ratio (N) Unity | pH | S % | S % | C % | CO2 % | S % | C % | S % | Ag ppm |
| L2040080-1 146680 | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 |
| L2040080-2 146681 | | 1.12 | 1 | <0.3 | 8 | 8 | 51.20 | 8.3 | <0.01 | <0.01 | <0.05 | <0.2 | <0.01 | 0.04 | 0.02 | 0.07 |
| L2040080-3 146682 | | 1.10 | 1 | 0.6 | 7 | 8 | 12.80 | 8.6 | 0.02 | 0.01 | <0.05 | 0.2 | 0.01 | 0.07 | 0.01 | 0.49 |
| L2040080-4 146683 | | 1.12 | 1 | <0.3 | 6 | 6 | 38.40 | 8.7 | <0.01 | <0.01 | <0.05 | <0.2 | 0.01 | 0.05 | 0.02 | 0.36 |
| L2040080-5 146690 | | 1.16 | 1 | <0.3 | 14 | 14 | 89.60 | 8.5 | <0.01 | <0.01 | 0.09 | 0.3 | <0.01 | 0.17 | 0.02 | 0.09 |
| L2040080-6 146691 | | 1.12 | 1 | <0.3 | 16 | 16 | 102.40 | 8.9 | <0.01 | <0.01 | 0.11 | 0.4 | <0.01 | 0.17 | 0.01 | 0.03 |
| L2040080-7 146692 | | 1.12 | 2 | 3.8 | 31 | 35 | 9.33 | 8.6 | 0.12 | 0.12 | 0.43 | 1.6 | <0.01 | 0.52 | 0.02 | 0.67 |
| L2040080-8 146696 | | 1.18 | 2 | 2.2 | 25 | 27 | 12.34 | 8.6 | 0.07 | 0.07 | 0.26 | 1.0 | <0.01 | 0.33 | 0.03 | 0.23 |
| L2040080-9 146697 | | 1.18 | 1 | <0.3 | 9 | 9 | 57.60 | 8.7 | <0.01 | <0.01 | 0.05 | 0.2 | 0.02 | 0.08 | 0.01 | 1.23 |
| L2040080-9 146697 | | 1.18 | 1 | <0.3 | 15 | 15 | 96.00 | 8.7 | <0.01 | <0.01 | 0.11 | 0.4 | 0.02 | 0.15 | 0.01 | 0.72 |

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CERTIFICATE OF ANALYSIS VA18001254

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe |
| Units | | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % |
| LOR | | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 |
| L2040080-1 146680 | | 1.11 | 1.1 | <0.02 | <10 | 290 | 0.34 | 0.01 | 0.37 | 0.10 | 29.8 | 6.2 | 5 | 0.33 | 114.5 | 2.46 |
| L2040080-2 146681 | | 0.91 | 0.6 | 0.03 | <10 | 240 | 0.27 | 0.22 | 0.30 | 0.22 | 22.4 | 5.1 | 5 | 0.40 | 3010 | 2.05 |
| L2040080-3 146682 | | 1.05 | 0.7 | 0.03 | <10 | 360 | 0.21 | 0.09 | 0.22 | 0.21 | 10.95 | 7.5 | 4 | 0.43 | 2710 | 2.00 |
| L2040080-4 146683 | | 1.21 | 3.2 | <0.02 | <10 | 280 | 0.36 | 0.03 | 0.65 | 0.14 | 27.6 | 6.3 | 9 | 0.46 | 444 | 2.42 |
| L2040080-5 146690 | | 1.32 | 0.7 | <0.02 | <10 | 240 | 0.29 | 0.02 | 0.71 | 0.05 | 31.7 | 5.8 | 5 | 0.36 | 111.5 | 2.24 |
| L2040080-6 146691 | | 0.76 | 0.6 | 0.04 | <10 | 180 | 0.24 | 0.24 | 1.35 | 0.18 | 14.65 | 5.1 | 4 | 0.28 | 2050 | 2.05 |
| L2040080-7 146692 | | 1.04 | 0.8 | <0.02 | <10 | 150 | 0.28 | 0.06 | 1.05 | 0.19 | 47.6 | 5.7 | 4 | 0.29 | 1355 | 2.12 |
| L2040080-8 146696 | | 1.03 | 0.8 | 0.04 | <10 | 260 | 0.19 | 0.15 | 0.36 | 0.15 | 23.6 | 5.1 | 5 | 0.46 | 2420 | 2.38 |
| L2040080-9 146697 | | 1.14 | 0.8 | 0.06 | <10 | 270 | 0.26 | 0.34 | 0.58 | 0.15 | 21.7 | 5.7 | 5 | 0.40 | 2630 | 2.79 |



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Project: L2040080

CERTIFICATE OF ANALYSIS VA18001254

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P |
| Units | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm |
| LOR | | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 |
| L2040080-1 146680 | | 5.48 | 0.06 | 0.08 | 0.01 | 0.034 | 0.53 | 16.1 | 6.9 | 0.46 | 718 | 1.11 | 0.07 | 0.10 | 3.3 | 740 |
| L2040080-2 146681 | | 4.33 | <0.05 | 0.06 | 0.01 | 0.040 | 0.52 | 12.2 | 3.6 | 0.36 | 462 | 3.87 | 0.08 | 0.13 | 2.9 | 640 |
| L2040080-3 146682 | | 5.04 | <0.05 | 0.08 | 0.01 | 0.039 | 0.64 | 5.9 | 4.8 | 0.42 | 417 | 1.95 | 0.07 | 0.20 | 3.6 | 690 |
| L2040080-4 146683 | | 5.76 | 0.05 | 0.13 | 0.02 | 0.031 | 0.42 | 14.0 | 9.0 | 0.53 | 516 | 0.63 | 0.07 | 0.18 | 6.3 | 760 |
| L2040080-5 146690 | | 6.22 | 0.05 | 0.06 | 0.01 | 0.017 | 0.54 | 16.7 | 7.8 | 0.66 | 601 | 1.09 | 0.08 | 0.15 | 4.2 | 630 |
| L2040080-6 146691 | | 4.21 | <0.05 | 0.06 | 0.01 | 0.061 | 0.26 | 7.6 | 3.8 | 0.35 | 521 | 4.51 | 0.05 | 0.11 | 2.3 | 570 |
| L2040080-7 146692 | | 5.68 | 0.05 | 0.05 | 0.01 | 0.061 | 0.29 | 25.6 | 6.1 | 0.47 | 660 | 5.75 | 0.06 | 0.09 | 2.5 | 690 |
| L2040080-8 146696 | | 5.03 | 0.06 | 0.08 | 0.02 | 0.051 | 0.59 | 12.6 | 4.2 | 0.43 | 521 | 1.67 | 0.08 | 0.19 | 3.3 | 590 |
| L2040080-9 146697 | | 6.10 | 0.06 | 0.08 | 0.01 | 0.054 | 0.59 | 11.2 | 5.2 | 0.53 | 618 | 1.20 | 0.08 | 0.16 | 4.6 | 540 |



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Project: L2040080

CERTIFICATE OF ANALYSIS VA18001254

| Sample Description | Method Analyte Units LOR | ME-MS41 Pb ppm 0.2 | ME-MS41 Rb ppm 0.1 | ME-MS41 Re ppm 0.001 | ME-MS41 S % 0.01 | ME-MS41 Sb ppm 0.05 | ME-MS41 Sc ppm 0.1 | ME-MS41 Se ppm 0.2 | ME-MS41 Sn ppm 0.2 | ME-MS41 Sr ppm 0.2 | ME-MS41 Ta ppm 0.01 | ME-MS41 Te ppm 0.01 | ME-MS41 Th ppm 0.2 | ME-MS41 Tl % 0.005 | ME-MS41 Tl ppm 0.02 | ME-MS41 U ppm 0.05 |
|--------------------|-----------------------------------|-----------------------------|-----------------------------|-------------------------------|---------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|-----------------------------|
| L2040080-1 146680 | | 3.3 | 27.4 | <0.001 | 0.02 | 0.05 | 5.0 | 0.3 | 0.6 | 33.8 | <0.01 | 0.02 | 3.2 | 0.084 | 0.16 | 0.22 |
| L2040080-2 146681 | | 3.5 | 25.1 | 0.001 | 0.03 | <0.05 | 3.4 | 0.8 | 0.6 | 29.6 | <0.01 | 0.14 | 2.4 | 0.082 | 0.16 | 0.34 |
| L2040080-3 146682 | | 3.1 | 32.4 | 0.001 | 0.02 | <0.05 | 2.5 | 0.5 | 0.6 | 28.9 | <0.01 | 0.13 | 0.6 | 0.122 | 0.19 | 0.24 |
| L2040080-4 146683 | | 4.1 | 21.7 | <0.001 | 0.02 | 0.18 | 4.6 | 0.4 | 0.6 | 47.0 | <0.01 | 0.03 | 3.4 | 0.074 | 0.13 | 0.31 |
| L2040080-5 146690 | | 3.2 | 25.6 | <0.001 | 0.02 | <0.05 | 3.5 | 0.3 | 0.6 | 49.9 | <0.01 | 0.02 | 4.2 | 0.084 | 0.17 | 0.21 |
| L2040080-6 146691 | | 4.3 | 13.1 | 0.011 | 0.15 | <0.05 | 2.6 | 1.9 | 0.6 | 52.9 | <0.01 | 0.11 | 1.4 | 0.029 | 0.09 | 0.30 |
| L2040080-7 146692 | | 5.3 | 16.0 | 0.002 | 0.10 | <0.05 | 5.5 | 1.1 | 0.9 | 41.6 | <0.01 | 0.04 | 5.6 | 0.037 | 0.11 | 0.43 |
| L2040080-8 146696 | | 3.1 | 30.2 | <0.001 | 0.02 | <0.05 | 3.9 | 0.9 | 0.7 | 32.3 | <0.01 | 0.14 | 2.6 | 0.101 | 0.18 | 0.23 |
| L2040080-9 146697 | | 2.7 | 28.6 | 0.001 | 0.02 | <0.05 | 4.2 | 0.7 | 0.7 | 46.3 | <0.01 | 0.23 | 2.1 | 0.100 | 0.17 | 0.27 |



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Project: L2040080

| |
|---|
| CERTIFICATE OF ANALYSIS VA18001254 |
|---|

| Sample Description | Method Analyte Units LOR | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|--------------------|-----------------------------------|--------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| L2040080-1 146680 | | 54 | 0.40 | 12.15 | 86 | 1.3 |
| L2040080-2 146681 | | 49 | 1.16 | 6.89 | 65 | 1.1 |
| L2040080-3 146682 | | 57 | 1.29 | 5.82 | 75 | 1.6 |
| L2040080-4 146683 | | 52 | 0.31 | 10.25 | 77 | 2.9 |
| L2040080-5 146690 | | 48 | 0.52 | 6.69 | 62 | 0.8 |
| L2040080-6 146691 | | 38 | 0.38 | 5.06 | 58 | 1.1 |
| L2040080-7 146692 | | 46 | 0.15 | 8.31 | 71 | 0.9 |
| L2040080-8 146696 | | 55 | 0.48 | 8.01 | 74 | 1.3 |
| L2040080-9 146697 | | 63 | 0.57 | 9.24 | 88 | 1.2 |



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CERTIFICATE OF ANALYSIS VA18001254

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



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QC CERTIFICATE VA18001254

Project: L2040080
 P.O. No.: ALSM-CW16-102-APN
 This report is for 9 Other samples submitted to our lab in Vancouver, BC, Canada on 2-JAN-2018.
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| | |
|------------------|-------------|
| ALSEV DATASUBLET | SHANE STACK |
|------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% <75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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QC CERTIFICATE OF ANALYSIS VA18001254

| Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|----------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|---------------------------------|-------------------------|------------------|-------------------|---------------------|--------------------|------------------|-------------------|----------------------|--------------------|----------------------|
| Sample Description | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | |
| Buffer pH6 | | | | | | 6.0 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.3 | | | | | | | | | |
| Upper Bound | | | | | | 6.7 | | | | | | | | | |
| CO-ASSAY | | | | | | | | 0.50 | 1.8 | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.42 | 1.5 | | | | | | |
| Upper Bound | | | | | | | | 0.64 | 2.4 | | | | | | |
| DS-1 | | | | | | | 2.56 | | | | 3.14 | | | | |
| Target Range - Lower Bound | | | | | | | 2.51 | | | | 3.01 | | | | |
| Upper Bound | | | | | | | 2.71 | | | | 3.25 | | | | |
| GS313-8 | | | | | | | 1.21 | | | | 0.93 | | | | |
| Target Range - Lower Bound | | | | | | | 1.19 | | | | 0.90 | | | | |
| Upper Bound | | | | | | | 1.29 | | | | 0.98 | | | | |
| KZK-1 | 2 | 25.0 | 32 | 57 | 2.28 | | | | | | | | | | |
| KZK-1 | 2 | 25.0 | 32 | 57 | 2.28 | | | | | | | | | | |
| Target Range - Lower Bound | <1 | 22.9 | 30 | 54 | 2.18 | | | | | | | | | | |
| Upper Bound | >4 | 27.1 | 38 | 64 | 2.53 | | | | | | | | | | |
| MA-2c | | | | | | | | 1.54 | 5.7 | | | | | | |
| Target Range - Lower Bound | | | | | | | | 1.50 | 5.5 | | | | | | |
| Upper Bound | | | | | | | | 1.84 | 6.8 | | | | | | |
| MGeo08 | | | | | | | | | | | | | 4.29 | 2.63 | 31.6 |
| Target Range - Lower Bound | | | | | | | | | | | | | 4.00 | 2.44 | 29.6 |
| Upper Bound | | | | | | | | | | | | | 4.92 | 3.00 | 36.4 |
| OREAS 905 | | | | | | | | | | | | | 0.51 | 0.80 | 32.5 |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.45 | 0.73 | 28.4 |
| Upper Bound | | | | | | | | | | | | | 0.58 | 0.91 | 35.0 |
| UTS-1 | | | | | | | | | | | | 0.88 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | 0.83 | | | |
| Upper Bound | | | | | | | | | | | | 0.93 | | | |
| UTS-1 | | | | | | | | | 0.87 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 0.81 | | | | | | |
| Upper Bound | | | | | | | | | 0.95 | | | | | | |
| UTS-4 | | | | | | | | | | | | 1.74 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | 1.64 | | | |
| Upper Bound | | | | | | | | | | | | 1.84 | | | |
| UTS-4 | | | | | | | | | 1.72 | | | | | | |
| Target Range - Lower Bound | | | | | | | | | 1.61 | | | | | | |
| Upper Bound | | | | | | | | | 1.87 | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA18001254

| Method Analyte Units LOR | ME-MS41 Au ppm | ME-MS41 B ppm | ME-MS41 Ba ppm | ME-MS41 Be ppm | ME-MS41 Bi ppm | ME-MS41 Ca % | ME-MS41 Cd ppm | ME-MS41 Ce ppm | ME-MS41 Co ppm | ME-MS41 Cr ppm | ME-MS41 Cs ppm | ME-MS41 Cu ppm | ME-MS41 Fe % | ME-MS41 Ga ppm | ME-MS41 Ge ppm |
|----------------------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| STANDARDS | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| MRGeo08 | <0.02 | 10 | 440 | 0.74 | 0.61 | 1.08 | 2.20 | 74.5 | 17.7 | 91 | 10.70 | 624 | 3.55 | 9.14 | 0.10 |
| Target Range - Lower Bound | <0.02 | <10 | 370 | 0.67 | 0.60 | 1.00 | 2.01 | 66.2 | 17.0 | 81 | 9.40 | 587 | 3.22 | 8.73 | 0.07 |
| Upper Bound | 0.04 | 20 | 530 | 0.95 | 0.76 | 1.24 | 2.47 | 81.0 | 21.0 | 102 | 11.60 | 675 | 3.96 | 10.80 | 0.29 |
| OREAS 905 | 0.40 | <10 | 240 | 1.13 | 5.49 | 0.35 | 0.34 | 79.9 | 13.8 | 16 | 1.23 | 1525 | 3.39 | 6.16 | 0.07 |
| Target Range - Lower Bound | 0.33 | <10 | 200 | 0.78 | 5.16 | 0.29 | 0.30 | 72.0 | 12.4 | 15 | 1.14 | 1450 | 3.14 | 5.74 | <0.05 |
| Upper Bound | 0.45 | 20 | 300 | 1.08 | 6.32 | 0.38 | 0.38 | 88.0 | 15.4 | 20 | 1.50 | 1670 | 3.86 | 7.12 | 0.22 |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Hf ppm | Hg ppm | In ppm | K % | La ppm | Li ppm | Mg % | Mn ppm | Mo ppm | Na % | Nb ppm | Ni ppm | P ppm | Pb ppm | Rb ppm | |
| | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 0.71 | 0.06 | 0.149 | 1.22 | 36.7 | 29.6 | 1.13 | 416 | 13.35 | 0.33 | 1.05 | 694 | 1020 | 1080 | 138.0 | |
| Target Range - Lower Bound | 0.64 | 0.04 | 0.137 | 1.12 | 33.2 | 29.6 | 1.03 | 378 | 13.10 | 0.30 | 0.79 | 622 | 900 | 959 | 132.0 | |
| Upper Bound | 0.83 | 0.10 | 0.179 | 1.40 | 41.0 | 36.4 | 1.29 | 473 | 16.10 | 0.39 | 1.09 | 760 | 1130 | 1175 | 162.0 | |
| OREAS 905 | 0.98 | 0.02 | 0.571 | 0.31 | 39.7 | 6.1 | 0.14 | 338 | 2.74 | 0.09 | 0.32 | 8.8 | 230 | 16.3 | 18.6 | |
| Target Range - Lower Bound | 1.08 | <0.01 | 0.517 | 0.28 | 35.6 | 4.3 | 0.13 | 310 | 2.65 | 0.07 | 0.19 | 7.8 | | 15.2 | 17.3 | |
| Upper Bound | 1.36 | 0.04 | 0.643 | 0.36 | 44.0 | 5.5 | 0.19 | 390 | 3.35 | 0.12 | 0.43 | 10.0 | | 19.0 | 21.3 | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA18001254

| Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| Sample Description | Re ppm | S % | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm | V ppm | W ppm | |
| | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 | |
| STANDARDS | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Buffer pH6 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| CO-ASSAY | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| DS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| GS313-8 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| KZK-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MA-2c | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| MRGeo08 | 0.007 | 0.32 | 3.15 | 6.1 | 1.1 | 3.2 | 77.7 | 0.01 | 0.04 | 20.5 | 0.379 | 0.75 | 5.18 | 100 | 2.71 | |
| Target Range - Lower Bound | 0.006 | 0.27 | 2.80 | 6.7 | 0.9 | 2.8 | 72.1 | <0.01 | <0.01 | 19.1 | 0.338 | 0.64 | 4.93 | 90 | 2.44 | |
| Upper Bound | 0.010 | 0.35 | 3.90 | 8.4 | 1.9 | 4.0 | 88.5 | 0.03 | 0.04 | 23.7 | 0.424 | 0.92 | 6.13 | 112 | 3.42 | |
| OREAS 905 | <0.001 | 0.07 | 0.96 | 1.6 | 2.2 | 1.2 | 12.6 | 0.01 | 0.07 | 8.8 | 0.019 | 0.11 | 2.22 | 5 | 0.53 | |
| Target Range - Lower Bound | <0.001 | 0.04 | 0.90 | 1.6 | 1.8 | 0.8 | 10.9 | <0.01 | 0.04 | 7.8 | 0.008 | 0.06 | 2.08 | 4 | 0.44 | |
| Upper Bound | 0.002 | 0.09 | 1.34 | 2.2 | 2.8 | 1.7 | 13.7 | 0.02 | 0.09 | 10.0 | 0.030 | 0.16 | 2.66 | 8 | 0.76 | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-1 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |
| UTS-4 | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | |

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| |
|--|
| QC CERTIFICATE OF ANALYSIS VA18001254 |
|--|

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|--------------------------|--------------------|------------------|--------------------|
| STANDARDS | | | | |
| Buffer pH6 | | | | |
| Buffer pH6 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| CO-ASSAY | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| GS313-8 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| KZK-1 | | | | |
| KZK-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MA-2c | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| MGeo08 | | 18.35 | 791 | 23.3 |
| Target Range - Lower Bound | | 17.50 | 708 | 18.1 |
| Upper Bound | | 21.5 | 870 | 25.7 |
| OREAS 905 | | 7.03 | 65 | 41.2 |
| Target Range - Lower Bound | | 6.32 | 58 | 39.9 |
| Upper Bound | | 7.84 | 76 | 55.1 |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-1 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| UTS-4 | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

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| Method Analyte Units LOR | OA-VOL08m FIZZ RAT | OA-VOL08m MPA | OA-VOL08m NNP | OA-VOL08m NP | OA-VOL08m Ratio (N) | OA-ELE07 pH | S-IR08 S | C-GAS05 C | C-GAS05 CO2 | S-GRA06a S | C-IR07 C | S-GRA06 S | ME-MS41 Ag | ME-MS41 Al | ME-MS41 As |
|----------------------------|--------------------|---------------|---------------|--------------|---------------------|-------------|----------|-----------|-------------|------------|----------|-----------|------------|------------|------------|
| Sample Description | Unity | tCaCO3/1Kt | tCaCO3/1Kt | tCaCO3/1Kt | Unity | Unity | % | % | % | % | % | % | ppm | % | ppm |
| | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | <0.05 | <0.2 | | | | | | |
| Target Range - Lower Bound | | | | | | | | <0.05 | <0.2 | | | | | | |
| Upper Bound | | | | | | | | 0.10 | 0.4 | | | | | | |
| BLANK | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | <0.01 | <0.1 |
| Upper Bound | | | | | | | | | | | | | 0.02 | 0.02 | 0.2 |
| BLANK | | | | | | 6.0 | | | | | | | | | |
| Target Range - Lower Bound | | | | | | 5.5 | | | | | | | | | |
| Upper Bound | | | | | | 6.9 | | | | | | | | | |
| BLANK | | | | | | | | | | | | | <0.01 | | |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | | |
| Upper Bound | | | | | | | | | | | | | 0.02 | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | <0.01 | | | | | | | | |
| Target Range - Lower Bound | | | | | | | <0.01 | | | | | | | | |
| Upper Bound | | | | | | | 0.02 | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | 0.02 | 0.17 | 200 |
| Target Range - Lower Bound | | | | | | | | | | | | | <0.01 | 0.15 | 191.5 |
| Upper Bound | | | | | | | | | | | | | 0.03 | 0.19 | 212 |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | 0.13 | | | | | | | |
| Target Range - Lower Bound | | | | | | | | 0.14 | | | | | | | |
| Upper Bound | | | | | | | | 0.12 | | | | | | | |
| | | | | | | | | 0.15 | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| L2040080-9 146697 | 1 | <0.3 | 15 | 15 | 96.00 | 8.7 | | 0.11 | 0.4 | 0.02 | | | | | |
| DUP | 1 | <0.3 | 15 | 15 | 96.00 | 8.6 | | 0.11 | 0.4 | 0.01 | | | | | |
| Target Range - Lower Bound | <1 | <0.3 | 13 | 13 | 91.19 | 8.1 | | <0.05 | <0.2 | <0.01 | | | | | |
| Upper Bound | 2 | 0.6 | 17 | 17 | 100.81 | 9.2 | | 0.17 | 0.6 | 0.02 | | | | | |



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|----------------------------|----------------|---------------|----------------|----------------|----------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------------|----------------|
| Sample Description | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 |
| Target Range - Lower Bound | <0.02 | <10 | <10 | <0.05 | <0.01 | <0.01 | <0.01 | <0.02 | <0.1 | <1 | <0.05 | <0.2 | <0.01 | <0.05 | <0.05 |
| Upper Bound | 0.04 | 20 | 20 | 0.10 | 0.02 | 0.02 | 0.02 | 0.04 | 0.2 | 2 | 0.10 | 0.4 | 0.02 | 0.10 | 0.10 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | <0.02 | <10 | 30 | 0.36 | 0.02 | >25.0 | 0.10 | 16.95 | 1.3 | 11 | 0.64 | 15.0 | 0.59 | 0.59 | <0.05 |
| DUP | <0.02 | 10 | 30 | 0.32 | 0.02 | >25.0 | 0.11 | 17.60 | 1.3 | 12 | 0.66 | 15.0 | 0.61 | 0.58 | <0.05 |
| Target Range - Lower Bound | <0.02 | <10 | 20 | 0.27 | <0.01 | 23.7 | 0.09 | 16.40 | 1.1 | 10 | 0.57 | 14.3 | 0.56 | 0.51 | <0.05 |
| Upper Bound | 0.04 | 20 | 40 | 0.41 | 0.03 | >25.0 | 0.12 | 18.15 | 1.5 | 13 | 0.73 | 15.7 | 0.64 | 0.66 | 0.10 |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L2040080-9 146697 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA18001254

| Sample Description | Method Analyte Units LOR | ME-MS41 Hf ppm | ME-MS41 Hg ppm | ME-MS41 In ppm | ME-MS41 K % | ME-MS41 La ppm | ME-MS41 Li ppm | ME-MS41 Mg % | ME-MS41 Mn ppm | ME-MS41 Mo ppm | ME-MS41 Na % | ME-MS41 Nb ppm | ME-MS41 Ni ppm | ME-MS41 P ppm | ME-MS41 Pb ppm | ME-MS41 Rb ppm | |
|----------------------------|-----------------------------------|----------------------|----------------------|----------------------|-------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|---------------------|----------------------|----------------------|--|
| | | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 | |
| BLANKS | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | 0.02 | <0.01 | <0.005 | <0.01 | <0.2 | 0.2 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | |
| Target Range - Lower Bound | | <0.02 | <0.01 | <0.005 | <0.01 | <0.2 | <0.1 | <0.01 | <5 | <0.05 | <0.01 | <0.05 | <0.2 | <10 | <0.2 | <0.1 | |
| Upper Bound | | 0.04 | 0.02 | 0.010 | 0.02 | 0.4 | 0.2 | 0.02 | 10 | 0.10 | 0.02 | 0.10 | 0.4 | 20 | 0.4 | 0.2 | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | | | |
| ORIGINAL | | 0.09 | 0.22 | 0.009 | 0.07 | 16.1 | 1.7 | 0.94 | 131 | 2.10 | 0.01 | 0.06 | 8.1 | 510 | 4.5 | 3.5 | |
| DUP | | 0.09 | 0.21 | 0.009 | 0.07 | 16.4 | 1.4 | 0.95 | 135 | 2.10 | 0.02 | <0.05 | 8.1 | 500 | 4.7 | 3.4 | |
| Target Range - Lower Bound | | 0.07 | 0.19 | <0.005 | 0.06 | 15.2 | 1.4 | 0.89 | 121 | 1.95 | <0.01 | <0.05 | 7.5 | 470 | 4.2 | 3.2 | |
| Upper Bound | | 0.11 | 0.24 | 0.010 | 0.08 | 17.3 | 1.7 | 1.00 | 145 | 2.26 | 0.02 | 0.10 | 8.7 | 540 | 5.0 | 3.7 | |
| ORIGINAL | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |
| L2040080-9 146697 | | | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | | | |



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QC CERTIFICATE OF ANALYSIS VA18001254

| Method Analyte Units LOR | ME-MS41 Re ppm | ME-MS41 S % | ME-MS41 Sb ppm | ME-MS41 Sc ppm | ME-MS41 Se ppm | ME-MS41 Sn ppm | ME-MS41 Sr ppm | ME-MS41 Ta ppm | ME-MS41 Te ppm | ME-MS41 Th ppm | ME-MS41 Ti % | ME-MS41 Tl ppm | ME-MS41 U ppm | ME-MS41 V ppm | ME-MS41 W ppm |
|-----------------------------------|----------------------|-------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|---------------------|---------------------|---------------------|
| Sample Description | 0.001 | 0.01 | 0.05 | 0.1 | 0.2 | 0.2 | 0.2 | 0.01 | 0.01 | 0.2 | 0.005 | 0.02 | 0.05 | 1 | 0.05 |
| BLANKS | | | | | | | | | | | | | | | |
| BLANK | <0.001 | 0.01 | <0.05 | <0.1 | 0.2 | <0.2 | <0.2 | <0.01 | 0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Target Range - Lower Bound | <0.001 | <0.01 | <0.05 | <0.1 | <0.2 | <0.2 | <0.2 | <0.01 | <0.01 | <0.2 | <0.005 | <0.02 | <0.05 | <1 | <0.05 |
| Upper Bound | 0.002 | 0.02 | 0.10 | 0.2 | 0.4 | 0.4 | 0.4 | 0.02 | 0.02 | 0.4 | 0.010 | 0.04 | 0.10 | 2 | 0.10 |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| BLANK | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| DUPLICATES | | | | | | | | | | | | | | | |
| ORIGINAL | 0.001 | 0.03 | 17.10 | 1.6 | 0.9 | <0.2 | 251 | <0.01 | 0.02 | 1.9 | <0.005 | 1.26 | 2.29 | 7 | 0.65 |
| DUP | <0.001 | 0.03 | 17.85 | 1.5 | 1.1 | <0.2 | 251 | <0.01 | 0.02 | 2.0 | <0.005 | 1.41 | 2.33 | 7 | 0.67 |
| Target Range - Lower Bound | <0.001 | 0.02 | 16.10 | 1.4 | 0.8 | <0.2 | 238 | <0.01 | <0.01 | 1.7 | <0.005 | 1.21 | 2.14 | 6 | 0.56 |
| Upper Bound | 0.002 | 0.04 | 18.85 | 1.7 | 1.3 | 0.4 | 264 | 0.02 | 0.03 | 2.2 | 0.010 | 1.46 | 2.48 | 8 | 0.76 |
| ORIGINAL | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |
| L2040080-9 146697 | | | | | | | | | | | | | | | |
| DUP | | | | | | | | | | | | | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | | | |
| Upper Bound | | | | | | | | | | | | | | | |

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| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|----------------------------|-----------------------------------|-----------------------------|---------------------------|-----------------------------|
| BLANKS | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | <0.05 | <2 | <0.5 |
| Target Range - Lower Bound | | <0.05 | <2 | <0.5 |
| Upper Bound | | 0.10 | 4 | 1.0 |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| BLANK | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| DUPLICATES | | | | |
| ORIGINAL | | 13.85 | 31 | 2.9 |
| DUP | | 13.85 | 31 | 2.8 |
| Target Range - Lower Bound | | 13.10 | 27 | 2.1 |
| Upper Bound | | 14.60 | 35 | 3.6 |
| ORIGINAL | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |
| L2040080-9 146697 | | | | |
| DUP | | | | |
| Target Range - Lower Bound | | | | |
| Upper Bound | | | | |

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| Sample Description | Method Analyte Units LOR | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm | ME-MS41 Al % | ME-MS41 As ppm |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|-------------|---------------|--------------|------------|-------------|----------------|--------------|----------------|
| | | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.1 |
| DUPLICATES | | | | | | | | | | | | | | | | |
| L2035058-11 DUP | | | | | | | | | | | | | 0.05 | | | |
| Target Range - Lower Bound | | | | | | | | | | | | | 0.04 | | | |
| Upper Bound | | | | | | | | | | | | | 0.03 | | | |
| | | | | | | | | | | | | | 0.06 | | | |

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QC CERTIFICATE OF ANALYSIS VA18001254

| Sample Description | Method | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | |
|--------------------|---------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | Analyte | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga | Ge |
| | Units | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm |
| | LOR | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 | 0.05 | 0.05 |

| | |
|---|-------------------|
| L2035058-11 DUP Target Range - Lower Bound Upper Bound | DUPLICATES |
|---|-------------------|

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| Sample Description | Method | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | MS41 | |
|--------------------|---------|------|------|-------|------|------|------|------|------|------|------|------|------|------|------|-----|
| | Analyte | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P | Pb | Rb |
| | Units | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm |
| | LOR | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 | 0.2 | 0.1 |

| | |
|---|-------------------|
| L2035058-11 DUP Target Range - Lower Bound Upper Bound | DUPLICATES |
|---|-------------------|

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|--|--|
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QC CERTIFICATE OF ANALYSIS VA18001254

| Sample Description | Method Analyte Units LOR | ME-MS41 Re ppm 0.001 | ME-MS41 S % 0.01 | ME-MS41 Sb ppm 0.05 | ME-MS41 Sc ppm 0.1 | ME-MS41 Se ppm 0.2 | ME-MS41 Sn ppm 0.2 | ME-MS41 Sr ppm 0.2 | ME-MS41 Ta ppm 0.01 | ME-MS41 Te ppm 0.01 | ME-MS41 Th ppm 0.2 | ME-MS41 Ti % 0.005 | ME-MS41 Tl ppm 0.02 | ME-MS41 U ppm 0.05 | ME-MS41 V ppm 1 | ME-MS41 W ppm 0.05 |
|---|-----------------------------------|-------------------------------|---------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|-----------------------------|--------------------------|-----------------------------|
| DUPLICATES | | | | | | | | | | | | | | | | |
| L2035058-11 DUP Target Range - Lower Bound Upper Bound | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

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QC CERTIFICATE OF ANALYSIS VA18001254

| Sample Description | Method Analyte Units LOR | ME-MS41 Y ppm 0.05 | ME-MS41 Zn ppm 2 | ME-MS41 Zr ppm 0.5 |
|---|-----------------------------------|-----------------------------|---------------------------|-----------------------------|
| L2035058-11 DUP Target Range - Lower Bound Upper Bound | DUPLICATES | | | |
| | | | | |



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QC CERTIFICATE OF ANALYSIS VA18001254

| CERTIFICATE COMMENTS | | | | | | | | | | | | | | | | | |
|-----------------------------|--|----------|---------|--------|---------|----------|-----------|--------|--------|----------|---------|----------|--------|--------|--------|--|--|
| Applies to Method: | <p style="text-align: center;">ANALYTICAL COMMENTS</p> <p>Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g). ME-MS41</p> | | | | | | | | | | | | | | | | |
| Applies to Method: | <p style="text-align: center;">LABORATORY ADDRESSES</p> <p>Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">C-GAS05</td> <td style="width: 33%;">C-IR07</td> <td style="width: 33%;">LOG-22</td> <td style="width: 33%;">ME-MS41</td> </tr> <tr> <td>OA-ELE07</td> <td>OA-VOL08m</td> <td>PUL-31</td> <td>PUL-QC</td> </tr> <tr> <td>S-CAL06a</td> <td>S-GRA06</td> <td>S-GRA06a</td> <td>S-IR08</td> </tr> <tr> <td>SPL-21</td> <td>WEI-21</td> <td></td> <td></td> </tr> </table> | C-GAS05 | C-IR07 | LOG-22 | ME-MS41 | OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 | SPL-21 | WEI-21 | | |
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 | | | | | | | | | | | | | | |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC | | | | | | | | | | | | | | |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 | | | | | | | | | | | | | | |
| SPL-21 | WEI-21 | | | | | | | | | | | | | | | | |



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|--|--------|--|-------------|-------------------------|--|-------------------------------------|---|------------------------|--|-----------------------------|--|---------------------------|----------------------|---------------------|--|--------------------|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | | | |
| Contact: Minto Environment - Coordinator | | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | | | | |
| Phone: 1-604-759-4659 | | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | | | |
| Street: 2100-510 West Georgia St. | | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | | | | | | | | |
| City/Province: Vancouver, British Columbia | | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | | | |
| Postal Code: V6B 0M3 | | Email 3 | | | Analysis Request | | | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | Email 3 | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | PO# | | | | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | Routing Code: | | | | | | | | | | | | | |
| PO / AFE: TBD | | Requisitioner: | | | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | Sampler: | | | | | | | | | | | | | |
| ALS Sample # (lab use only) | | Sample Identification and/or Coordinates (This description will appear on the report) | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals - Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | | | |
| | | | | | | Composite | R | R | R | R | R | R | | | | | |
| | 146680 | | 03-DEC-2017 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 146681 | | 03-DEC-2017 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 146682 | | 05-DEC-2017 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 146683 | | 05-DEC-2017 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 146690 | | 13-DEC-2017 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 146691 | | 13-DEC-17 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 146692 | | 13-DEC-17 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 146696 | | 16-DEC-17 | | | WASTE | X | X | X | X | X | X | | | | | |
| | 146697 | | 16-DEC-17 | | | WASTE | X | X | X | X | X | X | | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | FINAL COOLER TEMPERATURES °C | | | | | | | | |
| | | | | | -2 | | | | 6.6 | | | | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | | | |
| Released by: <i>Sutta</i> | | Date: <i>Dec 22, 2017</i> | | Time: | | Received by: <i>r</i> | | Date: <i>DEC 28/17</i> | | Time: <i>13:55</i> | | Received by: <i>PAUL</i> | | Date: <i>DEC 29</i> | | Time: <i>13:10</i> | |



Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 04-JAN-18
Report Date: 08-FEB-18 16:54 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2041640
Project P.O. #: 228594
Job Reference:
C of C Numbers: 17-39
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2041640-1 Waste 15-DEC-17 146693 | L2041640-2 Waste 15-DEC-17 146694 | L2041640-3 Waste 15-DEC-17 146695 | L2041640-4 Waste 21-DEC-17 146726 | L2041640-5 Waste 22-DEC-17 146728 |
|-------------------------------|---|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 8.8 | 9.0 | 8.3 | 9.0 | 8.9 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.17 | 0.56 | 0.61 | 0.18 | 0.09 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 2 | 2 | 1 |
| | MPA (tCaCO3/1Kt) | 0.9 | 12.5 | 0.3 | 0.3 | 0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 16 | 37 | 55 | 21 | 10 |
| | NNP (tCaCO3/1Kt) | 15 | 25 | 55 | 21 | 10 |
| | Ratio (NP/MPA) (Unity) | 17.07 | 2.96 | 176.00 | 67.20 | 32.00 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.03 | 0.40 | 0.01 | <0.01 | 0.01 |
| | Total Sulfur (combustion) (%) | 0.03 | 0.40 | 0.01 | 0.01 | 0.01 |
| Total Metals | Aluminum (Al) (%) | 1.00 | 0.88 | 0.96 | 1.21 | 0.93 |
| | Antimony (Sb) (ppm) | 0.08 | 0.06 | 0.09 | 0.05 | 0.05 |
| | Arsenic (As) (ppm) | 1.9 | 0.6 | 3.0 | 0.4 | 0.9 |
| | Barium (Ba) (ppm) | 200 | 210 | 140 | 240 | 250 |
| | Beryllium (Be) (ppm) | 0.30 | 0.24 | 0.94 | 0.31 | 0.24 |
| | Bismuth (Bi) (ppm) | 0.32 | 0.09 | 0.05 | 0.04 | 0.26 |
| | Boron (B) (ppm) | <10 | 10 | 10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.21 | 0.13 | 0.43 | 0.06 | 0.23 |
| | Calcium (Ca) (%) | 0.63 | 1.09 | 2.33 | 0.91 | 0.42 |
| | Cerium (Ce) (ppm) | 21.1 | 27.0 | 29.0 | 28.3 | 25.6 |
| | Cesium (Cs) (ppm) | 0.50 | 0.55 | 0.40 | 0.34 | 0.44 |
| | Chromium (Cr) (ppm) | 5 | 4 | 3 | 6 | 5 |
| | Cobalt (Co) (ppm) | 6.2 | 8.1 | 5.7 | 6.2 | 5.6 |
| | Copper (Cu) (ppm) | 2630 | 2160 | 502 | 283 | 1950 |
| | Gallium (Ga) (ppm) | 5.19 | 4.76 | 5.66 | 5.77 | 4.72 |
| | Germanium (Ge) (ppm) | 0.06 | 0.06 | 0.05 | 0.07 | 0.07 |
| | Gold (Au) (ppm) | 0.08 | <0.02 | <0.02 | <0.02 | 0.04 |
| | Hafnium (Hf) (ppm) | 0.04 | 0.07 | 0.04 | 0.06 | 0.03 |
| | Indium (In) (ppm) | 0.063 | 0.080 | 0.026 | 0.022 | 0.047 |
| | Iron (Fe) (%) | 2.53 | 2.63 | 2.17 | 2.31 | 2.40 |
| | Lanthanum (La) (ppm) | 10.7 | 14.4 | 15.7 | 15.0 | 13.1 |
| | Lead (Pb) (ppm) | 3.9 | 3.7 | 5.4 | 2.7 | 2.8 |
| | Lithium (Li) (ppm) | 4.6 | 3.9 | 4.7 | 6.8 | 4.2 |
| | Magnesium (Mg) (%) | 0.46 | 0.71 | 0.31 | 0.64 | 0.38 |
| | Manganese (Mn) (ppm) | 598 | 767 | 621 | 544 | 441 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID Description Sampled Date Sampled Time Client ID | L2041640-6 Waste 23-DEC-17 146729 | L2041640-7 Waste 26-DEC-17 146733 | L2041640-8 Waste 21-DEC-17 146727 | L2041640-9 Waste 23-DEC-17 146730 | L2041640-10 Waste 26-DEC-17 146732 |
|-------------------------------|---|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Physical Tests | pH (Unity) | 9.0 | 8.8 | 8.4 | 9.0 | 8.9 |
| Organic / Inorganic Carbon | Carbon (C) (%) | 0.29 | 0.62 | 0.07 | 0.41 | 0.65 |
| Acid Base Accounting | FIZZ RATING (Unity) | 2 | 2 | 1 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | 0.3 | 1.9 | 3.8 | 4.4 | <0.3 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | 24 | 46 | 11 | 29 | 41 |
| | NNP (tCaCO3/1Kt) | 24 | 44 | 7 | 25 | 41 |
| | Ratio (NP/MPA) (Unity) | 76.80 | 24.53 | 2.93 | 6.63 | 262.40 |
| | Sulfate Sulfur (carbonate leach) (%) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfate Sulfur (HCl leach) (%) | <0.01 | <0.01 | <0.01 | 0.01 | 0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | 0.01 | 0.06 | 0.12 | 0.13 | <0.01 |
| | Total Sulfur (combustion) (%) | 0.01 | 0.06 | 0.12 | 0.14 | <0.01 |
| Total Metals | Aluminum (Al) (%) | 1.14 | 0.94 | 1.23 | 0.97 | 0.77 |
| | Antimony (Sb) (ppm) | <0.05 | 0.06 | <0.05 | 0.05 | 0.07 |
| | Arsenic (As) (ppm) | 0.3 | 1.1 | 0.5 | 1.2 | 0.9 |
| | Barium (Ba) (ppm) | 310 | 190 | 210 | 300 | 160 |
| | Beryllium (Be) (ppm) | 0.25 | 0.44 | 0.27 | 0.26 | 0.33 |
| | Bismuth (Bi) (ppm) | 0.03 | 0.04 | 0.25 | 0.06 | 0.03 |
| | Boron (B) (ppm) | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | 0.02 | 0.06 | 0.12 | 0.14 | 0.05 |
| | Calcium (Ca) (%) | 0.95 | 1.60 | 0.44 | 0.96 | 1.39 |
| | Cerium (Ce) (ppm) | 28.5 | 28.0 | 22.2 | 24.9 | 30.4 |
| | Cesium (Cs) (ppm) | 0.91 | 0.42 | 0.31 | 0.55 | 0.38 |
| | Chromium (Cr) (ppm) | 6 | 5 | 4 | 5 | 5 |
| | Cobalt (Co) (ppm) | 6.0 | 6.4 | 6.0 | 7.3 | 5.4 |
| | Copper (Cu) (ppm) | 163.0 | 454 | 3220 | 1170 | 44.7 |
| | Gallium (Ga) (ppm) | 5.48 | 4.80 | 7.15 | 4.80 | 4.17 |
| | Germanium (Ge) (ppm) | 0.08 | 0.08 | 0.06 | 0.06 | 0.05 |
| | Gold (Au) (ppm) | <0.02 | <0.02 | 0.09 | <0.02 | <0.02 |
| | Hafnium (Hf) (ppm) | 0.06 | 0.06 | 0.04 | 0.05 | 0.04 |
| | Indium (In) (ppm) | 0.024 | 0.036 | 0.110 | 0.058 | 0.030 |
| | Iron (Fe) (%) | 2.41 | 2.49 | 2.76 | 2.41 | 2.29 |
| | Lanthanum (La) (ppm) | 14.7 | 14.5 | 10.9 | 13.4 | 15.9 |
| | Lead (Pb) (ppm) | 1.9 | 3.3 | 3.6 | 2.7 | 3.3 |
| | Lithium (Li) (ppm) | 4.8 | 4.8 | 8.2 | 3.9 | 3.4 |
| | Magnesium (Mg) (%) | 0.60 | 0.71 | 0.62 | 0.59 | 0.53 |
| | Manganese (Mn) (ppm) | 526 | 696 | 437 | 537 | 603 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2041640-1 Waste 15-DEC-17 146693 | L2041640-2 Waste 15-DEC-17 146694 | L2041640-3 Waste 15-DEC-17 146695 | L2041640-4 Waste 21-DEC-17 146726 | L2041640-5 Waste 22-DEC-17 146728 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | 1.62 | 36.1 | 1.79 | 1.78 | 4.19 |
| | Nickel (Ni) (ppm) | 2.8 | 2.6 | 1.9 | 3.4 | 2.7 |
| | Niobium (Nb) (ppm) | 0.14 | 0.23 | <0.05 | 0.10 | 0.20 |
| | Phosphorus (P) (ppm) | 680 | 800 | 650 | 640 | 580 |
| | Potassium (K) (%) | 0.56 | 0.57 | 0.19 | 0.47 | 0.57 |
| | Rhenium (Re) (ppm) | <0.001 | 0.105 | 0.002 | 0.001 | 0.003 |
| | Rubidium (Rb) (ppm) | 28.4 | 33.6 | 9.2 | 22.0 | 30.0 |
| | Scandium (Sc) (ppm) | 4.4 | 5.6 | 3.6 | 3.7 | 3.9 |
| | Selenium (Se) (ppm) | 1.3 | 1.2 | 0.5 | <0.2 | 0.7 |
| | Silver (Ag) (ppm) | 0.68 | 0.43 | 0.10 | 0.10 | 0.48 |
| | Sodium (Na) (%) | 0.06 | 0.06 | 0.03 | 0.08 | 0.07 |
| | Strontium (Sr) (ppm) | 41.5 | 79.8 | 77.4 | 66.2 | 34.0 |
| | Sulfur (S) (%) | 0.05 | 0.44 | 0.02 | 0.02 | 0.03 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.15 | 0.05 | 0.02 | 0.01 | 0.11 |
| | Thallium (Tl) (ppm) | 0.20 | 0.30 | 0.05 | 0.14 | 0.19 |
| | Thorium (Th) (ppm) | 4.3 | 4.7 | 2.8 | 3.5 | 3.3 |
| | Tin (Sn) (ppm) | 0.6 | 1.7 | 0.5 | 0.6 | 0.6 |
| | Titanium (Ti) (%) | 0.084 | 0.090 | 0.008 | 0.079 | 0.092 |
| | Tungsten (W) (ppm) | 0.50 | 0.51 | 0.11 | 0.42 | 0.45 |
| | Uranium (U) (ppm) | 0.22 | 0.62 | 0.24 | 0.37 | 0.21 |
| | Vanadium (V) (ppm) | 55 | 72 | 41 | 50 | 52 |
| | Yttrium (Y) (ppm) | 6.50 | 9.44 | 7.68 | 6.99 | 5.95 |
| | Zinc (Zn) (ppm) | 67 | 65 | 63 | 66 | 71 |
| | Zirconium (Zr) (ppm) | 1.1 | 1.8 | 1.3 | 1.1 | 0.9 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.6 | 2.1 | 2.2 | 0.7 | 0.3 |
| Miscellaneous | Carbon (C) (%) | 0.23 | 0.66 | 0.72 | 0.23 | 0.12 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2041640-6 Waste 23-DEC-17 146729 | L2041640-7 Waste 26-DEC-17 146733 | L2041640-8 Waste 21-DEC-17 146727 | L2041640-9 Waste 23-DEC-17 146730 | L2041640-10 Waste 26-DEC-17 146732 |
|---|--------------------------|--|--|--|--|---|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | <0.01 | 0.01 | <0.01 | <0.01 |
| | Molybdenum (Mo) (ppm) | 2.86 | 1.14 | 6.81 | 5.71 | 0.59 |
| | Nickel (Ni) (ppm) | 3.4 | 2.4 | 2.6 | 2.5 | 2.3 |
| | Niobium (Nb) (ppm) | 0.13 | 0.14 | 0.12 | 0.19 | 0.07 |
| | Phosphorus (P) (ppm) | 620 | 690 | 800 | 820 | 530 |
| | Potassium (K) (%) | 0.67 | 0.43 | 0.38 | 0.63 | 0.34 |
| | Rhenium (Re) (ppm) | 0.005 | 0.003 | 0.002 | 0.016 | 0.001 |
| | Rubidium (Rb) (ppm) | 33.9 | 21.3 | 20.0 | 31.6 | 17.3 |
| | Scandium (Sc) (ppm) | 4.8 | 5.1 | 3.1 | 5.3 | 4.8 |
| | Selenium (Se) (ppm) | <0.2 | 0.2 | 2.7 | 0.5 | 0.2 |
| | Silver (Ag) (ppm) | 0.05 | 0.17 | 0.73 | 0.25 | 0.05 |
| | Sodium (Na) (%) | 0.09 | 0.07 | 0.05 | 0.07 | 0.07 |
| | Strontium (Sr) (ppm) | 61.2 | 136.0 | 35.3 | 81.4 | 98.9 |
| | Sulfur (S) (%) | 0.03 | 0.09 | 0.15 | 0.18 | 0.01 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.01 | 0.03 | 0.09 | 0.03 | 0.01 |
| | Thallium (Tl) (ppm) | 0.21 | 0.13 | 0.17 | 0.25 | 0.11 |
| | Thorium (Th) (ppm) | 3.3 | 3.6 | 2.9 | 3.2 | 3.5 |
| | Tin (Sn) (ppm) | 0.6 | 0.7 | 1.8 | 1.0 | 0.5 |
| | Titanium (Ti) (%) | 0.112 | 0.069 | 0.057 | 0.100 | 0.043 |
| | Tungsten (W) (ppm) | 0.79 | 0.50 | 0.34 | 0.44 | 0.23 |
| | Uranium (U) (ppm) | 0.43 | 1.11 | 0.28 | 0.38 | 0.30 |
| | Vanadium (V) (ppm) | 52 | 50 | 55 | 65 | 41 |
| | Yttrium (Y) (ppm) | 8.35 | 9.35 | 6.19 | 7.28 | 8.51 |
| | Zinc (Zn) (ppm) | 63 | 71 | 74 | 62 | 56 |
| | Zirconium (Zr) (ppm) | 1.1 | 1.3 | 1.3 | 1.5 | 0.7 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 1.1 | 2.3 | 0.3 | 1.5 | 2.4 |
| Miscellaneous | Carbon (C) (%) | 0.37 | 0.73 | 0.11 | 0.48 | 0.74 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-39

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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BURNABY BC V5A 1W9

Page: 1
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 30-JAN-2018
 Account: APN

CERTIFICATE VA18005872

Project: L2041640

This report is for 10 Other samples submitted to our lab in Vancouver, BC, Canada on 8-JAN-2018.

The following have access to data associated with this certificate:

| | | |
|------------------|-------------|--|
| ALSEV DATASUBLET | SHANE STACK | |
|------------------|-------------|--|

| SAMPLE PREPARATION | |
|---------------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| PUL-QC | Pulverizing QC Test |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|------------------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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To: ALS ENVIRONMENTAL
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Page: 2 - A
 Total # Pages: 2 (A - E)
 Plus Appendix Pages
 Finalized Date: 30-JAN-2018
 Account: APN

Project: L2041640

CERTIFICATE OF ANALYSIS VA18005872

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm |
|--------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|
| L2041640-1 146693 | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 |
| L2041640-2 146694 | | 1.06 | 2 | 0.9 | 15 | 16 | 17.07 | 8.8 | 0.03 | 0.03 | 0.17 | 0.6 | <0.01 | 0.23 | <0.01 | 0.68 |
| L2041640-3 146695 | | 1.06 | 2 | 12.5 | 25 | 37 | 2.96 | 9.0 | 0.40 | 0.40 | 0.56 | 2.1 | <0.01 | 0.66 | <0.01 | 0.43 |
| L2041640-4 146726 | | 0.94 | 2 | 0.3 | 55 | 55 | 176.00 | 8.3 | 0.01 | 0.01 | 0.61 | 2.2 | <0.01 | 0.72 | <0.01 | 0.10 |
| L2041640-5 146728 | | 1.08 | 2 | 0.3 | 21 | 21 | 67.20 | 9.0 | 0.01 | <0.01 | 0.18 | 0.7 | 0.01 | 0.23 | <0.01 | 0.10 |
| L2041640-6 146729 | | 1.12 | 1 | 0.3 | 10 | 10 | 32.00 | 8.9 | 0.01 | 0.01 | 0.09 | 0.3 | <0.01 | 0.12 | <0.01 | 0.48 |
| L2041640-7 146733 | | 1.04 | 2 | 0.3 | 24 | 24 | 76.80 | 9.0 | 0.01 | 0.01 | 0.29 | 1.1 | <0.01 | 0.37 | <0.01 | 0.05 |
| L2041640-8 146727 | | 1.10 | 2 | 1.9 | 44 | 46 | 24.53 | 8.8 | 0.06 | 0.06 | 0.62 | 2.3 | <0.01 | 0.73 | <0.01 | 0.17 |
| L2041640-9 146730 | | 0.90 | 1 | 3.8 | 7 | 11 | 2.93 | 8.4 | 0.12 | 0.12 | 0.07 | 0.3 | <0.01 | 0.11 | <0.01 | 0.73 |
| L2041640-10 146732 | | 1.34 | 2 | 4.4 | 25 | 29 | 6.63 | 9.0 | 0.14 | 0.13 | 0.41 | 1.5 | 0.01 | 0.48 | <0.01 | 0.25 |
| | | 1.10 | 2 | <0.3 | 41 | 41 | 262.40 | 8.9 | <0.01 | <0.01 | 0.65 | 2.4 | 0.01 | 0.74 | <0.01 | 0.05 |

***** See Appendix Page for comments regarding this certificate *****



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 Plus Appendix Pages
 Finalized Date: 30-JAN-2018
 Account: APN

Project: L2041640

CERTIFICATE OF ANALYSIS VA18005872

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe |
| Units | | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % |
| LOR | | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 |
| L2041640-1 146693 | | 1.00 | 1.9 | 0.08 | <10 | 200 | 0.30 | 0.32 | 0.63 | 0.21 | 21.1 | 6.2 | 5 | 0.50 | 2630 | 2.53 |
| L2041640-2 146694 | | 0.88 | 0.6 | <0.02 | 10 | 210 | 0.24 | 0.09 | 1.09 | 0.13 | 27.0 | 8.1 | 4 | 0.55 | 2160 | 2.63 |
| L2041640-3 146695 | | 0.96 | 3.0 | <0.02 | 10 | 140 | 0.94 | 0.05 | 2.33 | 0.43 | 29.0 | 5.7 | 3 | 0.40 | 502 | 2.17 |
| L2041640-4 146726 | | 1.21 | 0.4 | <0.02 | <10 | 240 | 0.31 | 0.04 | 0.91 | 0.06 | 28.3 | 6.2 | 6 | 0.34 | 283 | 2.31 |
| L2041640-5 146728 | | 0.93 | 0.9 | 0.04 | <10 | 250 | 0.24 | 0.26 | 0.42 | 0.23 | 25.6 | 5.6 | 5 | 0.44 | 1950 | 2.40 |
| L2041640-6 146729 | | 1.14 | 0.3 | <0.02 | <10 | 310 | 0.25 | 0.03 | 0.95 | 0.02 | 28.5 | 6.0 | 6 | 0.91 | 163.0 | 2.41 |
| L2041640-7 146733 | | 0.94 | 1.1 | <0.02 | <10 | 190 | 0.44 | 0.04 | 1.60 | 0.06 | 28.0 | 6.4 | 5 | 0.42 | 454 | 2.49 |
| L2041640-8 146727 | | 1.23 | 0.5 | 0.09 | <10 | 210 | 0.27 | 0.25 | 0.44 | 0.12 | 22.2 | 6.0 | 4 | 0.31 | 3220 | 2.76 |
| L2041640-9 146730 | | 0.97 | 1.2 | <0.02 | <10 | 300 | 0.26 | 0.06 | 0.96 | 0.14 | 24.9 | 7.3 | 5 | 0.55 | 1170 | 2.41 |
| L2041640-10 146732 | | 0.77 | 0.9 | <0.02 | <10 | 160 | 0.33 | 0.03 | 1.39 | 0.05 | 30.4 | 5.4 | 5 | 0.38 | 44.7 | 2.29 |

***** See Appendix Page for comments regarding this certificate *****



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Project: L2041640

CERTIFICATE OF ANALYSIS VA18005872

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| | Analyte | Ga | Ge | Hf | Hg | In | K | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P |
| Units | | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppm |
| LOR | | 0.05 | 0.05 | 0.02 | 0.01 | 0.005 | 0.01 | 0.2 | 0.1 | 0.01 | 5 | 0.05 | 0.01 | 0.05 | 0.2 | 10 |
| L2041640-1 146693 | | 5.19 | 0.06 | 0.04 | <0.01 | 0.063 | 0.56 | 10.7 | 4.6 | 0.46 | 598 | 1.62 | 0.06 | 0.14 | 2.8 | 680 |
| L2041640-2 146694 | | 4.76 | 0.06 | 0.07 | 0.01 | 0.080 | 0.57 | 14.4 | 3.9 | 0.71 | 767 | 36.1 | 0.06 | 0.23 | 2.6 | 800 |
| L2041640-3 146695 | | 5.66 | 0.05 | 0.04 | <0.01 | 0.026 | 0.19 | 15.7 | 4.7 | 0.31 | 621 | 1.79 | 0.03 | <0.05 | 1.9 | 650 |
| L2041640-4 146726 | | 5.77 | 0.07 | 0.06 | <0.01 | 0.022 | 0.47 | 15.0 | 6.8 | 0.64 | 544 | 1.78 | 0.08 | 0.10 | 3.4 | 640 |
| L2041640-5 146728 | | 4.72 | 0.07 | 0.03 | <0.01 | 0.047 | 0.57 | 13.1 | 4.2 | 0.38 | 441 | 4.19 | 0.07 | 0.20 | 2.7 | 580 |
| L2041640-6 146729 | | 5.48 | 0.08 | 0.06 | 0.01 | 0.024 | 0.67 | 14.7 | 4.8 | 0.60 | 526 | 2.86 | 0.09 | 0.13 | 3.4 | 620 |
| L2041640-7 146733 | | 4.80 | 0.08 | 0.06 | <0.01 | 0.036 | 0.43 | 14.5 | 4.8 | 0.71 | 696 | 1.14 | 0.07 | 0.14 | 2.4 | 690 |
| L2041640-8 146727 | | 7.15 | 0.06 | 0.04 | 0.01 | 0.110 | 0.38 | 10.9 | 8.2 | 0.62 | 437 | 6.81 | 0.05 | 0.12 | 2.6 | 800 |
| L2041640-9 146730 | | 4.80 | 0.06 | 0.05 | <0.01 | 0.058 | 0.63 | 13.4 | 3.9 | 0.59 | 537 | 5.71 | 0.07 | 0.19 | 2.5 | 820 |
| L2041640-10 146732 | | 4.17 | 0.05 | 0.04 | <0.01 | 0.030 | 0.34 | 15.9 | 3.4 | 0.53 | 603 | 0.59 | 0.07 | 0.07 | 2.3 | 530 |



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CERTIFICATE OF ANALYSIS VA18005872

| Sample Description | Method Analyte Units LOR | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|--------------------|-----------------------------------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-----------|----------|
| | | Pb ppm | Rb ppm | Re ppm | S % | Sb ppm | Sc ppm | Se ppm | Sn ppm | Sr ppm | Ta ppm | Te ppm | Th ppm | Ti % | Tl ppm | U ppm |
| L2041640-1 146693 | | 3.9 | 28.4 | <0.001 | 0.05 | 0.08 | 4.4 | 1.3 | 0.6 | 41.5 | <0.01 | 0.15 | 4.3 | 0.084 | 0.20 | 0.22 |
| L2041640-2 146694 | | 3.7 | 33.6 | 0.105 | 0.44 | 0.06 | 5.6 | 1.2 | 1.7 | 79.8 | <0.01 | 0.05 | 4.7 | 0.090 | 0.30 | 0.62 |
| L2041640-3 146695 | | 5.4 | 9.2 | 0.002 | 0.02 | 0.09 | 3.6 | 0.5 | 0.5 | 77.4 | <0.01 | 0.02 | 2.8 | 0.008 | 0.05 | 0.24 |
| L2041640-4 146726 | | 2.7 | 22.0 | 0.001 | 0.02 | 0.05 | 3.7 | <0.2 | 0.6 | 66.2 | <0.01 | 0.01 | 3.5 | 0.079 | 0.14 | 0.37 |
| L2041640-5 146728 | | 2.8 | 30.0 | 0.003 | 0.03 | 0.05 | 3.9 | 0.7 | 0.6 | 34.0 | <0.01 | 0.11 | 3.3 | 0.092 | 0.19 | 0.21 |
| L2041640-6 146729 | | 1.9 | 33.9 | 0.005 | 0.03 | <0.05 | 4.8 | <0.2 | 0.6 | 61.2 | <0.01 | 0.01 | 3.3 | 0.112 | 0.21 | 0.43 |
| L2041640-7 146733 | | 3.3 | 21.3 | 0.003 | 0.09 | 0.06 | 5.1 | 0.2 | 0.7 | 136.0 | <0.01 | 0.03 | 3.6 | 0.069 | 0.13 | 1.11 |
| L2041640-8 146727 | | 3.6 | 20.0 | 0.002 | 0.15 | <0.05 | 3.1 | 2.7 | 1.8 | 35.3 | <0.01 | 0.09 | 2.9 | 0.057 | 0.17 | 0.28 |
| L2041640-9 146730 | | 2.7 | 31.6 | 0.016 | 0.18 | 0.05 | 5.3 | 0.5 | 1.0 | 81.4 | <0.01 | 0.03 | 3.2 | 0.100 | 0.25 | 0.38 |
| L2041640-10 146732 | | 3.3 | 17.3 | 0.001 | 0.01 | 0.07 | 4.8 | 0.2 | 0.5 | 98.9 | <0.01 | 0.01 | 3.5 | 0.043 | 0.11 | 0.30 |

***** See Appendix Page for comments regarding this certificate *****



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Project: L2041640

CERTIFICATE OF ANALYSIS VA18005872

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|--------------------|---------|---------|---------|---------|---------|---------|
| | Analyte | V | W | Y | Zn | Zr |
| | Units | ppm | ppm | ppm | ppm | ppm |
| | LOR | 1 | 0.05 | 0.05 | 2 | 0.5 |
| L2041640-1 146693 | | 55 | 0.50 | 6.50 | 67 | 1.1 |
| L2041640-2 146694 | | 72 | 0.51 | 9.44 | 65 | 1.8 |
| L2041640-3 146695 | | 41 | 0.11 | 7.68 | 63 | 1.3 |
| L2041640-4 146726 | | 50 | 0.42 | 6.99 | 66 | 1.1 |
| L2041640-5 146728 | | 52 | 0.45 | 5.95 | 71 | 0.9 |
| L2041640-6 146729 | | 52 | 0.79 | 8.35 | 63 | 1.1 |
| L2041640-7 146733 | | 50 | 0.50 | 9.35 | 71 | 1.3 |
| L2041640-8 146727 | | 55 | 0.34 | 6.19 | 74 | 1.3 |
| L2041640-9 146730 | | 65 | 0.44 | 7.28 | 62 | 1.5 |
| L2041640-10 146732 | | 41 | 0.23 | 8.51 | 56 | 0.7 |



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Project: L2041640

CERTIFICATE OF ANALYSIS VA18005872

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|----------|---------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | PUL-QC |
| S-CAL06a | S-GRA06 | S-GRA06a | S-IR08 |
| SPL-21 | WEI-21 | | |



| | | | | | | | | | | | | | |
|--|---|--|-----------------|--|--|---|-----------------------|--|--|---------------------------|----------------------|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | 4 day [P4] <input type="checkbox"/> | | | | 1 Business day [E1] <input type="checkbox"/> | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | Date and Time Required for all E&P TATs: | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | Analysis Request | | | | | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | Oil and Gas Required Fields (client use) | | | | | | | | | |
| Invoice To | Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Invoice Distribution | | ALS Account # / Quote #: | | | | | | | | | |
| | Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | Job #: | | | | | | | | | |
| Company: | Minto Explorations Ltd | Email 1 or Fax ap@mintomine.com | | PO / AFE: TBD | | | | | | | | | |
| Contact: | Ruth Cayetano | Email 2 | | LSD: | | | | | | | | | |
| Project Information | | ALS Contact: | | ALS Lab Work Order # (lab use only) | | | | | | | | | |
| | | Sampler: | | ALS Sample # (lab use only) | | | | | | | | | |
| Sample Identification and/or Coordinates (This description will appear on the report) | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals- Aqua regia digestion (CP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1301) | Number of Containers | | |
| 146693 | | | | Composite | R | R | R | R | R | R | | | |
| 146694 | | 15-DEC-17 | | WASTE | X | X | X | X | X | X | | | |
| 146695 | | 15-DEC-17 | | WASTE | X | X | X | X | X | X | | | |
| 146726 | | 15-DEC-17 | | WASTE | X | X | X | X | X | X | | | |
| 146728 | | 21-DEC-17 | | WASTE | X | X | X | X | X | X | | | |
| 146729 | | 22-DEC-17 | | WASTE | X | X | X | X | X | X | | | |
| 146733 | | 23-DEC-17 | | WASTE | X | X | X | X | X | X | | | |
| 146727 | | 26-DEC-17 | | WASTE | X | X | X | X | X | X | | | |
| 146730 | | 26-DEC-17 | | WASTE | X | X | X | X | X | X | | | |
| 146732 | | 26-DEC-17 | | WASTE | X | X | X | X | X | X | | | |
| Drinking Water (DW) Samples (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | |
| | | | | | Cooling Initiated <input type="checkbox"/> | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | FINAL COOLER TEMPERATURES °C | | | | |
| | | | | | 6°C | | | | 11 | | | | |
| Released by: [Signature] | | Date: Dec 23 2017 | | | Time: [Signature] | | | Received by: [Signature] | | | Date: JAN 4 18 | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | Time: 15:55 | | | Received by: [Signature] | | | Date: JAN - 5 2018 | | |
| Time: [Signature] | | Date: [Signature] | | | Time: [Signature] | | | Date: [Signature] | | | Time: 13:25 | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 10-JAN-18
Report Date: 09-FEB-18 15:07 (MT)
Version: FINAL REV. 2

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2043509
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: 17-40
Legal Site Desc:

Comments: Please note, the ALS Minerals version of the finalized report and QC can be found at the end of the attachment.

The PO for this submission is 229099

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | L2043509-1 Waste 24-DEC-17 146731 | L2043509-2 Waste 28-DEC-17 146735 | L2043509-3 Waste 28-DEC-17 146734 | L2043509-4 Waste 30-DEC-17 146736 | L2043509-5 Tails 01-DEC-17 DEC TAILS 2017 |
|---|--|--|--|--|--|
| Grouping | Analyte | | | | |
| SOIL | | | | | |
| Physical Tests | pH (Unity) | | | | |
| | 8.5 | 8.9 | 9.0 | 9.1 | 8.0 |
| Organic / Inorganic Carbon | Carbon (C) (%) | | | | |
| | 0.05 | 0.49 | 0.27 | 0.19 | 0.33 |
| Acid Base Accounting | FIZZ RATING (Unity) | | | | |
| | 1 | 2 | 2 | 2 | 2 |
| | MPA (tCaCO3/1Kt) | | | | |
| | 1.9 | 7.5 | 3.1 | 0.6 | 4.4 |
| | Neutralization Potential (NP) (tCaCO3/1Kt) | | | | |
| | 8 | 32 | 23 | 21 | 25 |
| | NNP (tCaCO3/1Kt) | | | | |
| | 6 | 25 | 20 | 20 | 21 |
| | Ratio (NP/MPA) (Unity) | | | | |
| | 4.27 | 4.27 | 7.36 | 33.60 | 5.71 |
| | Sulfate Sulfur (carbonate leach) (%) | | | | |
| | 0.02 | 0.01 | <0.01 | 0.01 | 0.04 |
| | Sulfate Sulfur (HCl leach) (%) | | | | |
| | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Sulfide Sulfur (T minus HCl leach) (%) | | | | |
| | 0.06 | 0.24 | 0.10 | 0.02 | 0.14 |
| | Total Sulfur (combustion) (%) | | | | |
| | 0.06 | 0.24 | 0.10 | 0.02 | 0.14 |
| Total Metals | Aluminum (Al) (%) | | | | |
| | 1.14 | 1.01 | 1.01 | 1.07 | 1.17 |
| | Antimony (Sb) (ppm) | | | | |
| | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | Arsenic (As) (ppm) | | | | |
| | 1.6 | 1.4 | 1.1 | 0.5 | 1.4 |
| | Barium (Ba) (ppm) | | | | |
| | 300 | 310 | 240 | 140 | 280 |
| | Beryllium (Be) (ppm) | | | | |
| | 0.25 | 0.25 | 0.19 | 0.31 | 0.18 |
| | Bismuth (Bi) (ppm) | | | | |
| | 0.13 | 0.05 | 0.50 | 0.02 | 0.20 |
| | Boron (B) (ppm) | | | | |
| | <10 | <10 | <10 | <10 | <10 |
| | Cadmium (Cd) (ppm) | | | | |
| | 0.27 | 0.15 | 0.09 | 0.04 | 0.26 |
| | Calcium (Ca) (%) | | | | |
| | 0.35 | 1.18 | 1.02 | 1.01 | 1.10 |
| | Cerium (Ce) (ppm) | | | | |
| | 29.7 | 26.9 | 23.1 | 20.0 | 21.5 |
| | Cesium (Cs) (ppm) | | | | |
| | 0.56 | 0.46 | 0.44 | 0.29 | 0.43 |
| | Chromium (Cr) (ppm) | | | | |
| | 5 | 5 | 5 | 6 | 7 |
| | Cobalt (Co) (ppm) | | | | |
| | 12.0 | 8.8 | 5.4 | 5.0 | 6.3 |
| | Copper (Cu) (ppm) | | | | |
| | 3140 | 1720 | 2310 | 48.9 | 1965 |
| | Gallium (Ga) (ppm) | | | | |
| | 5.86 | 5.38 | 5.20 | 5.47 | 6.34 |
| | Germanium (Ge) (ppm) | | | | |
| | 0.07 | 0.06 | 0.08 | 0.05 | 0.06 |
| | Gold (Au) (ppm) | | | | |
| | 0.04 | <0.02 | 0.06 | <0.02 | 0.07 |
| | Hafnium (Hf) (ppm) | | | | |
| | 0.06 | 0.05 | 0.06 | 0.06 | 0.05 |
| | Indium (In) (ppm) | | | | |
| | 0.099 | 0.080 | 0.040 | 0.019 | 0.066 |
| | Iron (Fe) (%) | | | | |
| | 3.45 | 3.00 | 2.65 | 2.05 | 3.70 |
| | Lanthanum (La) (ppm) | | | | |
| | 15.6 | 14.7 | 11.3 | 9.0 | 10.6 |
| | Lead (Pb) (ppm) | | | | |
| | 4.2 | 4.4 | 3.7 | 3.0 | 3.6 |
| | Lithium (Li) (ppm) | | | | |
| | 4.4 | 3.9 | 4.5 | 6.2 | 4.5 |
| | Magnesium (Mg) (%) | | | | |
| | 0.49 | 0.68 | 0.60 | 0.64 | 0.68 |
| | Manganese (Mn) (ppm) | | | | |
| | 683 | 720 | 667 | 529 | 653 |

ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID Description Sampled Date Sampled Time Client ID | | L2043509-1 Waste 24-DEC-17 146731 | L2043509-2 Waste 28-DEC-17 146735 | L2043509-3 Waste 28-DEC-17 146734 | L2043509-4 Waste 30-DEC-17 146736 | L2043509-5 Tails 01-DEC-17 DEC TAILS 2017 |
|---|--------------------------|--|--|--|--|--|
| Grouping | Analyte | | | | | |
| SOIL | | | | | | |
| Total Metals | Mercury (Hg) (ppm) | 0.01 | 0.01 | 0.01 | <0.01 | 0.01 |
| | Molybdenum (Mo) (ppm) | 24.9 | 19.20 | 4.41 | 1.28 | 6.69 |
| | Nickel (Ni) (ppm) | 3.7 | 3.2 | 2.7 | 4.9 | 2.5 |
| | Niobium (Nb) (ppm) | 0.16 | 0.22 | 0.14 | 0.10 | 0.19 |
| | Phosphorus (P) (ppm) | 780 | 850 | 610 | 680 | 800 |
| | Potassium (K) (%) | 0.65 | 0.60 | 0.59 | 0.26 | 0.61 |
| | Rhenium (Re) (ppm) | 0.007 | 0.040 | 0.007 | 0.003 | 0.010 |
| | Rubidium (Rb) (ppm) | 32.7 | 30.6 | 27.1 | 11.0 | 27.4 |
| | Scandium (Sc) (ppm) | 7.0 | 5.5 | 4.2 | 4.1 | 4.1 |
| | Selenium (Se) (ppm) | 1.5 | 1.4 | 1.8 | <0.2 | 1.1 |
| | Silver (Ag) (ppm) | 0.50 | 0.35 | 0.67 | 0.02 | 0.50 |
| | Sodium (Na) (%) | 0.05 | 0.06 | 0.06 | 0.09 | 0.06 |
| | Strontium (Sr) (ppm) | 44.8 | 78.2 | 64.1 | 60.5 | 73.2 |
| | Sulfur (S) (%) | 0.06 | 0.25 | 0.10 | 0.01 | 0.16 |
| | Tantalum (Ta) (ppm) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | Tellurium (Te) (ppm) | 0.11 | 0.03 | 0.09 | 0.01 | 0.11 |
| | Thallium (Tl) (ppm) | 0.27 | 0.21 | 0.16 | 0.07 | 0.20 |
| | Thorium (Th) (ppm) | 1.9 | 2.8 | 3.2 | 2.0 | 3.1 |
| | Tin (Sn) (ppm) | 1.8 | 1.4 | 0.5 | 0.5 | 1.1 |
| | Titanium (Ti) (%) | 0.101 | 0.098 | 0.095 | 0.053 | 0.110 |
| | Tungsten (W) (ppm) | 0.46 | 0.60 | 0.52 | 0.84 | 0.09 |
| | Uranium (U) (ppm) | 0.55 | 0.46 | 0.27 | 0.44 | 0.49 |
| | Vanadium (V) (ppm) | 95 | 72 | 52 | 42 | 75 |
| | Yttrium (Y) (ppm) | 12.35 | 9.31 | 7.39 | 7.72 | 6.96 |
| | Zinc (Zn) (ppm) | 80 | 76 | 71 | 53 | 99 |
| | Zirconium (Zr) (ppm) | 2.1 | 1.4 | 1.2 | 1.0 | 1.3 |
| Permanent Gases | Carbon Dioxide (CO2) (%) | 0.2 | 1.8 | 1.0 | 0.7 | 1.2 |
| Miscellaneous | Carbon (C) (%) | 0.09 | 0.54 | 0.33 | 0.24 | 0.36 |

Reference Information

Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|--|--------|--|-----------------------------------|
| ABA-OA-VOL08-AX | Soil | Acid Base Accounting | OA-VOL08 |
| CARBON-C-GAS05-AX | Soil | Carbon, TOC and CO2 | C-GAS05 |
| CARBON-C-IR07-AX | Soil | Carbon (C) using LECO analyzer | Total Carbon - Method Code C-IR07 |
| Total Carbon & Sulfur - Method Codes C-IR07 & S-IR08 | | | |
| A 0.1g sample is heated to approximately 1350°C in an induction furnace while passing a stream of oxygen through the sample. Carbon dioxide & sulfur dioxide released from the sample are measured by an IR detection system (Leco analyzer) and the total carbon & sulfur results are provided. | | | |
| ME-MS41-AX | Soil | Aqua Regia ICPMS | Aqua Regia ICPMS |
| A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences. | | | |
| PH-OA-ELE07-AX | Soil | pH | OA-ELE07 |
| SULPHUR-S-CAL06A-AX | Soil | Sulfide Sulfur Calc from HCl Leach | ALS Minerals S-CAL06A |
| Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion. | | | |
| SULPHUR-S-GRA06-AX | Soil | Sulfate Sulfur in Soil (Carbonate Leach) | ALS Minerals S-GRA06 |
| A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-GRA06A-AX | Soil | Sulfate Sulfur in Soil (HCl Leach) | ALS Minerals S-GRA06A |
| A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S). | | | |
| SULPHUR-S-IR08-AX | Soil | Total Sulfur in Soil by Combustion | ALS Minerals S-IR08 |
| The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided. | | | |

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

| Laboratory Definition Code | Laboratory Location |
|----------------------------|--|
| AX | ALS MINERALS - VANCOUVER, B.C., CANADA |

Chain of Custody Numbers:

17-40

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



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BURNABY BC V5A 1W9

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 Plus Appendix Pages
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 Account: APN

CERTIFICATE VA18008409

Project: L2043509

This report is for 5 Other samples submitted to our lab in Vancouver, BC, Canada on 12-JAN-2018.

The following have access to data associated with this certificate:

| | |
|------------------|-------------|
| ALSEV DATASUBLET | SHANE STACK |
|------------------|-------------|

| SAMPLE PREPARATION | |
|--------------------|--------------------------------|
| ALS CODE | DESCRIPTION |
| WEI-21 | Received Sample Weight |
| SPL-21 | Split sample - riffle splitter |
| LOG-22 | Sample login - Rcd w/o BarCode |
| PUL-31 | Pulverize split to 85% < 75 um |

| ANALYTICAL PROCEDURES | | |
|-----------------------|--------------------------------|---------|
| ALS CODE | DESCRIPTION | |
| C-GAS05 | Inorganic Carbon (CO2) | |
| C-IR07 | Total Carbon (Leco) | LECO |
| S-GRA06 | Sulfate Sulfur-carbonate leach | WST-SEQ |
| ME-MS41 | Ultra Trace Aqua Regia ICP-MS | |
| OA-VOL08m | Modified NP | |
| S-IR08 | Total Sulphur (Leco) | LECO |
| OA-ELE07 | Paste pH | |
| S-CAL06a | Sulfide Sulfur (calculated*) | |
| S-GRA06a | Sulfate Sulfur (HCl leachable) | WST-SEQ |

To: **ALS ENVIRONMENTAL**
ATTN: SHANE STACK
100 - 8081 LOUGHEED HWY.
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This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 
 Colin Ramshaw, Vancouver Laboratory Manager



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CERTIFICATE OF ANALYSIS VA18008409

| Sample Description | Method Analyte Units LOR | WEI-21 Recvd Wt. kg | OA-VOL08m FIZZ RAT Unity | OA-VOL08m MPA tCaCO3/1Kt | OA-VOL08m NNP tCaCO3/1Kt | OA-VOL08m NP tCaCO3/1Kt | OA-VOL08m Ratio (N) Unity | OA-ELE07 pH Unity | S-IR08 S % | S-CAL06a S % | C-GAS05 C % | C-GAS05 CO2 % | S-GRA06a S % | C-IR07 C % | S-GRA06 S % | ME-MS41 Ag ppm |
|---------------------------|--------------------------|---------------------|--------------------------|--------------------------|--------------------------|-------------------------|---------------------------|-------------------|------------|--------------|-------------|---------------|--------------|------------|-------------|----------------|
| | | 0.02 | 1 | 0.3 | 1 | 1 | 0.01 | 0.1 | 0.01 | 0.01 | 0.05 | 0.2 | 0.01 | 0.01 | 0.01 | 0.01 |
| L2043509-1 146731 | | 1.06 | 1 | 1.9 | 6 | 8 | 4.27 | 8.5 | 0.06 | 0.06 | 0.05 | 0.2 | <0.01 | 0.09 | 0.02 | 0.50 |
| L2043509-2 146735 | | 1.04 | 2 | 7.5 | 25 | 32 | 4.27 | 8.9 | 0.24 | 0.24 | 0.49 | 1.8 | <0.01 | 0.54 | 0.01 | 0.35 |
| L2043509-3 146734 | | 1.26 | 2 | 3.1 | 20 | 23 | 7.36 | 9.0 | 0.10 | 0.10 | 0.27 | 1.0 | <0.01 | 0.33 | <0.01 | 0.67 |
| L2043509-4 146736 | | 1.06 | 2 | 0.6 | 20 | 21 | 33.60 | 9.1 | 0.02 | 0.02 | 0.19 | 0.7 | <0.01 | 0.24 | 0.01 | 0.02 |
| L2043509-5 DEC TAILS 2017 | | 1.02 | 2 | 4.4 | 21 | 25 | 5.71 | 8.0 | 0.14 | 0.14 | 0.33 | 1.2 | <0.01 | 0.36 | 0.04 | 0.50 |



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CERTIFICATE OF ANALYSIS VA18008409

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| | Analyte | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe |
| Units | | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % |
| LOR | | 0.01 | 0.1 | 0.02 | 10 | 10 | 0.05 | 0.01 | 0.01 | 0.01 | 0.02 | 0.1 | 1 | 0.05 | 0.2 | 0.01 |
| L2043509-1 146731 | | 1.14 | 1.6 | 0.04 | <10 | 300 | 0.25 | 0.13 | 0.35 | 0.27 | 29.7 | 12.0 | 5 | 0.56 | 3140 | 3.45 |
| L2043509-2 146735 | | 1.01 | 1.4 | <0.02 | <10 | 310 | 0.25 | 0.05 | 1.18 | 0.15 | 26.9 | 8.8 | 5 | 0.46 | 1720 | 3.00 |
| L2043509-3 146734 | | 1.01 | 1.1 | 0.06 | <10 | 240 | 0.19 | 0.50 | 1.02 | 0.09 | 23.1 | 5.4 | 5 | 0.44 | 2310 | 2.65 |
| L2043509-4 146736 | | 1.07 | 0.5 | <0.02 | <10 | 140 | 0.31 | 0.02 | 1.01 | 0.04 | 20.0 | 5.0 | 6 | 0.29 | 48.9 | 2.05 |
| L2043509-5 DEC TAILS 2017 | | 1.17 | 1.4 | 0.07 | <10 | 280 | 0.18 | 0.20 | 1.10 | 0.26 | 21.5 | 6.3 | 7 | 0.43 | 1965 | 3.70 |

***** See Appendix Page for comments regarding this certificate *****



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CERTIFICATE OF ANALYSIS VA18008409

| Sample Description | Method Analyte Units LOR | ME-MS41 Ga ppm 0.05 | ME-MS41 Ge ppm 0.05 | ME-MS41 Hf ppm 0.02 | ME-MS41 Hg ppm 0.01 | ME-MS41 In ppm 0.005 | ME-MS41 K % 0.01 | ME-MS41 La ppm 0.2 | ME-MS41 Li ppm 0.1 | ME-MS41 Mg % 0.01 | ME-MS41 Mn ppm 5 | ME-MS41 Mo ppm 0.05 | ME-MS41 Na % 0.01 | ME-MS41 Nb ppm 0.05 | ME-MS41 Ni ppm 0.2 | ME-MS41 P ppm 10 |
|---------------------------|-----------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|---------------------------|-----------------------------|-----------------------------|----------------------------|---------------------------|------------------------------|----------------------------|------------------------------|-----------------------------|---------------------------|
| L2043509-1 146731 | | 5.86 | 0.07 | 0.06 | 0.01 | 0.099 | 0.65 | 15.6 | 4.4 | 0.49 | 683 | 24.9 | 0.05 | 0.16 | 3.7 | 780 |
| L2043509-2 146735 | | 5.38 | 0.06 | 0.05 | 0.01 | 0.080 | 0.60 | 14.7 | 3.9 | 0.68 | 720 | 19.20 | 0.06 | 0.22 | 3.2 | 850 |
| L2043509-3 146734 | | 5.20 | 0.08 | 0.06 | 0.01 | 0.040 | 0.59 | 11.3 | 4.5 | 0.60 | 667 | 4.41 | 0.06 | 0.14 | 2.7 | 610 |
| L2043509-4 146736 | | 5.47 | 0.05 | 0.06 | <0.01 | 0.019 | 0.26 | 9.0 | 6.2 | 0.64 | 529 | 1.28 | 0.09 | 0.10 | 4.9 | 680 |
| L2043509-5 DEC TAILS 2017 | | 6.34 | 0.06 | 0.05 | 0.01 | 0.066 | 0.61 | 10.6 | 4.5 | 0.68 | 653 | 6.69 | 0.06 | 0.19 | 2.5 | 800 |



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CERTIFICATE OF ANALYSIS VA18008409

| Sample Description | Method Analyte Units LOR | ME-MS41 Pb ppm 0.2 | ME-MS41 Rb ppm 0.1 | ME-MS41 Re ppm 0.001 | ME-MS41 S % 0.01 | ME-MS41 Sb ppm 0.05 | ME-MS41 Sc ppm 0.1 | ME-MS41 Se ppm 0.2 | ME-MS41 Sn ppm 0.2 | ME-MS41 Sr ppm 0.2 | ME-MS41 Ta ppm 0.01 | ME-MS41 Te ppm 0.01 | ME-MS41 Th ppm 0.2 | ME-MS41 Tl % 0.005 | ME-MS41 Tl ppm 0.02 | ME-MS41 U ppm 0.05 |
|---------------------------|-----------------------------------|-----------------------------|-----------------------------|-------------------------------|---------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|-----------------------------|
| L2043509-1 146731 | | 4.2 | 32.7 | 0.007 | 0.06 | <0.05 | 7.0 | 1.5 | 1.8 | 44.8 | <0.01 | 0.11 | 1.9 | 0.101 | 0.27 | 0.55 |
| L2043509-2 146735 | | 4.4 | 30.6 | 0.040 | 0.25 | <0.05 | 5.5 | 1.4 | 1.4 | 78.2 | <0.01 | 0.03 | 2.8 | 0.098 | 0.21 | 0.46 |
| L2043509-3 146734 | | 3.7 | 27.1 | 0.007 | 0.10 | <0.05 | 4.2 | 1.8 | 0.5 | 64.1 | <0.01 | 0.09 | 3.2 | 0.095 | 0.16 | 0.27 |
| L2043509-4 146736 | | 3.0 | 11.0 | 0.003 | 0.01 | <0.05 | 4.1 | <0.2 | 0.5 | 60.5 | <0.01 | 0.01 | 2.0 | 0.053 | 0.07 | 0.44 |
| L2043509-5 DEC TAILS 2017 | | 3.6 | 27.4 | 0.010 | 0.16 | <0.05 | 4.1 | 1.1 | 1.1 | 73.2 | <0.01 | 0.11 | 3.1 | 0.110 | 0.20 | 0.49 |



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CERTIFICATE OF ANALYSIS VA18008409

| Sample Description | Method | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 | ME-MS41 |
|---------------------------|---------|---------|---------|---------|---------|---------|
| | Analyte | V | W | Y | Zn | Zr |
| | Units | ppm | ppm | ppm | ppm | ppm |
| | LOR | 1 | 0.05 | 0.05 | 2 | 0.5 |
| L2043509-1 146731 | | 95 | 0.46 | 12.35 | 80 | 2.1 |
| L2043509-2 146735 | | 72 | 0.60 | 9.31 | 76 | 1.4 |
| L2043509-3 146734 | | 52 | 0.52 | 7.39 | 71 | 1.2 |
| L2043509-4 146736 | | 42 | 0.84 | 7.72 | 53 | 1.0 |
| L2043509-5 DEC TAILS 2017 | | 75 | 0.09 | 6.96 | 99 | 1.3 |



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CERTIFICATE OF ANALYSIS VA18008409

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

| | | | |
|----------|-----------|--------|----------|
| C-GAS05 | C-IR07 | LOG-22 | ME-MS41 |
| OA-ELE07 | OA-VOL08m | PUL-31 | S-CAL06a |
| S-GRA06 | S-GRA06a | S-IR08 | SPL-21 |
| WEI-21 | | | |



Chain of Custody (COC) / Analytical Request Form



L2043509-COFC

COC Number: 15-17-40

Page of

Canada Toll Free: 1 800 668 9878

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| | | | | | | | | | | | | | | | |
|--|---|--|-------------------|-------------------|---|-------------------------------------|---|---------------|-----------------------|--|--|---------------------------|----------------------|--|--|
| Report To Contact and company name below will appear on the final report | | Report Format / Distribution | | | Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply | | | | | | | | | | |
| Company: | Minto Explorations Ltd. | Select Report Format: <input checked="" type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL) | | | Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply | | | | | | | | | | |
| Contact: | Minto Environment - Coordinator | Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | | | PRIORITY (Business Days) | 4 day [P4] <input type="checkbox"/> | | | EMERGENCY | 1 Business day [E1] <input type="checkbox"/> | | | | | |
| Phone: | 1-604-759-4659 | <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked | | | | 3 day [P3] <input type="checkbox"/> | | | | Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/> | | | | | |
| Company address below will appear on the final report | | Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | 2 day [P2] <input type="checkbox"/> | | | | | | | | | |
| Street: | 2100-510 West Georgia St. | Email 1 or Fax minto_environment@mintomine.com | | | Date and Time Required for all E&P TATs: | | | | | dd-mmm-yy hh:mm | | | | | |
| City/Province: | Vancouver, British Columbia | Email 2 | | | For tests that can not be performed according to the service level selected, you will be contacted. | | | | | | | | | | |
| Postal Code: | V6B 0M3 | Email 3 | | | Analysis Request | | | | | | | | | | |
| Invoice To | | Invoice Distribution | | | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below | | | | | | | | | | |
| Same as Report To <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX | | | | | | | | | | | | | |
| Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | Email 1 or Fax ap@mintomine.com | | | | | | | | | | | | | |
| Company: Minto Explorations Ltd. | | Email 2 | | | | | | | | | | | | | |
| Contact: Ruth Cayetano | | | | | | | | | | | | | | | |
| Project Information | | Oil and Gas Required Fields (client use) | | | | | | | | | | | | | |
| ALS Account # / Quote #: | | AFE/Cost Center: | | | PO# | | | | | | | | | | |
| Job #: | | Major/Minor Code: | | | Routing Code: | | | | | | | | | | |
| PO / AFE: TBD | | Requisitioner: | | | | | | | | | | | | | |
| LSD: | | Location: | | | | | | | | | | | | | |
| ALS Lab Work Order # (lab use only) | | ALS Contact: | | | Sampler: | | | | | | | | | | |
| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | | | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Total Metals - Aqua regia digestion (ICP) | Paste pH | % Inorganic Carbonate | Total Carbon/Sulphur (Leco) | AP - determination by % sulphide sulphur | Modified NP - (MEND 1991) | Number of Containers | | |
| | 146731 | | | 24-Dec-17 | | Composite | R | R | R | R | R | | | | |
| | 146735 | | | 28-Dec-17 | | WASTE | X | X | X | X | X | | | | |
| | 146734 | | | 28-Dec-17 | | WASTE | X | X | X | X | X | | | | |
| | 146736 | | | 30-Dec-17 | | WASTE | X | X | X | X | X | | | | |
| | DEC TAILS 2017 | | | Dec-17 | | TAILS | X | X | X | X | X | | | | |
| Drinking Water (DW) Samples¹ (client use) | | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) | | | SAMPLE CONDITION AS RECEIVED (lab use only) | | | | | | | | | | |
| Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | |
| Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | | | | Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/> | | | | | | | | | | |
| | | | | | Cooling Initiated <input checked="" type="checkbox"/> | | | | | | | | | | |
| | | | | | INITIAL COOLER TEMPERATURES °C | | | | | FINAL COOLER TEMPERATURES °C | | | | | |
| | | | | | 1.0 | | | | | 4 | | | | | |
| SHIPMENT RELEASE (client use) | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | | | | | | | | | |
| Released by: | Date: 04 Jan 14 | Time: | Received by: LEHF | Date: 10 Jan 2018 | Time: 12:20 | Received by: JC | Date: JAN 11 2018 | Time: 12:05pm | | | | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form

OCTOBER 2015 FROM

Appendix D: 2017 Modified NP Method (MEND 1991) ABA Results for Tailings

| Appendix D. 2017 Summary Tailings Analysis Results from ALS Minerals | | | | | | | | | |
|--|----------|------|------|---------------------|---------------------|------------------------------|--------|---------------------|-------------|
| Monthly Tails Sample ID | Paste pH | TIC | S(T) | S(SO ₄) | S(S ⁻²) | AP | Net NP | NP:AP Ratio (NP/AP) | NP Modified |
| | | % | % | % | % | CaCO ₃ kg / tonne | | (NP/AP) | NP |
| FEBTAL2017 | 8.2 | 0.26 | 0.06 | 0.02 | 0.04 | 1.25 | 23 | 20.0 | 25 |
| MARTAL2017 | 8 | 0.19 | 0.09 | 0.05 | 0.04 | 1.25 | 18 | 16.8 | 21 |
| APRTAL2017 | 8 | 0.23 | 0.06 | 0.03 | 0.03 | 0.94 | 23 | 26.7 | 25 |
| APR10TAL2017 | 8 | 0.19 | 0.09 | 0.02 | 0.07 | 2.19 | 20 | 10.5 | 23 |
| MAY8TAL2017 | 8 | 0.18 | 0.09 | 0.03 | 0.06 | 1.88 | 16 | 10.1 | 19 |
| MAY29TAL2017 | 7.9 | 0.21 | 0.16 | 0.07 | 0.09 | 2.81 | 14 | 6.8 | 19 |
| JUN5TAL2017 | 7.8 | 0.2 | 0.09 | 0.04 | 0.05 | 1.56 | 18 | 13.4 | 21 |
| JUN12TAL2017 | 7.9 | 0.25 | 0.12 | 0.06 | 0.06 | 1.88 | 19 | 12.3 | 23 |
| JUN21TAL2017 | 7.8 | 0.25 | 0.11 | 0.05 | 0.06 | 1.88 | 20 | 12.3 | 23 |
| JULTAL2017 | 8.1 | 0.19 | 0.15 | 0.08 | 0.07 | 2.19 | 13 | 8.2 | 18 |
| AUGTAL2017 | 8.2 | 0.33 | 0.1 | <0.01 | 0.1 | 3.13 | 20 | 7.4 | 23 |
| SEPTAL2017 | 8.2 | 0.3 | 0.08 | 0.05 | 0.03 | 0.94 | 22 | 25.6 | 24 |
| OCTTAL2017 | 8 | 0.26 | 0.1 | <0.01 | 0.1 | 3.13 | 18 | 6.7 | 21 |
| NOVTAL2017 | 7.9 | 0.22 | 0.11 | 0.05 | 0.06 | 1.88 | 24 | 14.4 | 27 |
| DECTAL2017 | 8 | 0.33 | 0.14 | <0.01 | 0.14 | 4.38 | 5.71 | 4.8 | 21 |

Appendix P – Wildlife and Hazing Tracking Report

| Date | Time | Type of Animal | Number of Animals | Location | Description: Size/Color/Markings and Additional Notes |
|-----------|-------|----------------|-------------------|----------------------------------|---|
| 5-Jan-17 | 11:30 | Fox | 1 | Airport Road near the core shack | Red |
| 5-Jan-17 | 13:30 | Fox | 1 | Minto North | Red/Orange |
| 8-Jan-17 | 10:30 | Fox | 1 | Surface Magazine | |
| 8-Jan-17 | 10:00 | Fox | 1 | bicycle shack | ran away |
| 15-Jan-17 | 12:40 | Fox | 1 | Burn Pit | Red |
| 18-Jan-17 | 10:45 | Moose | 1 | Airstrip | Bull moose, walking around |
| 19-Jan-17 | 16:00 | Fox | 1 | Portal | |
| 20-Jan-17 | 13:00 | Fox | 1 | Surface Magazine | |
| 10-Feb-17 | 17:30 | Fox | 1 | A2S3 Pit | |
| 11-Feb-17 | 9:40 | Moose | 2 | Jump ramp A2S3 | Large moose |
| 17-Feb-17 | 5:00 | Lynx | 1 | km 6 | good shape, running for hills |
| 24-Feb-17 | 9:00 | Fox | 1 | Access Rd. Km 0.8 | |
| 24-Feb-17 | 17:35 | Fox | 2 | KM 0.75 | Red |
| 24-Feb-17 | 21:30 | Fox | 1 | Pit, 823 Bench | |
| 25-Feb-17 | 14:25 | Lynx | 5 | W3 area | momma and four kittens |
| 11-Mar-17 | 13:45 | Fox | 1 | Dry Stack | Healthy, red |
| 22-Mar-17 | 10:00 | Lynx | 1 | km 16 | |
| 23-Mar-17 | 9:00 | Fox | 1 | Selkirk Towers | |
| 25-Mar-17 | 16:15 | Bald Eagle | 1 | km 22 | Healthy adult in tree |
| 25-Mar-17 | 15:30 | Otter | 1 | Big Creek Bridge | Tracks in snow on river |
| 31-Mar-17 | 15:45 | Deer | 8 | KM 24 | on side of road |
| 1-Apr-17 | 10:00 | Rabbit | 1 | Airstrip SS course | white |
| 1-Apr-17 | 11:00 | Rabbit | 1 | Dyno SS course | white |
| 8-Apr-17 | 5:30 | Rabbit | 1 | warehouse | |
| 15-Apr-17 | 6:30 | Porcupine | 1 | walking along berm by W15 | great big sucker |
| 17-Apr-17 | 17:30 | Bear | 1 | 0.5 km | Cinnamon Black Bear |
| 17-Apr-17 | 17:20 | Bear | 1 | km 0.5 | walking around |
| 19-Apr-17 | 14:38 | Bear | 1 | 3.5Km | Cinnamon Black Bear |
| 19-Apr-17 | 16:45 | Lynx | 1 | Landfill/LTF entrance | Adult |
| 22-Apr-17 | 17:05 | Bear | 1 | WMA | checking out pallet of buckets |
| 1-May-17 | 19:00 | Bear | 2 | near km2 | Sow and Cub (black bear) |
| 3-May-17 | 10:00 | Bear | 1 | airport road | passing through going north |
| 3-May-17 | 10:15 | Bear | 1 | below air strip | Black Bear |
| 5-May-17 | 11:00 | Bear | 1 | Airport Road (top of Dumas) | Light brown, healthy (Black Bear) |
| 5-May-17 | 11:30 | Bear | 3 | KM 9 hill | Sow and 2 cubs |
| 5-May-17 | 2:00 | Wolf | 1 | Pelly | Grey Wolf |
| 6-May-17 | 12:20 | Lynx | 1 | W2 | Light grey |
| 6-May-17 | 11:50 | Bear | 1 | Airport Road behind Dumas | Light brown, healthy (Black Bear) |
| 7-May-17 | 18:30 | Bear | 1 | Behind Selkirk Tower | Dark Brown (Black Bear) |
| 8-May-17 | 19:00 | Bear | 1 | Sewage Lagoon Road | Light brown, healthy (Black Bear) |
| 9-May-17 | 13:00 | Moose | 2 | Km 2.5 | Healthy Cow moose and year old calf. Both healthy and grazing |
| 14-May-17 | 12:30 | Bear | 1 | access road between 0.5 and 1.0 | just chilling |
| 16-May-17 | 19:30 | Bear | 1 | km 3.5 | headed south |
| 18-May-17 | 20:30 | Bear | 1 | km 3 | |
| 19-May-17 | 13:30 | Bear | 1 | Dyno road | Large Cinnamon Black bear |
| 19-May-17 | 9:00 | Bear | 1 | airport road | small black bear w/ tan on nose |
| 20-May-17 | 10:15 | Bear | 2 | Dyno | one was larger cinnamon, the other was slightly smaller and all black with tan on the muzzle. |

| Date | Time | Type of Animal | Number of Animals | Location | Description: Size/Color/Markings and Additional Notes |
|-----------|-------|----------------|-------------------|---|--|
| 20-May-17 | 11:00 | Bear | 2 | Km 1.5 on the hill | Black Bear |
| 24-May-17 | 16:30 | Bear | 1 | Willows behind Dumas Shop | Small Black Bear ~250 lbs |
| 24-May-17 | 22:15 | Bear | 1 | Willows behind Dumas Shop | black bear - approx 300-350 lb, light brown with silver/grey |
| 26-May-17 | 14:00 | Wolf | 1 | km 18 | white, scruffy |
| 27-May-17 | 8:10 | Mule deer | 1 | 0.5 | healthy looking doe |
| 28-May-17 | 23:00 | Bear | 1 | Willows behind Dumas Shop | small black bear w/ tan on nose |
| 1-Jun-17 | 14:00 | Bear | 1 | Km 0.75 | Dark Brown (Black Bear) |
| 1-Jun-17 | 14:15 | Fox | 1 | WSP | cross-fox, dark colouring with white-ended tail |
| 3-Jun-17 | 15:00 | Ermine | 1 | top of WSP dam | small weasal, approx. 15 cm.long, brown back and head, white belly, dark tipped tail |
| 3-Jun-17 | 11:30 | Bear | 1 | km 0.8 | |
| 3-Jun-17 | 14:00 | Bear | 2 | airport road | left towards the bush opposite side of dumas, Black bear |
| 13-Jun-17 | 2:30 | Fox | 1 | haul road by buttress | ran down towards buttress |
| 23-Jun-17 | 13:00 | Seagull | 1 | barge | seagull ate 5 ducklings |
| 24-Jun-17 | 7:45 | Bear | 1 | Dumas shop (behind) | Light brown, healthy (Black Bear) |
| 25-Jun-17 | 19:30 | Bear | 1 | Km 1.7 | Young, tall/lanky very aggressive and predatory male. |
| 25-Jun-17 | 11:00 | Deer | 1 | crusher pad | walking around |
| 25-Jun-17 | 7:58 | Bear | 1 | km 1.7 | |
| 25-Jun-17 | 8:00 | Porcupine | 1 | Dyno gate | |
| 26-Jun-17 | 21:15 | Deer | 1 | in camp | skittish |
| 27-Jun-17 | 8:00 | Fox | 1 | Km 10 | Dark grey fox, with a rabbit in its mouth |
| 27-Jun-17 | 16:00 | Porcupine | 1 | SWD | |
| 30-Jun-17 | 8:30 | Bear | 1 | Portal Road | Beautiful cinnamon coloured, big black bear |
| 30-Jun-17 | 8:35 | Fox | 1 | Dumas shop (behind) | Dark grey fos with a mouse/rodent in its mouth |
| 1-Jul-17 | 5:45 | Deer | 1 | Offices | |
| 1-Jul-17 | 9:00 | Black Bear | 1 | km 1 | Skinny |
| 2-Jul-17 | 6:30 | Fox | 1 | near A2 radar | |
| 3-Jul-17 | 17:00 | Deer | 1 | between mine tech office and warehouse | |
| 4-Jul-17 | 13:20 | Ravens | 3 | Warehouse Yard | 3 Ravens were picking in the calcium chloride bag |
| 6-Jul-17 | 15:00 | Deer | 1 | between mine tech office and bunk house | Adult in healthy condition |
| 7-Jul-17 | 11:00 | Ravens | 3 | Warehouse Laydown | Resting and pecking at small calcium bags |
| 8-Jul-17 | 15:45 | Bear | 2 | KM9 | Black bear |
| 9-Jul-17 | 9:15 | Bear | 2 | Access Road 7km | Sow & Cub, Black Bears |
| 9-Jul-17 | 8:30 | Bear | 1 | Access Road 15km | black bear |
| 12-Jul-17 | 21:30 | Bear | 1 | In front of camp, DSTF and Dumas | Large brown coloured black bear |
| 12-Jul-17 | 21:30 | Bear | 1 | In big field in back of camp | |
| 19-Jul-17 | 9:15 | Wolf | 1 | km 12 | adult |
| 20-Jul-17 | 8:45 | Bear | 1 | Behind Selkirk Tower | black bear |
| 21-Jul-17 | 2:00 | Porcupine | 1 | by green tents | |
| 21-Jul-17 | 2:30 | Black Bear | 1 | km 7 | |
| 22-Jul-17 | 10:00 | Black Bear | 1 | smoking area beside the rink | |
| 22-Jul-17 | 13:30 | Black Bear | 2 | river landing | healthy and young |
| 22-Jul-17 | 10:00 | Black Bear | 3 | Dumas Corner | mother and two cubs |
| 22-Jul-17 | 10:30 | Black Bear | 1 | near ice rink by camp | single small black bear |
| 24-Jul-17 | 20:30 | Bear | 1 | Trails above camp | Tall thin Black bear (young) |
| 27-Jul-17 | 8:15 | Bear | 1 | Access Road 18.75km | black bear |
| 27-Jul-17 | 15:00 | Frog | 1 | Tailings Pond | Body ~7cm long |
| 28-Jul-17 | 6:30 | Bear | 1 | Dumas shop (behind) | Black Bear |
| 29-Jul-17 | 10:35 | Bear | 3 | Landfill | Sow and 2 cubs (Black Bear) |
| 29-Jul-17 | 11:00 | Bear | 1 | Dumas shop (behind) | Black bear |

| Date | Time | Type of Animal | Number of Animals | Location | Description: Size/Color/Markings and Additional Notes |
|-----------|-------|----------------|-------------------|---|---|
| 1-Aug-17 | 10:30 | Bear | 1 | Corner between Driftwood and Airstrip | Smaller bear, possibly young, sandy coloured body with darker legs (Black Bear) |
| 1-Aug-17 | 16:30 | Bear | 1 | Main Waste Dump Expansion | black bear |
| 1-Aug-17 | 10:50 | Bear | 1 | Airstrip/WMA intersection | Healthy Condition. Cinnamon colour. Medium size |
| 2-Aug-17 | 14:05 | Bear | 1 | W33 | Light body with dark legs (Black Bear) |
| 4-Aug-17 | 8:00 | Bear | 1 | Core Shack | Light body with dark legs (Black Bear) |
| 4-Aug-17 | 16:00 | Bear | 1 | Portal | no description provided |
| 4-Aug-17 | 16:15 | Black Bear | 1 | km 17 | healthy and young |
| 6-Aug-17 | 5:50 | Fox | 2 | OB dump behind Pelly | red foxes |
| 6-Aug-17 | 13:30 | Deer | 1 | WMA | Small adult deer |
| 12-Aug-17 | 18:35 | Black Bear | 2 | Pelly laydown | Sow and cub |
| 13-Aug-17 | 12:00 | Bear | 1 | between 11 & 12 km | Black bear |
| 13-Aug-17 | 13:45 | Deer | 1 | WMA | small adult deer |
| 14-Aug-17 | 24:00 | Deer | 1 | WMA | Doe Deer. Eating not timid but alert |
| 15-Aug-17 | 13:00 | Bear | 1 | Airport | Black bear |
| 19-Aug-17 | 10:30 | Fox | 1 | Main Waste Dump east of Pelly | Friendly Red Fox |
| 21-Aug-17 | 8:00 | Bear | 1 | Dumas Corner | unknown |
| 21-Aug-17 | 6:30 | Fox | 1 | A253 Access road | |
| 22-Aug-17 | 8:00 | Bear | 1 | WMA | black throughout, 250-300lbs (Black Bear) |
| 22-Aug-17 | 17:00 | Bear | 1 | WMA | black throughout, 250-300lbs (Black Bear) |
| 22-Aug-17 | 16:45 | Bear | 2 | WMA | Black bears |
| 23-Aug-17 | 15:00 | Bear | 1 | STP | Black throughout (Black Bear) |
| 23-Aug-17 | 17:25 | Bear | 1 | STP/Camp | Dark brown with a light chest patch (Black Bear) |
| 23-Aug-17 | 19:00 | Bear | 2 | STP/Camp | Dark brown with a light chest patch (Black Bear) |
| 24-Aug-17 | 18:45 | Bear | 1 | behind camp (sherwood) | Large healthy black (Black Bear) |
| 24-Aug-17 | 23:00 | Bear | 1 | behind camp (sherwood), in camp by main parking (gym) | Large healthy black bear |
| 25-Aug-17 | 18:45 | Bear | 2 | behind camp | 2 black bears: 1 black in colour and one brown in colour |
| 25-Aug-17 | 19:45 | Bear | 2 | Behind camp | 2 black bears: 1 black in colour and one brown in colour |
| 25-Aug-17 | 20:30 | Bear | 1 | In camp, by the ice rink | The brown coloured bear in the dynamic duo (black bear) |
| 25-Aug-17 | 22:20 | Bear | 1 | In camp by the bicycle shack | The brown coloured bear in the dynamic duo |
| 25-Aug-17 | 6:45 | Porcupine | 1 | Portal pad | "large for a porcupine" |
| 25-Aug-17 | 13:00 | Black Bear | 1 | Km 1.5 on the hill | large |
| 26-Aug-17 | 0:00 | Bear | 1 | In camp , by the STP road | Not clear which one as it was dark, but most likely one of our pair |
| 26-Aug-17 | 0:25 | Bear | 1 | By the Dumas shop | Black throughout (Black Bear) |
| 26-Aug-17 | 6:45 | Bear | 1 | STP/Selkirk towers | Large healthy black bear |
| 26-Aug-17 | 7:30 | Fox | 1 | Nuway corner where we store the drill | Red in colour, pretty srawny |
| 26-Aug-17 | 9:30 | Bear | 2 | At the underground fuel farm | Black sow, with a brown young cub |
| 26-Aug-17 | 9:00 | Black Bear | 2 | UG fuel tanks | one sow and one cub healthy and brown in colour |
| 27-Aug-17 | 7:00 | Fox | 1 | | |
| 28-Aug-17 | 10:30 | Bear | 1 | Up the hill at KM1.5 | All black |
| 29-Aug-17 | 10:00 | Bear | 1 | At the emergency pullout at KM9.5 | All black |
| 29-Aug-17 | 15:00 | Bear | 1 | Up on the ridge behind camp | All Black |
| 29-Aug-17 | 19:45 | Bear | 1 | At the fuel farm | All black |
| 30-Aug-17 | 8:30 | Bear | 1 | Up on the ridge behind camp-behind the Selkirk Tower Corridor | Small (brown) black bear |
| 1-Sep-17 | 17:00 | Bear | 1 | Km 1.5 on the hill | Black |
| 1-Sep-17 | 15:50 | Bear | 1 | Site Service shop | Black bear |
| 3-Sep-17 | 7:10 | Fox | 1 | airport | healthy |
| 20-Sep-17 | 12:15 | Deers | 2 | On the walkway behind Mine Tech | Light brown, one doe and her offspring |
| 20-Sep-17 | 11:45 | Deer | 2 | Warehouse Laydown | Doe and Calf |
| 21-Sep-17 | 12:40 | Wolf | 1 | between 4 & 5km | Grey with some black, medium size |

| Date | Time | Type of Animal | Number of Animals | Location | Description: Size/Color/Markings and Additional Notes |
|-----------|-------|----------------|-------------------|----------------------------|---|
| 21-Sep-17 | 14:00 | Bear | 1 | Km 3 access road | Black bear |
| 22-Sep-17 | 8:00 | Bear | 1 | between 11 & 12 km | Black bear |
| 23-Sep-17 | 8:00 | Black Bear | 1 | Km 1 | Large black |
| 23-Sep-17 | 16:00 | Fox | 1 | minto north road | |
| 25-Sep-17 | 18:10 | Deer | 5 | A2 ramp | mule |
| 25-Sep-17 | 5:00 | Wolves | 2 | haul road behind dumas | one grey, one black |
| 26-Sep-17 | 9:20 | Deer | 1 | Nuway | small, possibly female |
| 26-Sep-17 | 10:30 | Deer | 1 | nuway | young and skinny |
| 28-Sep-17 | 4:45 | Porcupine | 1 | In front of 840 dump | Porcupine colour |
| 28-Sep-17 | 22:00 | Wolf | 1 | Between Nuway and the Mill | Small, black |
| 6-Oct-17 | 14:30 | Wolf | 1 | KM 9 hill | Healthy |
| 15-Oct-17 | 6:30 | Wolf | 1 | Road to the green tents | Grey. Ran into the bush by the vent raise road |
| 18-Oct-17 | 18:30 | Fox | 1 | West wall above A2S3 | moved away when the vehicle approached and parked in the area |
| 22-Oct-17 | 12:15 | Black Bear | 1 | Camp | Adult in healthy condition |
| 22-Oct-17 | 12:20 | Fox | 1 | Site Service shop | red fox |
| 13-Nov-17 | 16:00 | Fox | 1 | A2S4/MVF22 Intersection | Running back and forth across the road |
| 23-Nov-17 | 14:00 | Coyote | 1 | KM 10 | running along road |
| 14-Dec-17 | 13:15 | Rabbit | 1 | Road to the mags | Carcass |
| 31-Dec-17 | 14:15 | Wolf | 1 | Fresh Tracks by W33 | |
| 31-Dec-17 | 7:50 | Fox | 1 | Capstone East entrance | Red |

Appendix Q – 2017 Update Minto Mine Constructed Wetland Treatment Research Program



Contango
STRATEGIES LTD.

Forward looking. Lateral thinking.

Minto Mine Constructed Wetland Treatment Research Program – Demonstration-Scale 2017

Document # 011_1117_10C



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Date: November 2017

Executive Summary

The Minto Mine is an open pit and subsurface copper mine located 240 km northwest of Whitehorse in the Yukon Territory. As a result of mining activities, cadmium, copper, molybdenum, selenium, and zinc are slightly elevated beyond background concentrations and have been identified as constituents of concern in the Reclamation and Closure Plan for the Minto Mine. As part of the Reclamation and Closure Plan, a constructed wetland treatment system (CWTS) was designed by Contango with the objective of attaining suitable passive treatment of water quality at mine closure.

A phased approach is being followed to guide the site-specific design and implementation of a constructed wetland treatment system at closure. The phased approach for Minto Mine was initiated with a site assessment in 2013 that identified plants suitable for a CWTS as well as natural treatment processes that were already occurring on-site. Following the site assessment, pilot-scale testing was undertaken to confirm and provide proof-of-concept before constructing the on-site demonstration-scale wetland.

The demonstration-scale constructed wetland treatment system was constructed at Minto in 2014 and commissioned from 2015 through mid-2017 during which time the system matured and operational adjustments were made. Commissioning successfully established plant and microbial populations and achieved conditions conducive for treatment of constituents of concern. The demonstration-scale CWTS operational period ran for a month from mid-August to mid-September 2017. Various aspects of the system were measured in 2017 and are detailed in this report including operating conditions, water treatment performance, fate and distribution of treated metals, evapotranspiration, detritus decomposition rates, microbial community characterization (catalyzing treatment reactions), and pest control.

Throughout the operational period, the demonstration-scale CWTS successfully achieved an average decrease in concentrations of 0.0169 µg/L for cadmium (from 0.0261 µg/L to 0.0092 µg/L), 31.8 µg/L for copper (from 49.1 µg/L to 17.3 µg/L), 3.6 µg/L for molybdenum (from 6.3 µg/L to 2.7 µg/L), 3.5 µg/L for selenium (from 4.0 µg/L to 0.5 µg/L), and 47.3 µg/L for zinc (from 49.2 µg/L to 1.9 µg/L). Leaching of copper and other constituents from the mineralized soils used in the construction decreased by the end of 2017 with constituents showing a shift into stable reduced mineral forms in the soil (as the CWTS was designed to do for constituents from the water, but also has now done for the elements in the soil). Additional positive results were also documented; plant uptake of constituents remained minimal throughout operation and high abundance of beneficial sulphide-producing bacteria for treatment of Cu, Cd, Zn, as well as nitrate- and selenium-treating bacteria associated with plant roots.

The operational period of the demonstration CWTS confirmed that the predicted water quality for the Minto Mine at closure is amenable to treatment by these methods. Results from ongoing monitoring of the system in future years will be used to optimize performance and inform the designs for the full-scale constructed wetland treatment system.

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Abbreviations and definitions

Acid volatile sulphides (AVS) – Sulphide complexed with Fe (FeS) where the sulphide can preferentially exchange Fe for heavy metals (e.g., Ni, Zn, Cd, Pb, Cu, Hg) which are then more stably bound.

Amendment – A chemical or organic material added to encourage specific conditions (e.g., aerobic/anaerobic, pH, ORP) or as a source of something that is needed for passive treatment (e.g., nutrients, alkalinity, binding sites, etc).

Carbon source – A source of carbon (energy/electrons) for microbes (see **electron donors**). Examples include ethanol, methanol, acetate, sugar (glucose), molasses, wood chips, detritus (dead plant matter).

Carex aquatilis – A plant (emergent macrophyte) commonly known as water sedge.

Contango – Contango Strategies Ltd.

Constructed wetland treatment system (CWTS) – Wetlands that are designed and constructed to remove compounds from water, using natural processes to sequester them into the soils rendering them less bioavailable. They are different from wetlands that provide habitat for wildlife.

Constituent of Concern (COC) – Specific elements that have been identified for evaluation, including cadmium, copper, molybdenum, selenium, and zinc.

Denitrification – Where nitrate (NO_3^-) is reduced by microorganisms to form nitrite (NO_2^-), nitric oxide (NO), or nitrous oxide (N_2O), or nitrogen gas (N_2) (see **nitrate reduction**).

Dissolved oxygen (DO) – Diatomic oxygen (O_2) dissolved in water; oxygen can dissolve in water by diffusion from surrounding air, as a product of photosynthesis, or through forced aeration.

Electron donor(s) – A chemical compound that donates electrons to another compound (see **carbon source**). An electron donor is a reducing agent, which that by virtue of it donating electrons, is itself oxidized (see **oxidation and reduction**).

Explanatory parameters – Quantifiable parameters that indicate the type of water treatment reactions that are likely to take place (i.e., dissolved oxygen, pH, soil redox).

Evapotranspiration – The combined effects of open water evaporation and plant transpiration (Beebe *et al*, 2014).

Genetic analysis – Analysis to assess the presence, identity, and diversity of different microbes in a sample.

ICP-MS – Inductively coupled plasma mass spectrometry.

Macrophytes – An aquatic plant, large enough to be seen by eye. Can be emergent, submergent, or floating.

Microbes – Microscopic organisms that can be uni- or multi-cellular. This includes algae, bacteria, fungi, viruses, and yeast.

Most probable number (MPN) – A statistical value representing the viable population of microbes in a sample through use of dilution and multiple inoculations.

Oxidation – The loss of electrons, or increase in valence state, by a molecule, atom, or ion. Can be driven by microbes. Process is complementary to chemical reduction.

Oxidation-reduction potential (ORP) – A measure of the tendency of a chemical species to acquire or donate electrons, thus becoming reduced or oxidized, respectively, measured in millivolts.

Passive or semi-passive treatment system(s) (PTS) – General term used to refer to both passive and semi-passive treatment systems that use processes coupling transformations (e.g., chemical and biogeochemical reactions) with physical transfers (e.g., sorption, filtration) to remove constituents from water, often operationally passive with little long-term management required.

Redox – Oxidation-reduction potential (in sediment), a measure of the tendency of a chemical species acquire or donate electrons, thus becoming reduced or oxidized, measured in millivolts. This measurement is relative to the water ORP.

Reduction – The gain of electrons, or a decrease in valence state, by a molecule, atom, or ion. Can be catalyzed by microbes. Process is complementary to chemical oxidation.

Simultaneously extracted metals (SEM) – Amounts of heavy metals such as Ni, Zn, Cd, Pb, Cu, Hg in sediment, assessed in the context of AVS for excess sulphide. (also see **acid volatile sulphide**)

Sorption – The physical and/or chemical process by which one substance becomes attached to another substance.

Specific conductivity (SPC) – A measurement of electrical conductivity in water that is typically expressed in $\mu\text{s}/\text{cm}$, which has been adjusted for temperature (25°C).

Species (sp.) – One of the basic units of biological classification and a taxonomic rank. Rank in the classification of organisms below genus and above strain. Also can be used to refer to the oxidation state of a mineral (e.g., selenate and selenite are species of selenium).

SPLP – Synthetic precipitation leachate procedure.

Sulphide – An inorganic anion of sulphur that can form stable complexes with metals and make them insoluble in water (remove them from the water).

Sulphide producing bacteria (SPB) – Microbial reduction of sulphur compounds, such as sulphate, sulphite, thiosulphate, and sulphur, which produces sulphides and alkalinity. (see also **SRB**).

Sulphate reducing bacteria (SRB) – A form of sulphide producing bacteria that specifically uses sulphate for reduction (see **sulphide producing bacteria**).

Sulphide production – Microbial reduction of sulphur compounds, such as sulphate, sulphite, thiosulphate, and sulphur, which produces sulphides and alkalinity.

Thermodynamic minimum – The minimum concentration of a contaminant of concern that is consistently achievable.

Total dissolved solids (TDS) – A measure of the combined organic and inorganic salts dissolved in water.

Total organic carbon (TOC) – A measurement of the total organic carbons present in water.

Transfer – Processes that treat water by transferring a constituent to another location without changing its form. For example: absorption, adsorption, dilution, dispersion, filtration, precipitation (aqueous to solid), and volatilization.

Transform – Processes that change the chemical form or state of a constituent. For example: biodegradation, biotransformation, hydrolysis, ionization, oxidation, photolysis, and reduction.

1. Introduction

The Minto Mine, owned and operated by Capstone Mining Corp., is located 240 km northwest of Whitehorse on the west side of the Yukon River. The Minto property lies within the eastern part of the Dawson Range, with elevations from 700 to 1,000 m above mean sea level. The landscape has rounded mountains intersected by broad valleys and drainages that are part of the Yukon River watershed.

The Minto Mine has been in commercial operation since October 2007 and the deposits being mined are copper sulphide mineralized zones. Surface and groundwater water quality is a key consideration in the evaluation of potential effects of mining and mineral development projects and changes to water quality parameters have the potential to affect aquatic and human use of water resources. A Reclamation and Closure Plan (RCP) is required under both the Water License and the Quartz Mining License. The RCP is intended to address the long-term physical and chemical stability of the site and closure of the proposed features and disturbances associated with the mine. As a part of the RCP, a Constructed Wetland Treatment System (CWTS) is being designed, evaluated, and optimized for water treatment at closure through a phased program approved during the Minto Phase V/VI Expansion Project (Yukon Online Registry Project Number 2013-0100). Constituents of concern that are being evaluated through the CWTS program include cadmium, copper, molybdenum, selenium, and zinc.

1.1. Purpose and Objectives

The primary objective for operation of the demonstration-scale CWTS in 2017 was to complete commissioning and progress into operational performance. Once operational performance is achieved, the removal rate coefficients (RRC; k) can be assessed to evaluate and refine full-scale designs. To achieve the operational performance, it was recognized that the remaining copper in the soils used in construction needed to be converted into metal-sulphide form; therefore, this was addressed in the early months of 2017 and paired with evapotranspiration trials to make best use of this time.

In 2017, the monitoring program shifted focus from commissioning to testing of operational performance. Activities carried out in 2017 to achieve these objectives were:

- Monitor explanatory parameters and performance to determine when commissioning is complete and the operational period has begun;
- Assess removal of constituents from the water;
- Determine the hydraulic retention time (HRT) by tracer trial and associated correction factor to apply to the nominal (calculated) HRT;
- Evaluate CWTS performance, and determine achievable concentrations of contaminants of concern (thermodynamic minimums);
- Update site-specific removal rate coefficients (from commissioning period) with data from operational period;
- Determine amount of water loss due to evapotranspiration and effect on outflow concentrations;
- Monitor metals leaching from mineralized soils used in construction;

- Assess stability of constituents of concern in soils;
- Determine the rate and extent of detritus decomposition (*C. aquatilis* leaves) in the CWTS over time;
- Assess treatment mechanisms (including microbes); and
- Determine an appropriate method for insect pest control (aphids) in the CWTS.

1.2. Overall CWTS Project Approach

For a CWTS to be effective, it must be designed, piloted (tested), optimized, implemented, and maintained in a site-specific manner. A phased approach allows for improvements and optimization at each step. The phases used at the Minto Mine include:

- 1) site assessment and information gathering;
- 2) technology selection and conceptual design;
- 3) pilot-scale testing and optimization (controlled environment, off-site);
- 4) demonstration-scale confirmation and optimization (on-site); and
- 5) full-scale implementation.

Phases 1 to 3 are complete at Minto. This work is summarized in the Research Program, Pilot Plant and Demonstration reports completed by Contango (2014a and 2014b). Phase 4 of the project is underway, with the on-site demonstration CWTS constructed at the Minto Mine during fall 2014 (Contango, 2015). Commissioning of the CWTS occurred from 2015-2017 with operations beginning in late 2017. Performance results of the demonstration CWTS indicate that the CWTS is maturing as expected (Contango, 2015; 2016; 2017). This document reports on the 2017 on site demonstration-scale CWTS data, with focus on results from the operational period from August 18 – September 22, 2017.

2. Demonstration-Scale Constructed Wetland Treatment System Design

2.1. CWTS Layout and Dimensions

The demonstration-scale CWTS is located on the northeast side of the mine site, perched on the MVFE area as shown in Figure 1.

Construction of the demonstration-scale CWTS was completed in 2014 and includes two series in parallel with two cells in each series and a final catchment basin (Figure 1). Water flows from the feed tank through the A cells, through the B cells and into the final combined catchment basin. Water from the catchment basin of the demonstration-scale CWTS is not discharged off-site, rather it is collected in a sump at the toe of the Mill Valley Fill Extension (MVFE). Series 1 and series 2 flow independently of each other and are intended as replicates for analytical testing and operation confirmation. Additional details can be found in the Minto Demonstration-Scale Report (Contango, 2015) and Appendix A of this report.



Figure 1 – Picture of demonstration-scale CWTS at Minto Mine.
Demonstration-scale CWTS location in relation to its surroundings. To the far right is the mine camp while below is the tree line. This photo was taken on September 24, 2017.

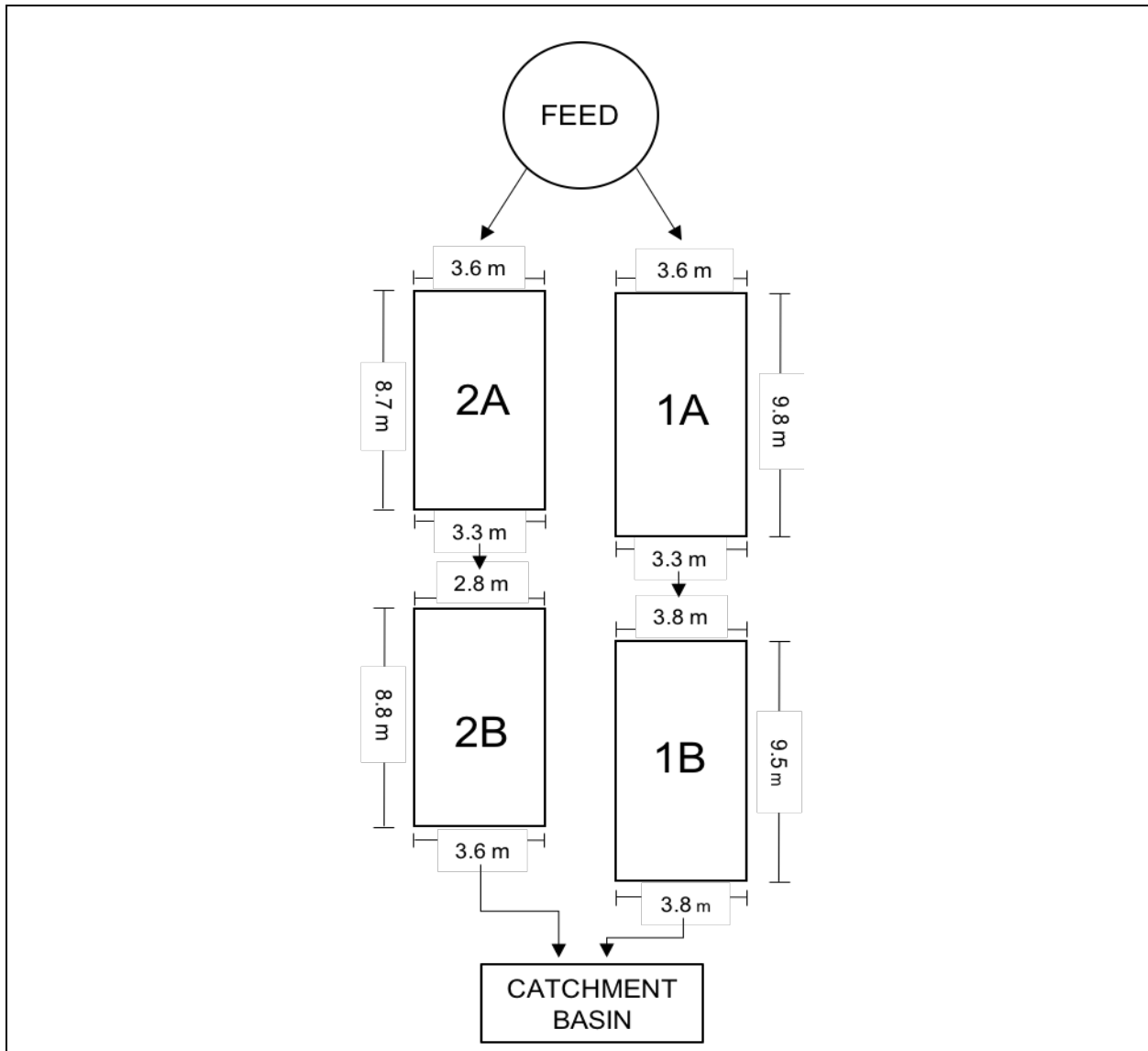


Figure 2 – Diagram of demonstration-scale CWTS.

Dimension measurements are indicated at soil surface. Water flows are indicated with black arrows. Water flows from the feed tank into the A cells, into the B cells then into the final catchment basin. Series 1 and series 2 flow independently of each other, and serve as replicates.

2.2. Soils

Soils used to construct the CWTS are described in Appendix A of this report and in the initial report that outlines construction (Contango, 2015). In brief, the recommended soil for the CWTS was sand, with 2-7% by volume organic material (e.g., woodchips, peat). The material used in the construction of the demonstration-scale CWTS was an organic peat, and analyses received after construction indicated an elevated concentration of leachable copper (Appendix A, Table A2). This leachable copper has affected the CWTS performance results. Therefore, this has been a focus of efforts through the commissioning period to transition these leachable copper minerals into stable sulphide minerals which will not leach from the CWTS.

2.3. Vegetation

The demonstration-scale CWTS was planted with *Carex aquatilis* (aquatic sedge) and aquatic mosses (bryophytes) from the W10 area of the Minto Site. The plant selection and borrow source were identified during the site assessment in 2014 (Contango, 2014a) and pilot-scale testing (Contango, 2014b).

2.4. Water Source

The water source for the demonstration-scale CWTS is seepage from the toe of the Mill Valley Fill Extension (MVFE) and was selected for the demonstration-scale CWTS as the seepage is similar to that expected upon closure in the MVFE area. Zinc concentrations were elevated in the water being used in the CWTS in 2016, and it was uncertain if this was due to a culvert used for water collection in the area or seasonal variation. However, zinc concentrations remained elevated in 2017, suggesting that the culvert is contributing to elevated zinc concentrations. Further details can be found in Appendix A and Contango's 2016 update report (Contango, 2017).

3. Commissioning and Operations

The period between the construction of the CWTS and achieving the expected treatment performance is referred to as the commissioning period. During this period, several criteria are monitored to determine when the commissioning period has been successfully completed. Criteria that were achieved that indicated the end of the commissioning period and the beginning of the operational period for the Minto Mine demonstration-scale CWTS include the following and are further discussed in the sections listed:

- Plant establishment and maturation such that the plants have grown in to densities visually similar to natural wetlands in the area, but in monoculture (Section 3.2),
- Establishment of reducing conditions within the CWTS (i.e., average soil redox was below -100 mV consistently in 2017; Section 5.1),
- No increase in aqueous copper concentrations through the CWTS (due to copper containing soils used in construction; Sections 5.2.1 and 5.6), and
- Microbial population establishment and maturation to levels similar or better to pilot-scale (Section 5.9).

Once the above criteria were met, the CWTS was deemed to be in the operational period. The same criteria, other than the copper leaching, could be used for the full-scale CWTS. The on-site demonstration-scale CWTS was commissioned from 2015 to 2017, comprising of 135 days in 2015, 150 days in 2016 and 82 days in 2017 (Table 1). The CWTS then proceeded to the operational period and operated for 35 days in 2017 (Table 1).

Table 1 – Days of operation of demonstration-scale CWTS.

| Scale | Year | Period (days) | Date | |
|------------------------------|-------------------|---------------|--------|---------|
| | | | Start | End |
| Commissioning-A ² | 2014 ¹ | 23 | Aug 27 | Sept 19 |
| | 2015 | 135 | May 16 | Sept 29 |
| | 2016 | 87 | May 2 | Jul 28 |
| Commissioning-B ³ | 2016 | 63 | Jul 29 | Sept 30 |
| | 2017 | 82 | May 27 | Aug 17 |
| Operational Period | 2017 | 35 | Aug 18 | Sept 22 |

¹ The CWTS was constructed in 2014, but no water testing occurred during this first month of commissioning-A.
² The end of the commissioning-A period and the beginning of the commissioning-B period was marked by the addition of organics on July 28, 2016.
³ The end of the commissioning-B period and the beginning of the operational period was marked by stabilization of flow rates and resolution of feed water delivery complications.

For the demonstration-scale CWTS the commissioning period was divided into two periods, commissioning-A, and commissioning-B. The end of the commissioning-A period and the beginning of the commissioning-B period was marked by the addition of organics on July 28, 2016. These organics (straw and wood chips) were added to further aid the copper in the soils to transition into sulphide mineral forms, and represents an amount of organic material similar to what would be produced by the CWTS once fully established with *Carex aquatilis*.

The end of the commissioning-B period was expected to be between July 16 and August 2, 2017. However, due to issues with feed-water pumps and flow meters, the end of the commissioning-B period was extended to August 17, 2017 and was marked by stabilization of flow rates and resolution of feed water delivery complications. Additionally, sandbags were added at the end of each cell on August 11, 2017 to increase the water depth and further promote reducing conditions. Therefore, the operational period began on August 18, 2017 and ran until September 22, 2017. Flow was turned off to prepare for winter freeze-up on September 30, 2017, and the last sampling date used was September 22, 2017. Discussions in this document are focused on the operational period and further details on commissioning in 2015 and 2016 can be found in Contango's past reports (2015 and 2016).

3.1. Flow Rates

The targeted flow rates were varied during commissioning of the demonstration-scale CWTS to target desirable conditions for establishment of the CWTS. Since the cells in series 2 are smaller than cells in series 1, a faster flow rate is used for series 2 to obtain an equal HRT to series 1.

In 2017, a long HRT was selected to aid in generating reducing conditions in the CWTS and, therefore, flow rates were set to as slow as they could operate. The nominal HRT was targeted to be 5 days. The operational ranges of the flow meters used in the CWTS were 0.3 to 3 gallons per minute (GPM). To obtain this long HRT, the targeted flow rates used during the commissioning and operational periods of the CWTS in 2017 were 0.37 and 0.31 GPM for series 1 and series 2, respectively. Due to pump and flow meter issues, the actual flow rates varied from the target flow rates throughout 2017 commissioning and operational periods. Table 2 summarizes known pump and flow meter issues that occurred in 2017. The average flow rate for the 2017 operational period was a calculated flow rate of 0.38 GPM and 0.29 GPM for series 1 and series 2, respectively. Additional information on flow rates and associated HRT calculations are provided in Appendix A.

3.2. Health and Establishment of CWTS Vegetation

3.2.1. *Carex aquatilis*

During the commissioning period, plants establish and mature, with density expected to increase over time. From planting in 2014 to the last site visit in 2017 *C. aquatilis* thrived in the CWTS creating a dense emergent macrophyte monoculture, supplemented with aquatic mosses (Figure 3). This suggests that *C. aquatilis* are very robust and reaffirms that they are a good candidate for use in the full-scale CWTS at Minto. In July 2017, an aphid infestation occurred in the CWTS which affected the *C. aquatilis*. The biomass above water appeared to partially die off, however the plants continued to send out new shoots suggesting the *C. aquatilis* were resilient to the infestation. Further discussion about the aphids and the control measures in 2017 is presented in Section 6.

3.2.2. Moss

Aquatic mosses have continued to mature and expand in size from 2014 through 2017. The mature mosses are beginning to show characteristics of the desired coupled transfer (sorption, filtration) and transformation (mineralization, reduction) processes. The top of the moss is growing and producing new green biomass that provides transfer sites, and the older, bottom of the moss is turning black and beginning to decompose which creates sulphide reducing zones that allow for transformation (Figure 4 and Figure 5).

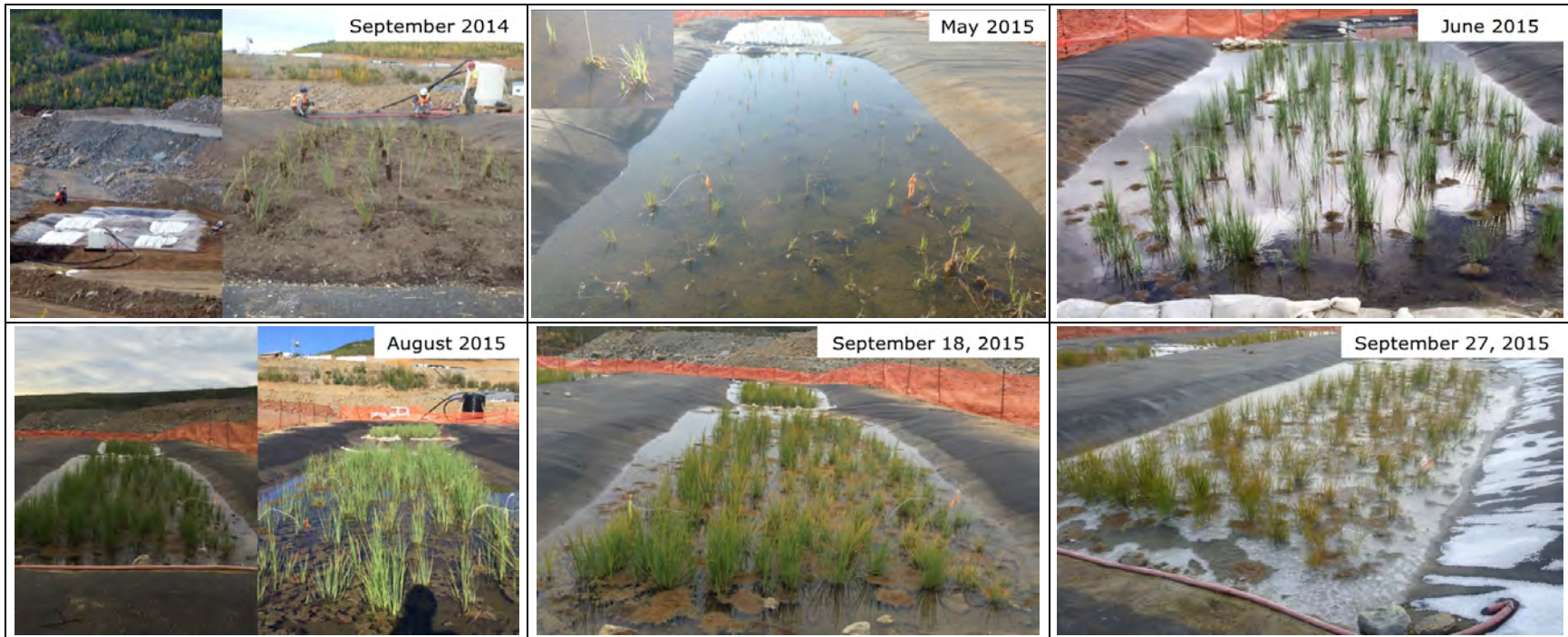


Figure 3 – Maturation of the CWTS from construction through operations.
2015 pictures show cell 2A.

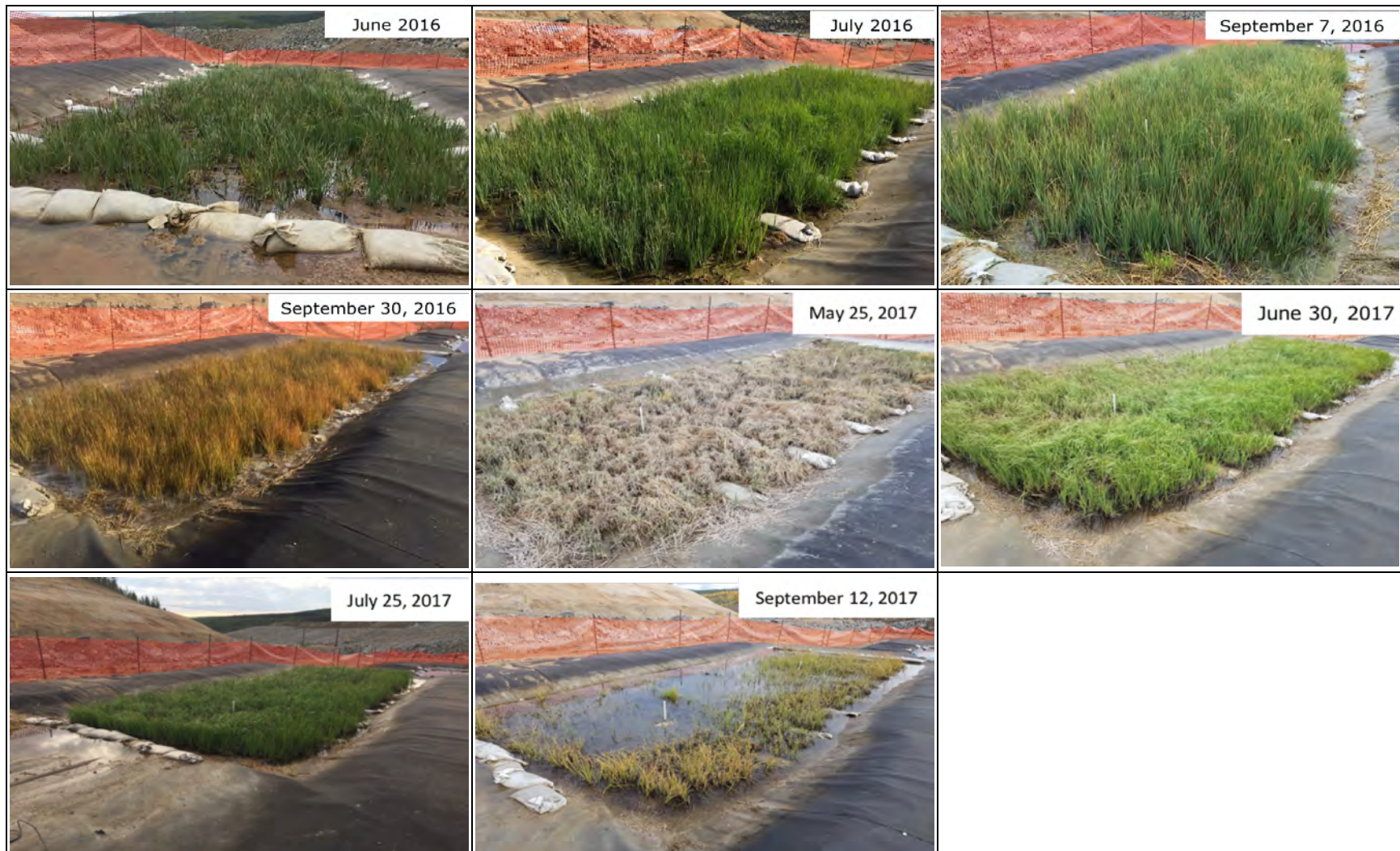


Figure 3 continued – Maturation of the CWTS from construction through operations.
 2016 and 2017 pictures show cell 1B. September 12, 2017 shows increased yellowing and die off in cell 1B due to aphid infestation.

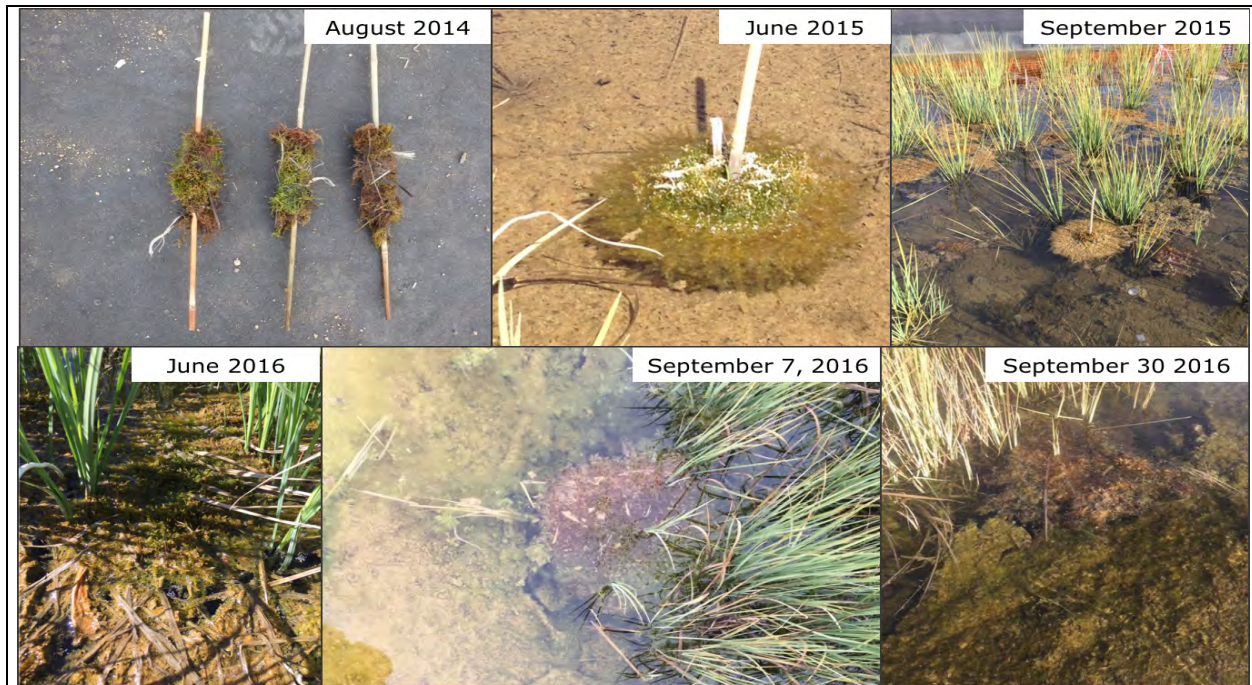


Figure 4 – Moss maturation in CWTS through 2016.



Figure 5 – Moss top and bottom view in June 2016 and September 2017.

4. Timeline and Sampling Schedule

Major events and operational adjustments or amendments for 2017 are listed in Table 2. Details for events up to 2017 can be found in the Minto Demonstration-scale 2016 Update Report (Contango, 2017). The actual dates as well as effective days of operation are provided, which adjusts for time that the CWTS was not receiving water when it was frozen. The effective days of operation allows for comparison to expected timelines from the pilot-scale testing, and for planning and scheduling to be done for full-scale construction and commissioning. The sampling schedule for 2017 was conceptually developed prior to beginning construction of the demonstration-scale CWTS (Appendix A). Actual dates of sampling were adjusted for timing of spring thaw and winter freeze-up, and the associated ability to have the pumps operating at the W62 sump to supply water to the demonstration-scale CWTS.

Table 2 – Events and sampling activities since construction.

| Event | Key Activity | Flow Rate Setting m ³ /day (gal/min) | | Dates | Effective Days of Operation |
|--|---|---|---------------|--|-----------------------------|
| | | CWTS Series 1 | CWTS Series 2 | | |
| CWTS constructed and planted | First sampling, water started. | * | * | August 27 – 31, 2014 | 0-4 |
| Freeze up for winter | Feed water pumps turned off. | * | * | September 19, 2014 | 23 |
| Winter 2014/2015 | | | | | |
| Commissioning-A ² | | | | May 16 – September 29, 2015 | 136 |
| Winter 2015/2016 | | | | | |
| Commissioning-A ² | | | | May 2 – July 27, 2016 | 86 |
| Commissioning-B ² | | | | July 28 – September 30, 2016 | 64 |
| Winter 2016/2017 | | | | | |
| Flow started | Flow started. | 2.18 (0.40) | 1.85 (0.34) | May 27, 2017 | 312 |
| Evaporation Study | Flow stopped. | - | - | June 8, 2017 | 324 |
| End of Evaporation Study | Flow re-started. | 4.80 (0.88) | 4.58 (0.84) | June 15, 2017 | 331 |
| Flush CWTS | Flow increased. | 5.07 (0.93) | 4.20 (0.77) | June 15 – 19, 2017 | 331-335 |
| Contango Site Visit #7 (Spring Sampling) | Microbiology, soils, and water tested. | 2.07 (0.38) | 1.42 (0.26) | June 20-22, 2017 | 336-338 |
| | Detritus decomposition trial started. | | | June 21, 2017 | 337 |
| Saline Tracer Study | Salt added to cells for tracer study. | 1.74 (0.32) | 0.55 (0.10) | June 21 – July 2, 2017 | 337-348 |
| Flow interruptions | Flow rates increased causing feed tank to collapse, and flow stoppage. | * | * | July 16, 2017 | 362 |
| Contango Site Visit #8 (Summer Sampling) | Microbiology and soils tested. Detritus bags collected. ³ | * | * | July 25 – 26, 2017 | 371-372 |
| Flow interruptions | Pump issues. Repairs required and new totalizer installed on CWTS 1. | * | * | July 25 - August 16, 2017 ¹ | 371-393 |
| Sprayed for aphids | Insecticide applied 7 times to CWTS. | N/A | N/A | July 25 – September 13, 2017 | 371-421 |
| Water level raised | Sand bags were added to the ends of each cell. | * | * | August 11, 2017 | 388 |
| Beginning of operational period | | | | | |
| Summer Water Sampling | Not completed during Contango Site Visit #8 due to flow interruptions. | 2.40 (0.44) | 1.64 (0.30) | August 18, 2017 | 395 |
| Fall Sampling | Completed by Minto. Microbiology, soils, water, and plants tested. Detritus bags collected. | 2.02 (0.37) | 1.42 (0.26) | September 11, 2017 | 419 |
| Freeze up for winter | Flow stopped. | - | - | September 30, 2017 | 438 |

* This indicates no flow rate was given, flow rate was unmeasurable or variable; however, cells remained flooded throughout.
¹ Resolution of the flow interruptions marked the end of commissioning-B and the beginning of the operational period.
² Detailed information for Commissioning-A and Commissioning-B in 2015 and 2016 can be found in the Minto Demonstration-Scale 2016 Update Report (Contango, 2017).
³ Due to flow interruptions during the Contango site visit, the summer seasonal water sampling occurred on August 18, 2017 when flows had re-started.

5. Performance

5.1. Monitoring Explanatory Parameters

The following are key findings regarding explanatory parameters, which are detailed further below:

- Dissolved oxygen (DO) decreased from an average of 8.4 mg/L during commissioning-B in 2016, to an average of 5.3 mg/L during operations in 2017. This elevated DO in the water column is likely the result of photosynthesis of algae and mosses. Despite this DO level in the water column being in oxidizing ranges, stable reducing conditions were achieved in CWTS soils within the targeted soil redox range (-100 to -250 mV).

Average water temperature of the demonstration-scale CWTS in 2017 were similar to those in 2015 (12.9°C) and 2016 (10.2°C). The average water temperature during the operational period in 2017 was 9.7°C, ranging from 5.3°C to 14.9°C. As expected, conductivity did not change from previous years and pH remained circumneutral.

DO concentrations in the CWTS cells were on average 5.3 mg/L, which is lower than commissioning-A and slightly higher than commissioning-B (Table 3). Reducing conditions are needed for nitrate and selenium treatment processes, and for creating metal sulphides that remove copper and cadmium from the water. Water oxidation-reduction potential (ORP) also decreased compared to 2016 by 73 mV, which is also indicative of reducing conditions in the CWTS.

Table 3 – Average in situ measurements from the pilot scale and demonstration-scale CWTS.

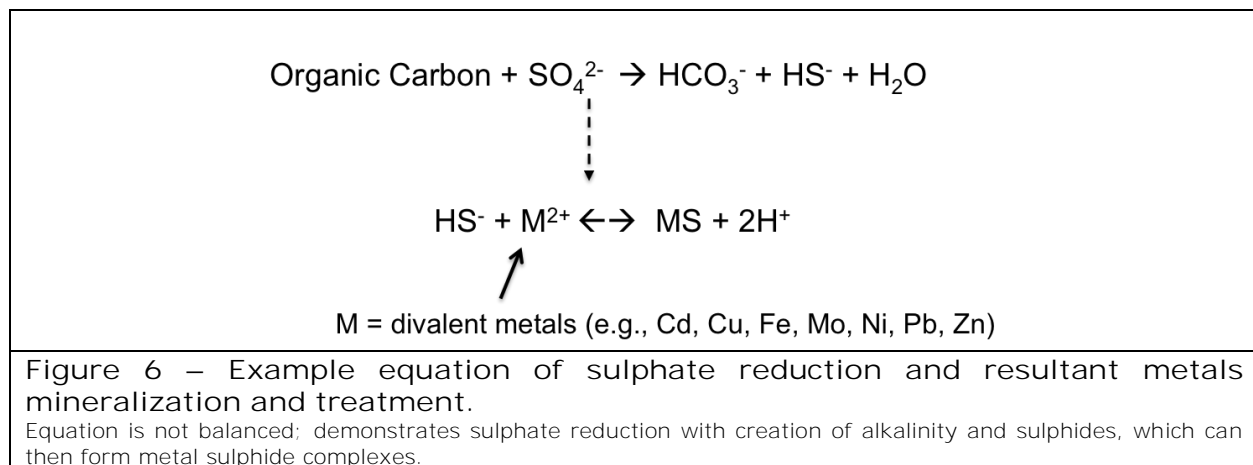
| Testing Period | | DO (mg/L) | Conductivity (µS/cm) | pH | ORP (mV) | Soil redox (mV) |
|--------------------------|---------------------------------|-----------|----------------------|------|----------|-----------------|
| Demonstration-scale 2015 | | 10.0 | 817.9 | 8.11 | 147.9 | -52 |
| Demonstration-scale 2016 | Commissioning-A ¹ | 15.9 | 890.9 | 7.79 | 143.7 | -85 |
| | Commissioning-B ² | 8.4 | 1020 | 7.59 | 157.6 | -89 |
| Demonstration-scale 2017 | Commissioning-B ³ | 4.3 | 795.9 | 7.43 | 18.7 | -162 |
| | Operational period ⁴ | 5.3 | 879.7 | 7.36 | 124.9 | -152 |

¹ Data for commissioning-A period is from May 2-July 28, 2016.
² Data for commissioning-B period is from July 29-September 30, 2016.
³ Data for commissioning-B period is from May 27-August 17, 2017.
⁴ Data for operational period is from August 18-September 22, 2017.

A key explanatory parameter used to monitor maturation of the CWTS during the commissioning period is the soil redox potential, which is measured using platinum tip probes (in soil) and Calomel electrodes (in water). This measurement offers insight into the direction of electron flux between the sediment/soil/pore water and overlying water column (Faulkner et al., 1989; Huddleston & Rodgers, 2008), and can be used to confirm reducing conditions

in the soil. Based on the information gathered in pilot-scale testing, the targeted soil redox for the demonstration-scale CWTS is between -100 and -250 mV. In these redox ranges, bacterial sulphide-production through reduction of sulphur compounds (e.g., sulphate) is expected. Sulphide production directly results in metals and metalloid treatment for constituents such as cadmium, copper, molybdenum, nickel, lead, and zinc by precipitation as metal sulphides (Figure 6).

This maturation period is necessary for sufficient quantities of microbes to populate the CWTS and become active in decomposing organic material. It is the electrons produced by the decomposition of organic material that is reported by the soil redox measurements. The decomposition of organic material then feeds the sulphate-reducing bacteria the type of energy they need to produce the sulphides that remove the copper, cadmium, molybdenum, and zinc from the water. The microbial activity of the CWTS is discussed further in Section 5.3.2.



As expected from the pilot-scale testing, the soil redox in all the demonstration-scale CWTS cells has decreased and stabilized over time, indicating maturation of the CWTS (Figure 7). At the end of 2016, the demonstration-scale CWTS had begun achieving soil redox values that are conducive to sulphide production due to the decomposition of the organics that were added on July 28, 2016 (Contango, 2017). By the end of 2017, soil redox values had decreased to within the targeted range, even without additional organics added to the CWTS. It is therefore evident that the commissioning period was successful and the CWTS has matured and become self-sufficient in producing organic matter to provide electrons to generate reducing conditions upon decomposition. Soil redox will continue to be monitored throughout operation in 2018.

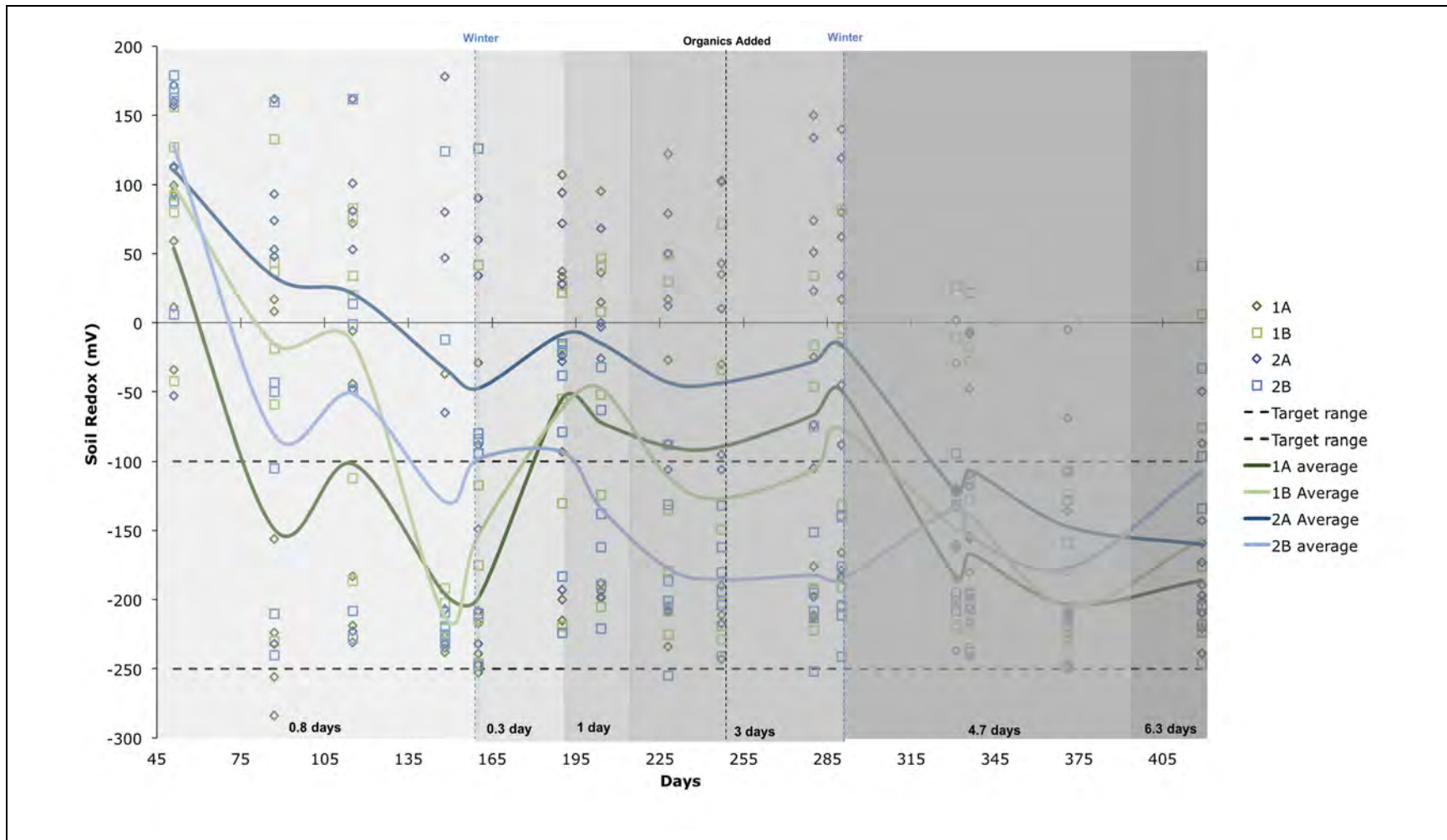


Figure 7 – Soil redox potential of each CWTS cell over time.

All demonstration-scale CWTS soil redox measurements are plotted. Targeted soil redox values based on pilot-scale testing are indicated with dotted lines. The blue dotted line indicates break in measurements for winter 2015 and 2016. Days and associated grey shading in 2015 and 2016 indicate the nominal HRT. Days and associated grey shading in 2017 indicate the actual HRT (average of series 1 and 2) using recorded water depths and flow rates during those time periods.

5.2. Water

The following are key findings regarding constituents in the water, which are detailed further below:

- Copper treatment in the CWTS was masked by leaching from the soils used in construction of the CWTS into the water, but this has mostly been remedied now by the wetland treating this copper and turning it into more stable sulphide forms in the soil.
- During the operational period the demonstration-scale CWTS successfully achieved an average decrease in concentrations of 0.0169 µg/L for cadmium (from 0.0261 µg/L to 0.0092 µg/L), 31.8 µg/L for copper (from 49.1 µg/L to 17.3 µg/L), 3.6 µg/L for molybdenum (from 6.3 µg/L to 2.7 µg/L), 3.5 µg/L for selenium (from 4.0 µg/L to 0.5 µg/L), and 47.3 µg/L for zinc (from 49.2 µg/L to 1.9 µg/L).
- Molybdenum and selenium treatment in the operational period is notable as the removal rates were negligible within the margins of error of the testing method in the commissioning-A period.

5.2.1. Metal Leaching from Soils into Overlaying Water

Although treatment improved through commissioning as the CWTS matured, copper and aluminum leaching from the soils into the overlaying water, masking the effects of treatment (Contango, 2017). Therefore, additional sampling was performed through the CWTS to identify these fluctuations. Details of the sampling methods can be found in Appendix A of this document and Figure A4 in Appendix A shows the sampling locations in series 2 of the demonstration-scale CWTS. Graphs showing concentrations of copper and selenium throughout the CWTS are presented below (Figure 8 and Figure 9, respectively) while graphs for the remaining constituents can be found in Appendix B (Figures B1 to B4).

Since the beginning of operations of the demonstration-scale CWTS, significant concentrations of copper have been leaching from the CWTS soils used in construction (Contango, 2016 and 2017; Section 5.6). Moreover, aluminum (which could not be accounted for by the influent water chemistry) was elevated in the CWTS. Because of metals leaching from the soils, the treatment occurring within the CWTS was far greater than what was being observed by simply measuring the inflow and outflow points (Contango, 2017). These soils first needed to be treated, before significant treatment could occur for the influent waters.

In early 2017 (June 20, 2017 sampling date), copper was still leaching from the soils into the water (Figure 8). However, at later sampling dates in 2017 copper was no longer leaching at a rate that the treatment wetland could not keep up with for treatment. Copper concentrations decreased by the end of the A cells and stabilized through B cells, indicating that treatment of copper is occurring and that copper leaching from the soils has subsided. Leaching of constituents from the soils is further described in Section 5.6.

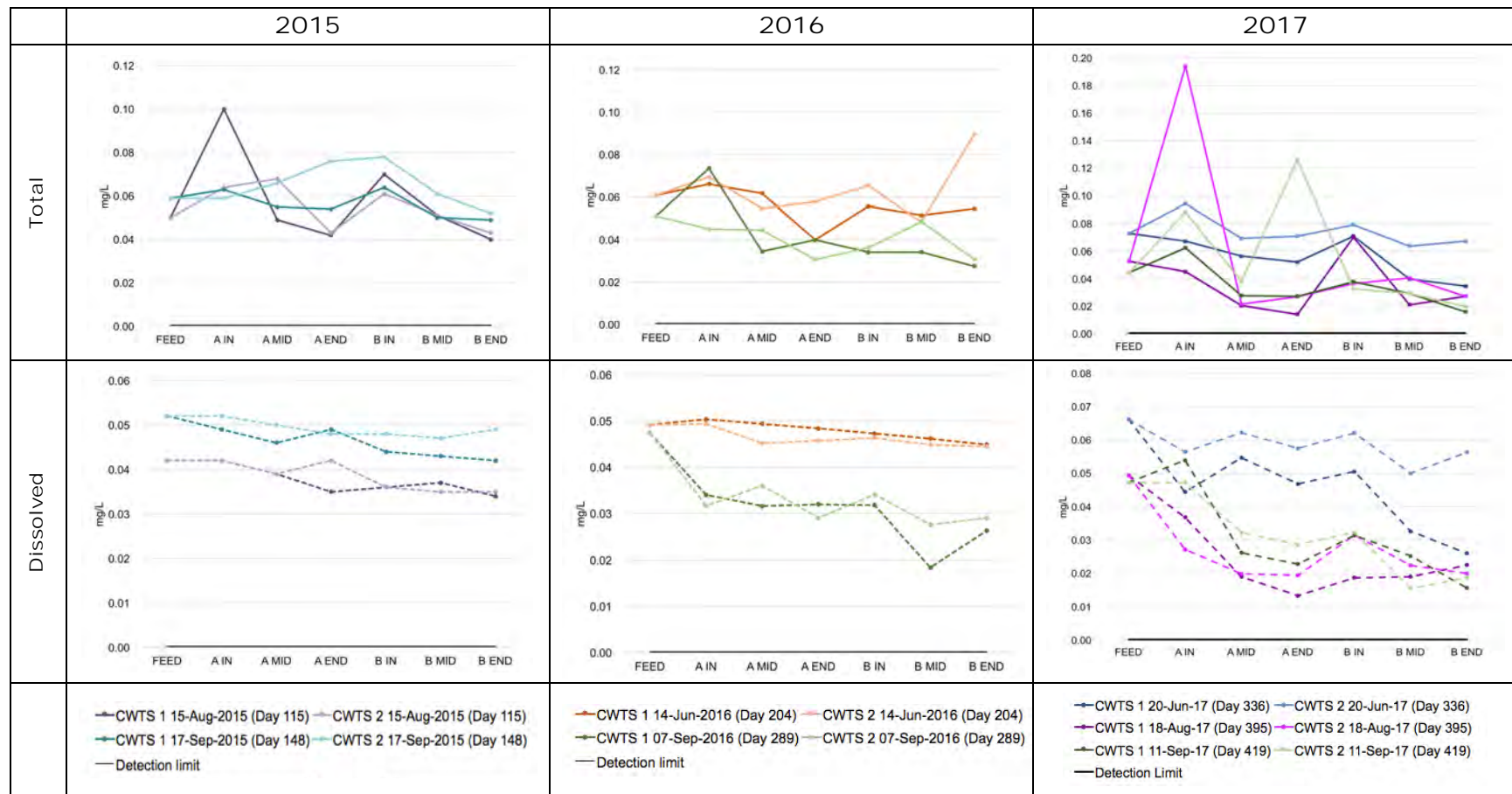


Figure 8 – Copper concentrations through the CWTS.

2015 (left), 2016 (middle), and 2017 (right) total (top) and dissolved (bottom) copper concentrations. Data shown for seven timepoints, where water was sampled at 7 locations through the flow path of the CWTS to assess for treatment fronts within the CWTS, or possible leaching of constituents from the soils into the CWTS. The Maxxam (2015 results) detection limit (DL; black line) for copper is 0.0002 mg/L. The ALS (2016 and 2017 results) DL for copper is 0.0005 mg/L. Spikes in copper concentrations were observed in early sampling points in the CWTS indicating leaching from the soils is occurring; however, later sampling points do not show any copper spikes and, therefore, leaching has subsided. The 2017 graphs are on different y-axes than previous graphs due to one data point from 18-Aug-17 for total copper and two data points from 20-Jun-17 for dissolved copper that are higher than previous axes.

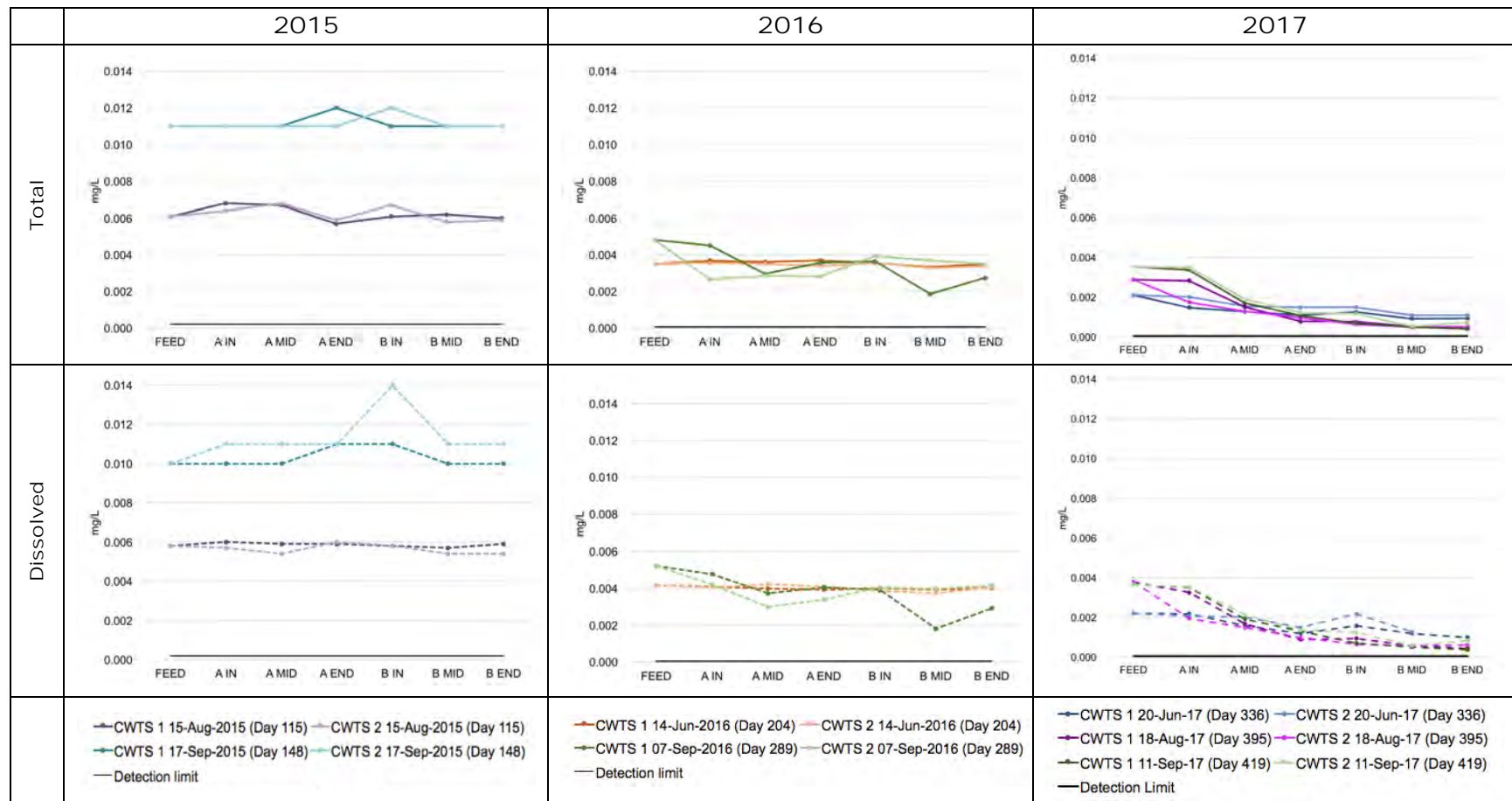


Figure 9 – Selenium concentrations through the CWTS.

2015 (left), 2016 (middle), and 2017 (right) total (top) and dissolved (bottom) copper concentrations. Data shown for seven timepoints, where water was sampled at 7 locations through the flow path of the CWTS to assess for treatment fronts within the CWTS, or possible leaching of constituents from the soils into the CWTS. Y-axes are set to be the same for total and dissolved. The Maxxam (2015 results) detection limit (DL; black line) for selenium is 0.0002 mg/L. The ALS (2016 and 2017 results) DL is 0.000050 mg/L. This graph indicates that leaching is not occurring as there are no spikes in selenium concentrations throughout the CWTS.

5.2.2. Performance during Commissioning-A

The commissioning-A period occurred from May 16 to September 29 in 2015 and May 2 to July 28 in 2016. Details regarding the results of the commissioning-A period can be found in Demonstration-Scale 2016 Update Report (Contango, 2017).

5.2.3. Performance during Commissioning-B

The beginning of commissioning-B was marked by the addition of organics to the CWTS and ran from July 29 to September 30 in 2016 and from May 27 to August 17 in 2017. These organics (straw and wood chips) were added to further aid the copper in the soils to transition into sulphide mineral forms, and represents an amount of organic material similar to what would be produced by the CWTS once fully established with *Carex*. Treatment of constituents was similar through 2016 and 2017 for commissioning-B. An evapotranspiration trial was also completed during commissioning-B to allow water to stagnate and provide time for copper in the soils to convert to sulphide mineral forms more readily.

5.2.4. Performance during Operations

Figures showing performance of the demonstration-scale CWTS in 2017 (commissioning-B and operational period) can be found in Appendix B (Figures B5 to B12). In the operational period from August 18 to September 22, 2017, dissolved cadmium, copper, selenium, and zinc treatment improved from the 2017 commissioning-B period. Dissolved metals concentrations were used for the discussion in this report instead of total metals concentrations, as total values were highly variable and not representative of the metals concentrations in the CWTS. The variability of the total metals concentrations is likely owing to particulate material containing metals being part of the grab sample collection method. During the operational period the CWTS achieved an average decrease of 0.0169 µg/L for cadmium (from 0.0261 µg/L to 0.0092 µg/L), 31.8 µg/L for copper (from 49.1 µg/L to 17.3 µg/L), 3.5 µg/L for selenium (from 4.0 µg/L to 0.5 µg/L), and 47.3 µg/L for zinc (from 49.2 µg/L to 1.9 µg/L; Table 4, Figure 10, Figure 11, Figure 12, and Figure 13, respectively). In contrast, molybdenum removal was fairly constant through 2017 (both commissioning-B and operations) with a decrease of 3.9 µg/L (5.7 µg/L to 1.8 µg/L) during commissioning-B and a decrease of 3.6 µg/L (from 6.3 µg/L to 2.7 µg/L) during operations (Table 4). The percent removal of molybdenum and selenium in 2017 is notable, as it has increased from 0% removal during commissioning-A in 2015 and 2016 (Contango, 2016 and 2017) (Table 4). Furthermore, nitrite and nitrate outflow concentrations also decreased from feed water concentrations throughout the demonstration-scale CWTS. Nitrite and nitrate are therefore being removed through treatment in the CWTS (Figure 15 and Figure 16). These results indicate that the commissioning periods were successful in establishing beneficial conditions for the removal of constituents in the CWTS and treatment of these constituents should continue through 2018.

Table 4 – Percent removal of dissolved constituents in the demonstration-scale CWTS.

| COC (µg/L) | | Commissioning period | | | | Operational period |
|------------|-----|----------------------|-------------------|-------------------|-------------------|--------------------|
| | | 2015 ¹ | 2016 ² | 2016 ³ | 2017 ⁴ | 2017 ⁵ |
| Cd | In | 0.0505 | 0.0240 | 0.0185 | 0.0163 | 0.0261 |
| | Out | 0.0248 | 0.0142 | 0.0066 | 0.0093 | 0.0092 |
| | % | 49 | 40 | 64 | 41 | 66 |
| Cu | In | 54.5 | 61.6 | 46.1 | 59.5 | 49.1 |
| | Out | 45.0 | 56.7 | 28.8 | 35.5 | 17.3 |
| | % | 17 | 8 | 37 | 36 | 65 |
| Mo | In | 11.0 | 7.6 | 7.3 | 5.7 | 6.3 |
| | Out | 11.3 | 7.6 | 5.7 | 1.8 | 2.7 |
| | % | 0 | 0 | 21 | 62 | 57 |
| Se | In | 11.0 | 3.7 | 5.7 | 2.5 | 4.0 |
| | Out | 11.3 | 3.4 | 3.3 | 0.9 | 0.5 |
| | % | 0 | 8 | 41 | 61 | 87 |
| Zn | In | 12.3 | 92.8 | 37.6 | 135.3 | 49.2 |
| | Out | 6.8 | 49.0 | 11.6 | 4.9 | 1.9 |
| | % | 42 | 47 | 69 | 95 | 96 |

¹ Values calculated from end of last two sampling event in 2015 before the addition of EDTA (September 9 and 17, 2015; during commissioning-A).

² Commissioning-A (May 2, 2016 to July 28, 2016).

³ Commissioning-B (July 29, 2016 to September 30, 2016).

⁴ Commissioning-B (May 27, 2017 to August 17, 2017).

⁵ Operational period (August 18, 2017 to September 22, 2017).

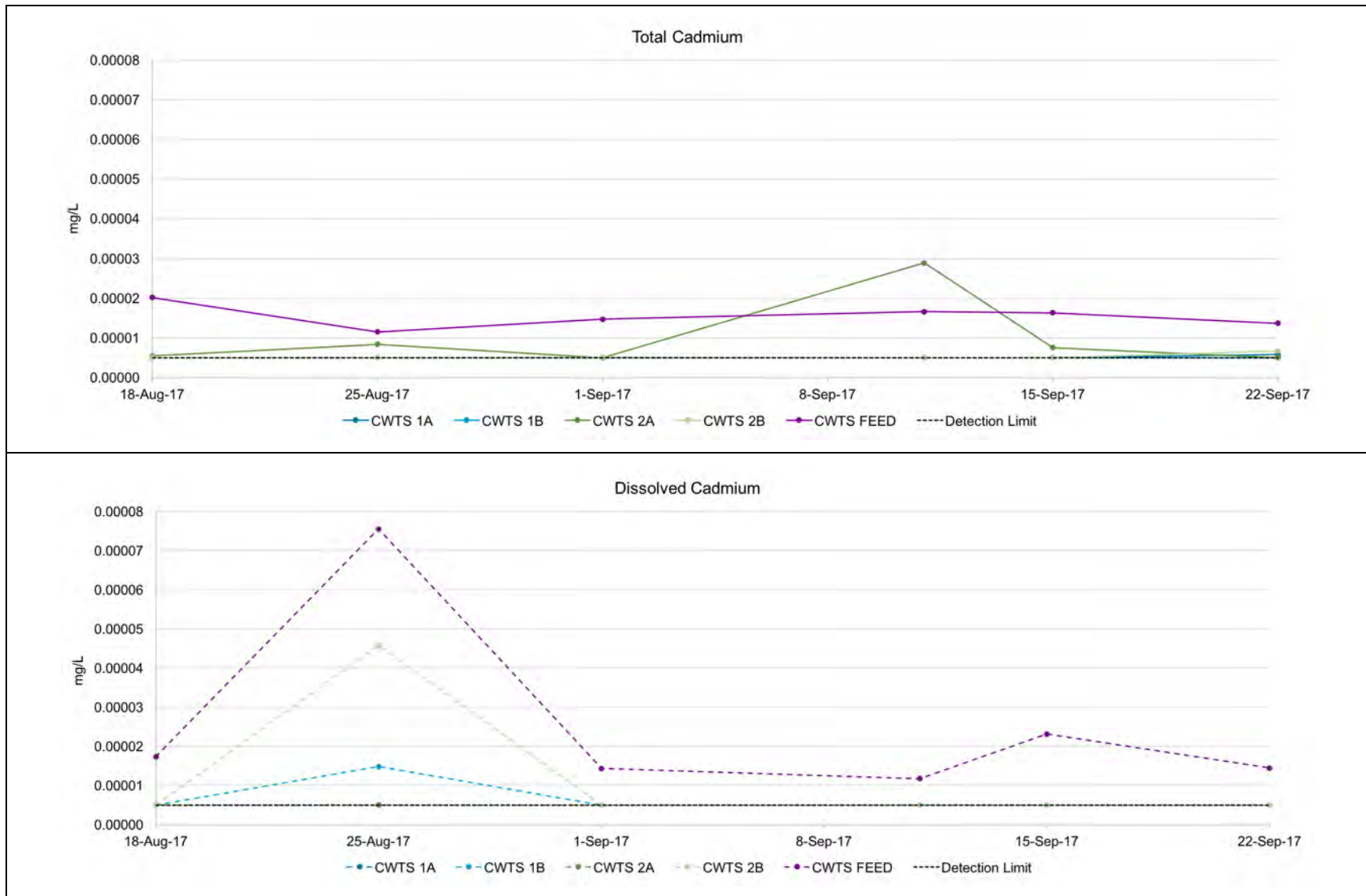


Figure 10 – Cadmium concentrations in operational period of the demonstration-scale CWTS. The ALS detection limit for cadmium is 0.000005 mg/L.

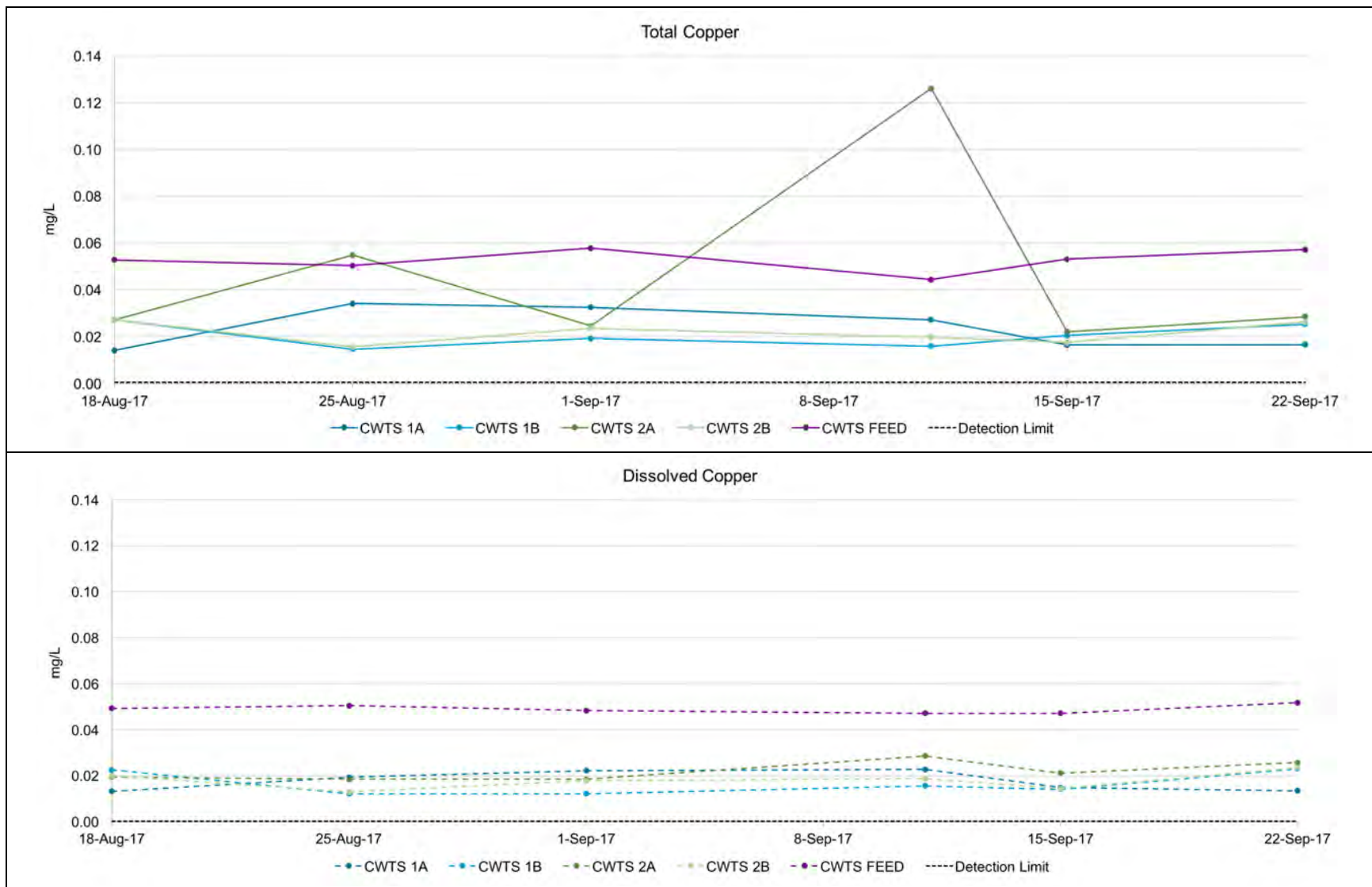


Figure 11 – Copper concentrations in operational period of the demonstration-scale CWTS.
 The ALS detection limit for dissolved and total copper is 0.0002 mg/L and 0.0005 mg/L, respectively.

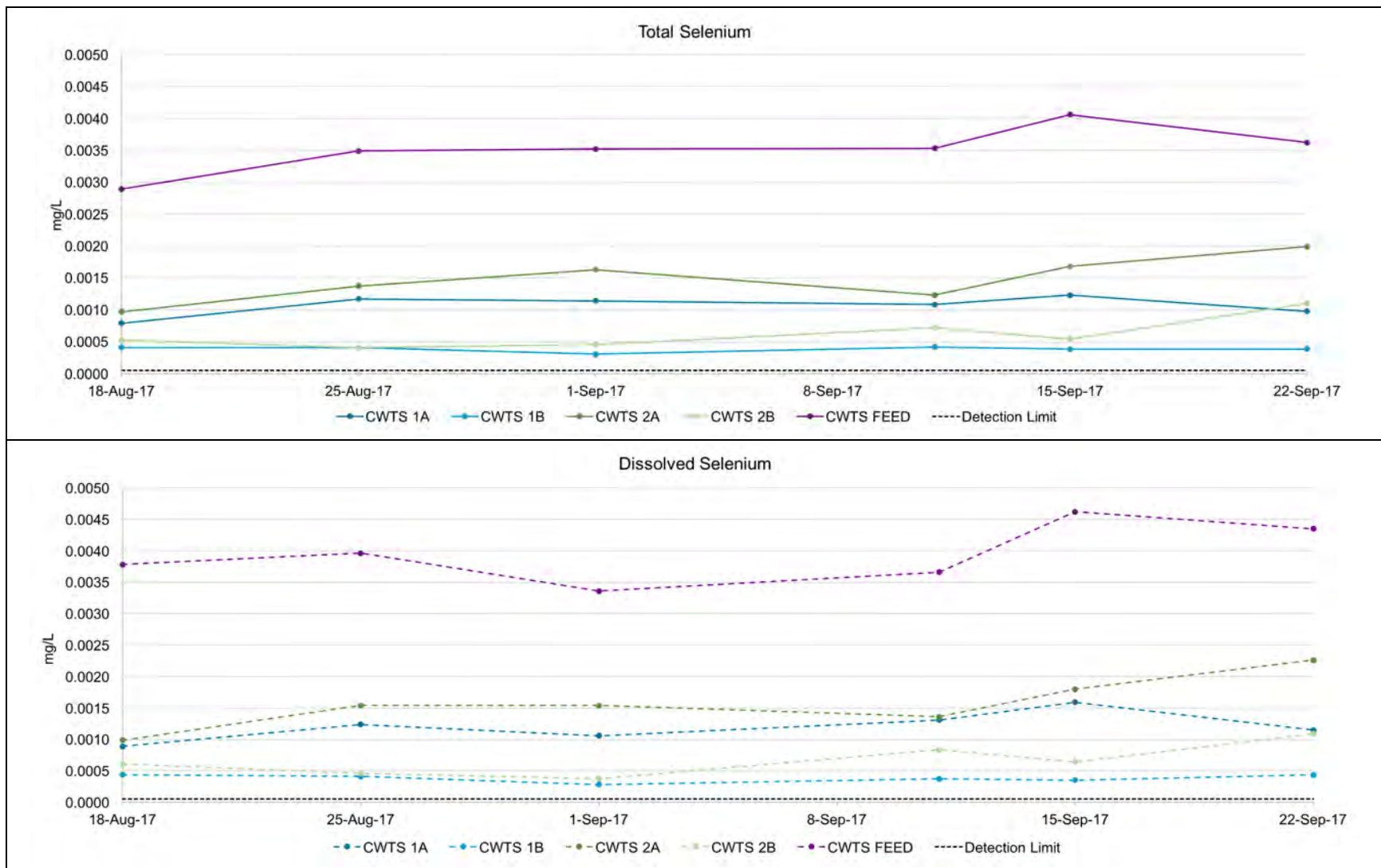


Figure 12 – Selenum concentrations in operational period of the demonstration-scale CWTS. The ALS detection limit for selenum is 0.000050 mg/L.

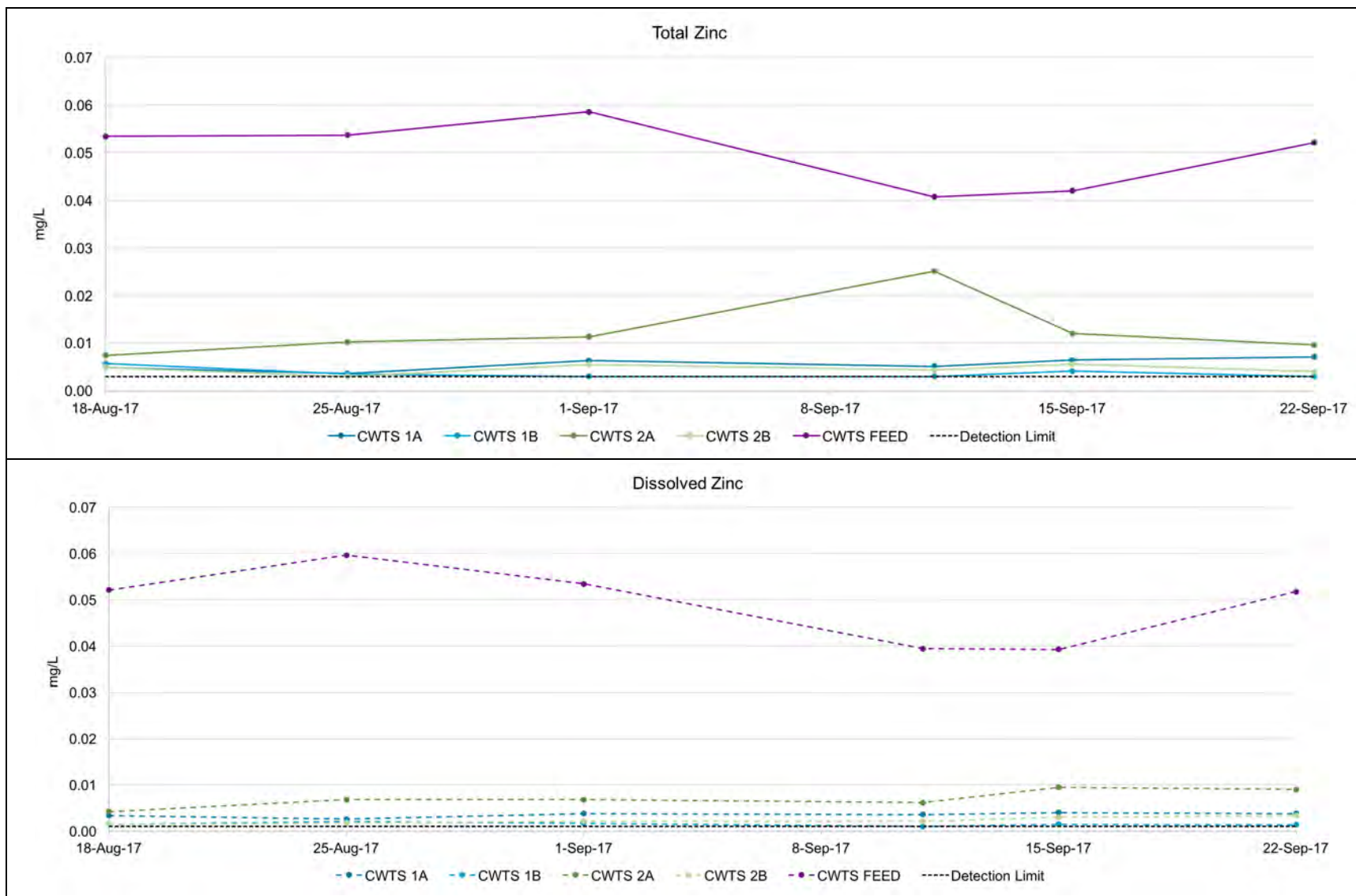
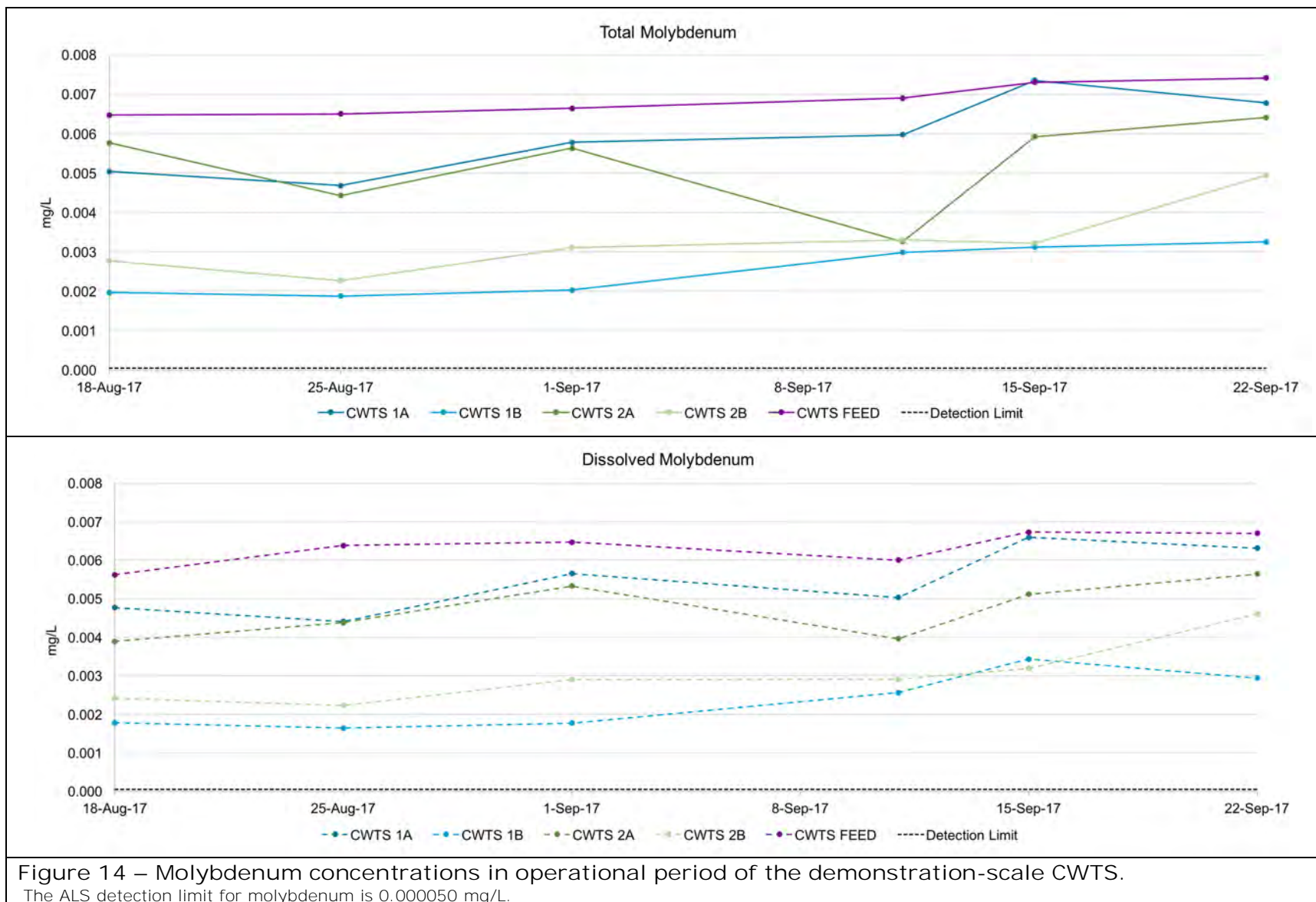


Figure 13 – Zinc concentrations in operational period of the demonstration-scale CWTS. The ALS detection limit for dissolved and total zinc is 0.001 mg/L and 0.003 mg/L, respectively.



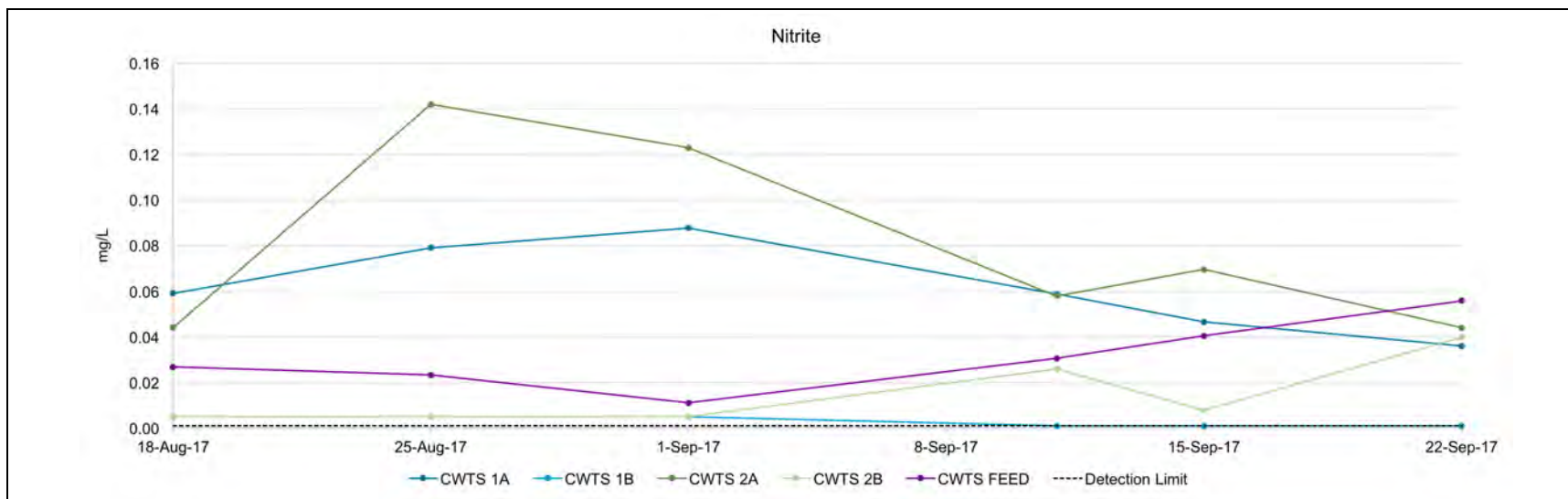


Figure 15 – Nitrite as N (NO₂) concentrations in operational period of the demonstration-scale CWTS.
The ALS detection limit for nitrite is 0.0050 mg/L.

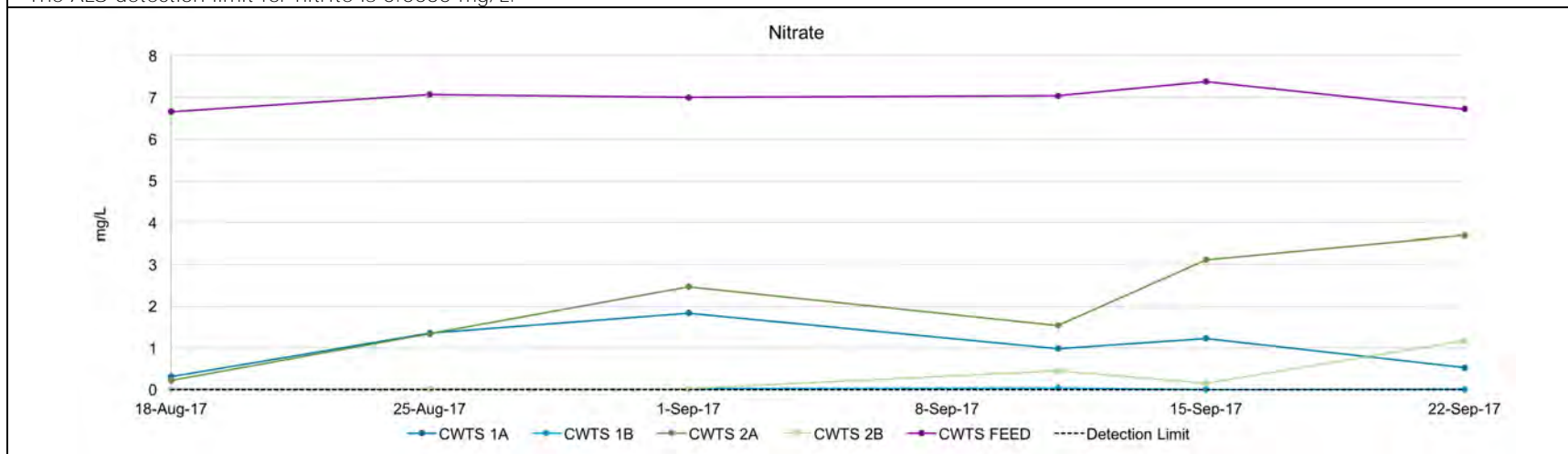


Figure 16 - Nitrate as N (NO₃) concentrations in operational period of the demonstration-scale CWTS.
The ALS detection limit for nitrate is 0.025 mg/L.

5.3. Hydraulic Retention Time

The following are key findings regarding the hydraulic retention time, which are detailed further below:

- The tracer study effectively demonstrated the HRT and flow symmetry through the CWTS.
- There was a single flow path in the CWTS (shown by a single peak in the tracer study)
- Water is incorporating in to the CWTS soils (shown by the long tail for depletion of the tracer).
- The nominal HRT is calculated from the area of the CWTS and the depth at the in situ measuring points. This nominal HRT does not account for depth variations, embankment slopes, vegetation (using space in the water), or substrate pore space involvement. It was found that once all of these factors are in play, the correction factor from nominal to actual is only 0.01 added to the depth of the CWTS, which is incorporated into the HRT calculation as expressed in Equation 3.

5.3.1. Tracer Study

A tracer study was conducted in cell 1A of the CWTS in 2016 (June 13-15, 2016) and in 2017 (June 21-July 2, 2017). Results from the 2016 tracer study can be found in the 2016 demonstration-scale CWTS report (Contango, 2017). The methods of the 2017 tracer study were refined from the 2016 tracer study methods and are further discussed in Appendix A. The nominal HRT is calculated from the area of the CWTS and the depth at the in situ measuring points. This nominal HRT does not account for depth variations, embankment slopes, vegetation (using space in the water), or substrate pore space involvement. The purpose of the tracer studies was to determine the actual hydraulic retention time (HRT) that occurs in the CWTS with a known inflow rate and depth measurement. Then, using this actual HRT from the tracer study, a correction factor can be developed for future CWTS HRT calculations.

Salt (NaCl) was used as the tracer in these tracer studies. By adding a salt solution at the inflow of the CWTS, and placing a YSI meter at the outflow of the CWTS, it could be determined how long it took for the salt to pass through the CWTS by monitoring the specific conductance (SPC) in situ (as salt raises the SPC). The actual HRT of the CWTS was determined by calculating the amount of time that passed between the addition of the salt tracer at the inflow of the CWTS and the peak in SPC at the outflow.

The nominal HRT at the time of the tracer study was calculated based on the flow rate at the time of the tracer study, the known area of cell 1A, and measured depth of cell 1A obtained from the depth sticks that were installed in the CWTS in June 2016 (Appendix A, Figure A5). The results from the 2017 HRT tracer study suggests that the actual HRT of cell 1A is 2.25 days while the nominal HRT of cell 1A is 2.05 days. Therefore, the actual HRT was approximately 10% slower than the nominal HRT. The actual HRT of 2.25 days obtained from the 2017 tracer study was used to solve Equation 1, implying 0.14 m of water involvement

as the “depth”, which was 0.01 m greater than the measured depth of 0.13 m of water. This results in a correction factor of 0.01 (Equation 2). Therefore, the correction factor can be applied to the operational HRT as shown in Equation 3 in order to more accurately estimate HRT of the CWTS.

This HRT correction factor has been incorporated into calculations for the operational HRT for the demonstration-scale CWTS in 2017. The correction factor was incorporated into the operational HRT calculations in Section 5.3.2 and used to determine the 2017 removal rate coefficients in Section 5.4.2.

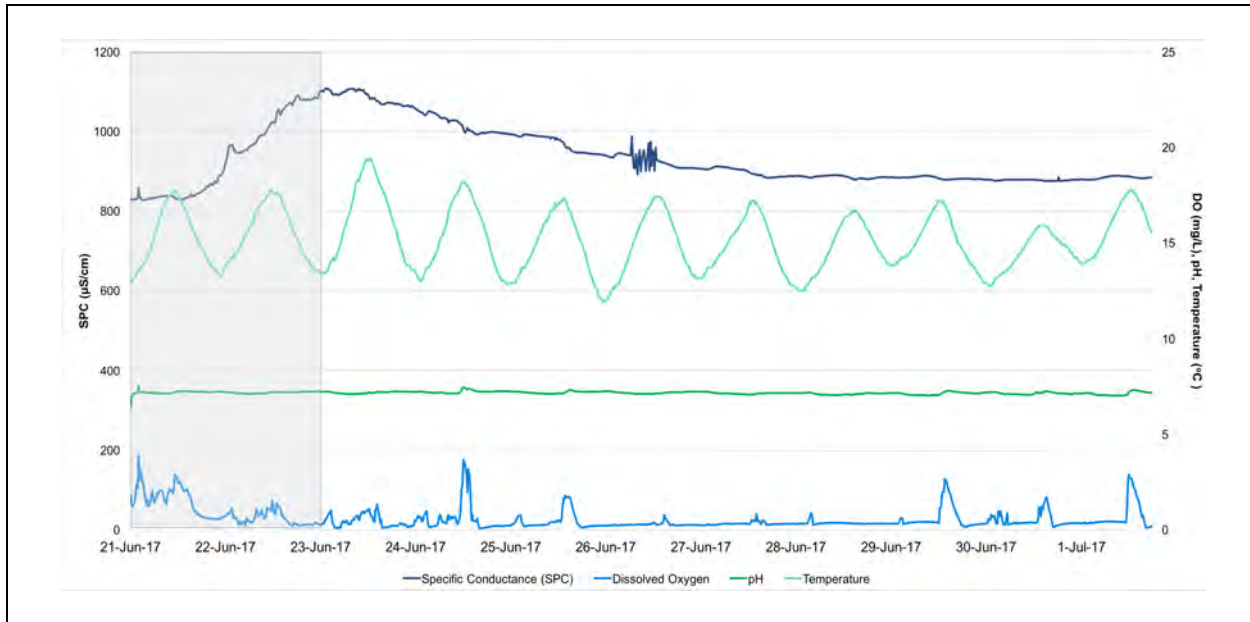


Figure 17 – Hydraulic retention time tracer study results.

Specific Conductance (SPC; $\mu\text{S}/\text{cm}$) on primary y-axis. Dissolved oxygen (mg/L), pH, and temperature ($^{\circ}\text{C}$) on secondary y-axis. Grey shading indicates time from when CWTS was dosed to the peak of tracer breakthrough, which was used as the actual HRT. The fluctuation in temperature correspond to day (peaks) and night (lows). The dates on the x-axis are at 24 hr intervals, beginning from 7:52 am on June 21, 2017.

$$\text{Actual depth} = \frac{(Q \times \text{actual HRT})}{A}$$

Equation 1 – Equation for calculation of the actual CWTS depth including the correction factor.

Q is the flow rate; actual HRT is the HRT obtained from the tracer study (2.25 days); A is the area of cell 1A.

$$\text{Correction factor} = \text{Actual depth} - \text{measured depth}$$

Equation 2 – Equation for calculation of the correction factor.

The actual depth was calculated via Equation 1 (0.14 m); measured depth is the depth of cell 1A during the tracer study (0.13 m).

5.3.2. Operational Hydraulic Retention Time

The operational HRTs of the demonstration-scale CWTS for 2017 were calculated for each series using Equation 3. Equation 3 uses the volume of a CWTS series including a correction factor (calculated from the results of the tracer study in Equation 2; Section 5.3) and the flow rate from the operational period under consideration. For the operating period in 2017, the average HRT was calculated for August 17 – September 22, 2017 as the flows and depths were relatively stable during this time. The operational HRTs calculated were 5.85 days and 6.82 days for series 1 and series 2, respectively. The operational HRTs were then averaged and used in the calculation of removal rate coefficients in Section 5.4.2.

$$\text{Operational HRT} = \frac{A \times \text{actual depth}}{Q}$$

Equation 3 – Equation for calculation of hydraulic retention time.

Operational HRT is the confirmed hydraulic retention time; A is the area of the CWTS; actual depth was calculated using Equation 1 (0.14 m); Q is the flow rate.

5.4. Treatment Effectiveness

The following are key findings regarding treatment effectiveness of the CWTS, which are detailed further below:

- All targeted constituents are being treated by mineralization and sequestered to the soils (minimal plant uptake).
- The lowest concentrations consistently achievable for the treatment design (thermodynamic minimums) were reached by the end of the A cells for cadmium and copper.
- RRCs for cadmium and zinc in the 2017 demonstration-scale CWTS were artificially low because low flow rates did not provide the resolution needed to determine a RRC.
- Removal rate coefficients (RRCs, k) have been developed that can be used for full-scale sizing.
- Copper leaching from soils has decreased but is still likely making the RRC artificially low in this CWTS; however, the RRC is expected to improve once copper leaching has subsided.

5.4.1. Thermodynamic Minimums

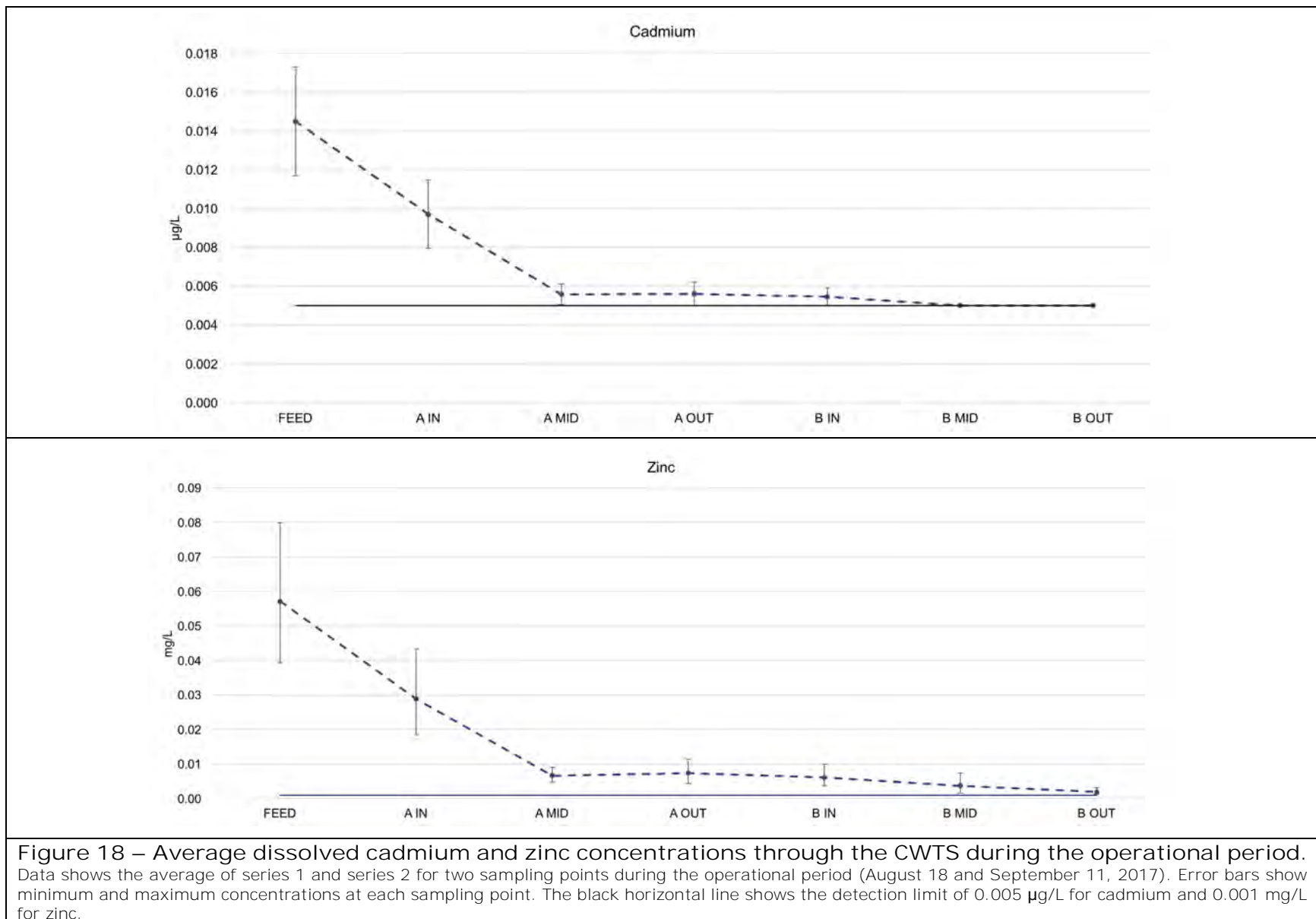
The thermodynamic minimum is the lowest concentration consistently achievable for a given treatment design and water chemistry. Once reached, making the CWTS bigger will not result in further decrease of outflow concentration (although outflow load may continue to decrease). Therefore, thermodynamic minimums are useful parameters to aid in developing appropriate RRCs and determining appropriate sizing and outflow water quality objectives of a CWTS. The thermodynamic minimum was determined for each constituent in the demonstration-scale CWTS. The thermodynamic minimum was calculated by comparing the A cell and the B cell concentrations in a series to determine if the concentrations were significantly different or not. If a concentration had stabilized between the A and B cell in a series, the thermodynamic minimum was considered to have been met. To determine when concentrations had stabilized, statistical analyses were done (paired t-test, one-tailed, $\alpha=0.05$) to determine if the concentrations were significantly different or not. These analyses were then also visually compared to the concentrations of constituents at seven sampling locations throughout the CWTS from two time points, to further evaluate and confirm whether concentrations appeared to have leveled off (Figure 8 and Figure 9 for copper and selenium, respectively; Figures B1 to B4 in Appendix B for remaining constituents). However, there was not enough time points in the operational period for this data to be used in the statistical analyses to further refine the expected HRT for the thermodynamic minimums. This can be refined in 2018, by varying flow rates.

Based on the results of the t-test for the A cell and B cell concentrations, it was determined that the thermodynamic minimum was achieved for cadmium and copper by the end of the A cells in the demonstration-scale CWTS. The detection limit was reached for cadmium prior to the outflow of cell A, suggesting that faster flows would be needed to accurately determine the HRT at which the thermodynamic minimum was met (Figure 18). The thermodynamic minimum for molybdenum, nitrate, and selenium were not yet statistically achieved,

suggesting that a larger CWTS would achieve lower concentrations of these constituents (Appendix B, Figures B13 to B17). The thermodynamic minimum for zinc was not statistically achieved, however, the majority of zinc load was removed within the beginning of cell A, with minimal load removal in the remainder of the CWTS (Figure 18). Furthermore, outflow concentrations of both cell A and B for zinc are at or near detection limit (Figure B17), so it is not necessarily beneficial to build a larger CWTS for zinc.

As shown by the graphs previously mentioned, concentrations in A cells and B cells were very similar for cadmium and copper. This shows that treatment is occurring in the A cells and has reached a thermodynamic minimum which does not decrease further for the B cells. However, these results for copper should be taken with consideration that there is still some residual copper in the soils from construction that is being treated, and therefore, there is more copper treatment ongoing that can be noted by just the water concentrations.

Interestingly, once cadmium, copper and nitrate are treated, zinc and molybdenum begin to have an increase in treatment. This phenomenon is referred to as a treatment front, which generally abides by reaction orders (i.e., nitrate treatment before sulphate, etc.; Murray-Gulde, 2008).



5.4.2. Removal Rate Coefficients

An important factor for CWTS design is the rate of treatment, also known as the removal rate coefficient (RRC; k). The RRC is based on the treatability of a specific compound and the hydraulic retention time of the CWTS, both of which are site-specific based on water chemistry, CWTS designs, and characteristics of the CWTS. A RRC was calculated and applied for cadmium, copper, molybdenum, selenium, zinc, and nitrate which can be used to refine future sizing and performance estimations of a full-scale CWTS (Table 5). In pilot-scale testing specific for the Minto CWTS, the RRC for selenium was a zero-order reaction kinetic, however, optimizations of the operation of the system through the demonstration-scale commissioning have enabled a first-order RRC to be maintained. Therefore, cadmium, copper, selenium, zinc, and nitrate are calculated as first-order kinetics, but molybdenum followed a zero-order kinetic. In other words, the reaction rate for molybdenum is a constant rate and does not depend on concentration, whereas the reaction rates for cadmium, copper, selenium, zinc, and nitrate are proportional to concentration (a half-life type of reaction).

In Equation 4 and Equation 5, C_f is the final concentration, C_i is the initial concentration, and HRT is the operational hydraulic retention time calculated in Equation 3 (Section 5.3.2) using the CWTS depth and correction factor calculated from the tracer study (Equation 1 and Equation 2; Section 5.3).

$$k = \frac{-\ln\left(\frac{C_f}{C_i}\right)}{HRT}$$

Equation 4 – Equation for calculation of first-order removal rate coefficient.

k is the removal rate coefficient; C_f is the final concentration; C_i is the initial concentration; HRT is the operational hydraulic retention time.

$$k = \frac{(C_i - C_f)}{HRT}$$

Equation 5 – Equation for calculation of zero-order removal rate coefficient.

k is the removal rate coefficient; C_f is the final concentration; C_i is the initial concentration; HRT is the operational hydraulic retention time.

RRCs were calculated for each constituent (dissolved and total) and series 1 and series 2 were averaged for the operational period in 2017 and compared to RRCs calculated to the commissioning period of 2016, and pilot-scale RRCs (Table 6). In 2016, all RRCs were calculated using outflow concentrations from the B cells while in 2017, cadmium and copper RRCs were calculated using outflow concentrations and HRTs from the A cells as they had reached their thermodynamic minimum at the end of cells 1A and 2A (Section 5.4.1). The RRCs for the remaining constituents did not reach their thermodynamic minimum in the A cells and, therefore, outflow concentrations and HRTs from the B cells were used. RRCs for cadmium and zinc in the 2017 demonstration-scale CWTS were artificially low because low flow rates did not provide the resolution needed to determine a RRC. Additionally, RRCs for copper in demonstration-scale CWTS are also artificially low due to copper leaching from soils used in construction of the system. Therefore, the RRCs for copper are expected to improve

once leaching has subsided. In general, RRCs improved from those calculated in 2016 (Table 5; Contango, 2017).

Applying the removal rate coefficients (k) from Table 5 to Equation 3 above, parameters can be rearranged to solve for those of interest, such as the volume needed, that in turn determines the area of CWTS required which is dependent upon the design. Analytical results from August 17 – September 22, 2017 were chosen to calculate k because this is the operational period after commissioning-B was completed and flow rates were stable and at targeted values. The treatment rate coefficients applied here are intended to be conservative estimates for conceptual sizing purposes and will need to be refined through further demonstration-scale (on site) testing.

Table 5 – Removal rate coefficients (*k*) for constituents of concern.

| COC | Pilot ¹ | 2016 Demonstration ² | | 2017 Demonstration ³ (Operational) | | Recommended ⁴ |
|---------------------------------------|-----------------------------|---------------------------------|---------------------|---|----------------------|-----------------------------|
| | <i>k</i> *day ⁻¹ | <i>k</i> *day ⁻¹ | | <i>k</i> *day ⁻¹ | | <i>k</i> *day ⁻¹ |
| | Total | Dissolved | Total | Dissolved | Total | Dissolved |
| First order removal rate coefficients | | | | | | |
| Cd | 1.142 | 0.172 | 0.174 | >0.521 ⁵ | >0.226 ⁵ | 1.142 |
| Cu ⁶ | 1.171 | 0.0778 ⁶ | 0.0740 ⁶ | >0.3100 ⁶ | >0.1356 ⁶ | 1.171 |
| Mo | 0.1010 | 0.0416 | 0.0468 | N/A | N/A | N/A |
| Se | N/A | N/A | N/A | 0.3186 | 0.3069 | 0.3186 |
| Zn | 1.144 | 0.195 | 0.183 | 0.512 ⁵ | 0.394 ⁵ | 1.144 |
| Nitrate | 0.559 | 0.0914 | N/A | 0.591 | N/A | 0.591 |
| Zero order removal rate coefficients | | | | | | |
| Mo | N/A | N/A | N/A | 0.0006 | 0.0006 | 0.0006 |
| Se | 0.00181 | 0.000357 | 0.000316 | N/A | N/A | N/A |

¹ Values calculated from data in Contango, 2014b (pilot-scale report) for *Carex aquatilis* + moss with low nitrogen scenario.

² Analytical results from August 10 – September 17, 2016 were used.

³ Analytical results from August 18 – September 22, 2017 were used.

⁴ Cadmium, copper, and zinc recommended RRCs are developed from total concentrations in pilot-scale testing and are conservative proxies for dissolved concentrations.

⁵ RRCs for cadmium and zinc in the 2017 demonstration-scale CWTS were artificially low because low flow rates did not provide the resolution needed to determine a RRC, so the lowest potential *k* value based on available data is reported here.

⁶ RRC's for copper in demonstration-scale CWTS are artificially lowered due to copper leaching from soils used in construction of the system and are therefore expected to improve once leaching has subsided.

N/A = an RRC is not available. All RRCs are for first-order reaction kinetics except for selenium in the 2016 demonstration-scale CWTS and molybdenum in the 2017 demonstration-scale CWTS, which are zero-order reaction rate kinetics. All RRCs in 2016 and 2017 used outflow concentrations for the B cells in the CWTS.

5.5. Evapotranspiration in the Demonstration-Scale CWTS

The following are key findings regarding the evapotranspiration studies, which are detailed further below:

- The evapotranspiration studies revealed a significant loss of water, which will impact calculations of loads to the receiving environment (making them lower than previously estimated).
- In May and June, an average water loss of 5.3 L/day/m² was observed, which is equivalent to 18-20% of water (~700 L/day lost in the demonstration CWTS).
- During the evapotranspiration trials, copper leached into the water as it was transformed from an oxide mineral to a sulphide mineral (because of the copper in the soils used for construction). This is not representative of what would occur during periods with no flow in a full-scale CWTS, where soils with minimal leachable copper are used and copper is deposited in sulphide form (fraction 4) by the biogeochemical activity of the CWTS (Section 5.6).

Total evapotranspiration from a CWTS is measured as the combined effects of open water evaporation and plant transpiration (Beebe et al., 2014). The purpose of calculating the evapotranspiration of a CWTS is to understand the amount of water lost per day over the surface area of a wetland, which in turn concentrates constituents, and should be considered in the context of the decrease in outflow concentration (or not) and outflow load reduction. It should also be noted that evapotranspiration will vary depending on temperature, humidity, and wind on-site and, therefore, will fluctuate over time. This should be considered when interpreting evapotranspiration rates, however, for conceptual calculation purposes, a set rate is applied here.

The off-site evapotranspiration study conducted in 2016 suggested that approximately 15.5 L/day/m² could be lost due to evapotranspiration (Contango, 2017). The results of the 2017 on-site evapotranspiration studies were intended to provide more accurate estimates at the CWTS than the off-site study and had an average water loss of 5.3 L/day/m² (Table 6). These results are consistent with pilot-scale results from another CWTS planted with *Carex* where 5.1 L/day/m² were lost through evapotranspiration. Although the off-site study can be informative, the on-site study is more representative of what would occur during operation of the full-scale CWTS in the spring. The difference in the two rates is expected to be due to temperature difference of the trial. The on-site during the evapotranspiration study were on average 9.6°C in May and 13.7°C in June while temperatures in the off-site study were on average 22°C during the day (12 hr) and 16°C during the night (12 hr) which is less representative of site conditions. Temperatures in July and August at Minto were only slightly higher than June temperatures and were on average 15.8°C and 13.9°C, respectively. Therefore, we would expect marginally higher rates of evapotranspiration in these months.

Table 7 shows the amount of water lost to evapotranspiration during the operational period (August 18 – September 22, 2017) in each cell of the demonstration-scale CWTS. The amount of water lost in the CWTS during each flow rate period tested is calculated using Equation 6.

| |
|--|
| $\text{Water loss (\%)} = \frac{ET}{Q} \times 100$ |
| Equation 6 – Equation for the calculation of the water loss due to evapotranspiration. Q is the flow rate (L/day); ET is the evapotranspiration rate (L/day). |

Table 6– Water loss through evapotranspiration in the CWTS.

| Study | Cell | Water loss ¹ (L/day) | Water loss ² (L/day/m ²) |
|--|------|------------------------------------|--|
| Trial 1: May 16 – 24, 2017 | 1A | 575.0 | 8.3 |
| | 1B | 143.7 | 2.1 |
| | 2A | 509.0 | 8.8 |
| | 2B | 152.7 | 2.6 |
| L/day/m ² Average | | | 5.4 |
| Trial 2: June 8 – 11, 2017 | 1A | 580.8 | 8.3 |
| | 1B | 116.2 | 1.7 |
| | 2A | 775.7 | 13.3 |
| | 2B | 339.4 | 5.8 |
| L/day/m ² Average | | | 7.3 |
| Trial 3: June 11 – 15, 2017 | 1A | 292.7 | 4.2 |
| | 1B | 27.9 ³ | 0.4 |
| | 2A | 273.4 | 4.7 |
| | 2B | 203.6 | 3.5 |
| L/day/m ² Average | | | 3.2 |
| L/day/m ² Overall Average | | | 5.3 |
| ¹ Water loss (L/day) = (initial depth (m) – final depth (m)) * area of CWTS (m ²) * 1000 L/m ³ /days. ² Water loss (L/day/m ²) = Water loss (L/day) / area of CWTS (m ²). Total days of study in trials 1, 2, and 3 were 8, 3, and 5 days, respectively. The area of series 1 is 69.7 m ² and the area of series 2 is 58.2 m ² . ³ Depths in this cell had minimal change throughout trial 3. | | | |

Table 7 shows how this water loss likely affected the load leaving the wetland. The average ambient temperature on-site for this time period was 9.9°C, and so the evapotranspiration rates from the trials are expected to be relevant to the operational period. The information in Table 7 is calculated based on Equation 7 and Equation 8.

Evapotranspiration has a significant effect on the calculation of constituent load to the receiving environment. Therefore, future models for assimilative capacity in the downstream receiving environment should take into account not only the predicted outflow concentrations from the CWTS using removal rate coefficients (Section 5.4.2), but also adjust the load accounting for evapotranspiration.

Concentrations of copper (and other metals) were measured in the water during the evapotranspiration studies to determine if any leaching occurred during periods of no flow because the soils used in construction contained oxidized copper minerals. In the 2017 study, this is noted by an average decrease of 63.3 µg/L copper after flow was restarted and treatment of copper resumed. This is not representative of what would occur during periods

with no flow in a full-scale CWTS, where soils with minimal leachable copper are used and copper is deposited in sulphide form (fraction 4) by the biogeochemical activity of the CWTS (Section 5.6). In a full-scale CWTS, lower flows and stagnation will result in greater treatment of constituents into sulphide mineral forms.

The demonstration-scale evapotranspiration studies were conducted to inform evapotranspiration rate estimates for full-scale CWTS design. However, these results are fortuitous because the study was conducted during the commissioning-B period, rather than the operational period when the CWTS was running optimally. Additionally, since the studies were conducted in the spring, they do not capture the seasonality of evapotranspiration rates and are therefore conservative numbers. Thus, it is recommended that another evapotranspiration study be conducted on-site in 2018.

$$Load_{in} = C_i \times V$$

Equation 7 – Equation for the calculation of load of a constituent into a CWTS over a period of time.

$Load_{in}$ is the mass of a constituent that enters a CWTS over a period of time; C_i is the inflow concentration of the constituent; V is the volume of water that enters a CWTS over a period of time.

$$Load_{out(ET)} = Water\ Out_{ET} \times C_f$$

Equation 8 – Equation for the calculation of the load out of a constituent over a period of time, adjusted for evapotranspiration.

$Load_{out(ET)}$ is load out of a constituent over a period of time, adjusted for evapotranspiration; $Water\ Out_{ET}$ is the outflow water volume over a period of time, adjusted for evapotranspiration; C_f is the outflow concentration of the constituent.

Table 7 – Average constituent load in, load out, load out adjusted for evapotranspiration and load removed adjusted for evapotranspiration in the demonstration-scale CWTS.

| COC | Form | Load in (mg/day) | Load out ¹ (mg/day) | Load out Adjusted for evapotranspiration ² (mg/day) | Load removed adjusted for evapotranspiration (mg/day) | Load removed ³ (%) |
|-----|------|------------------|--------------------------------|--|---|-------------------------------|
| Cd | D | 0.0476 | 0.0162 | 0.0131 | 0.0345 | 71 |
| | T | 0.0283 | 0.0094 | 0.0076 | 0.0207 | 73 |
| Cu | D | 89.7 | 31.4 | 25.4 | 64.3 | 72 |
| | T | 96.2 | 38.4 | 31.1 | 65.1 | 67 |
| Mo | D | 11.5 | 4.8 | 3.9 | 7.6 | 65 |
| | T | 12.6 | 5.2 | 4.2 | 8.3 | 66 |
| Se | D | 7.2 | 0.9 | 0.7 | 6.5 | 89 |
| | T | 6.4 | 0.9 | 0.7 | 5.7 | 88 |
| Zn | D | 90.0 | 3.4 | 2.8 | 87.2 | 97 |
| | T | 91.6 | 7.5 | 6.0 | 85.5 | 93 |

¹ Inflow volume was used for the calculation of load out using outflow concentrations without adjusting for evapotranspiration (Appendix A, Equation A2).
² Outflow volume adjusted for evapotranspiration was used for the calculation of load out adjusted for evapotranspiration.
³ Load Removed (%) = (Load out adjusted for evapotranspiration)/(Load in) * 100
Water loss for each flow period is an average of all time points and is calculated using Equation 7. Average water loss in series 1 and 2 is 377.9 L/day/m² (18%) and 315.4 L/day/m² (20%), respectively. D = dissolved, T = total. Results in the table are from the operational period only (August 18 – September 22, 2017) and are therefore not representative of what would occur year-round. Ambient temperature on-site for this period was on average 9.9°C.

5.6. Soils

The following are key findings regarding constituents in the soil, which are detailed further below:

- In 2017, leachable copper concentrations in soils decreased in the top 0-10cm while total copper concentrations increased.
- Most constituents, including copper, have shifted primarily into stable reduced and residual minerals fractions in the soil.
- Acid volatile sulphides (AVS) were non-detectable in the CWTS in 2016. In 2017 small amounts of AVS were detected in cells 1A and 2A which indicates that residual sulphides are starting to become available for metal treatment and that copper in the soils are becoming rendered inert through sulphide mineralization.

Although unintentional, the high initial leachable copper concentrations in the CWTS soils (Appendix A, Table A2) allowed for additional testing to be carried out on these CWTSs. Because the soil substrates used for construction of the CWTS were from overburden sources, the copper was in oxidized form rather than in a mineral form that would typically be found in a reducing CWTS (i.e., soils with negative redox). Therefore, there was some initial leaching of copper from the soils into the water.

To assess the effect of the elevated metals in the soils used in construction on CWTS functionality, four soil analytical test methods were used and are described in Appendix A. Analytical methods tested for total metals, leachable metals, and metal speciation. Results of these test methods during the operational period are discussed in the following sections. Table 8 shows the definitions of extractable fractions from the sequential extraction procedure for the speciation of metals (Tessier et al., 1979).

Table 8 - Summary of extractable fractions from sequential extraction procedure for the speciation of metals¹.

| Fraction | Description | When COCs Become Unstable and Release to the Water Column |
|----------|---|---|
| 1 | Exchangeable fraction for adsorbed minerals | Readily released (i.e., soluble and exchangeable) |
| 2 | Mineral fraction bound to carbonates or solubilized at pH 5 | Decreased pH |
| 3 | Oxidized mineral fraction bound to Fe-Mn oxides | Reducing conditions |
| 4 | Reduced mineral fraction and sulphides | Oxidizing conditions |
| 5 | Residual mineral fraction (primary and secondary minerals) | Not expected to be released in solution over time under conditions normally encountered in nature |

¹Method based on Tessier et al., 1979.

Analysis of leachable metals in 2017 used the same leach method as in 2016 and results can be found in Appendix B, Table B2. When compared to early 2016 results, leachable copper concentrations in 2017 soils decreased throughout the CWTS (Figure 19) while total copper concentrations increased overall as copper shifted from its leachable to mineral form (Figure 20). In general, soils in the demonstration-scale CWTS appear to be reaching a steady-state with concentrations of leachable copper changing little throughout 2017. We expect leachable copper decrease further in 2018.

Sequential extraction procedure for the speciation of particulate trace metals was conducted for all constituents of concern and results and figures can be found in Appendix B (Tessier et al., 1979). The analysis shows that despite elevated initial leachable copper concentrations, the soils have become more stable (less leachable) over time in the CWTS setting as the soils have aged, shifting from oxidized to reduced, mineral forms (Figure 21; Figures B18 and B19). This beneficial aging of soils to a less soluble mineralized form of sulphide is expected for this type of treatment CWTS design. It should also be noted that copper leached from the original substrate into the water put additional treatment demands on the CWTSs.

For the CWTS to treat the copper from the soils, additional organic carbon is needed beyond that necessary for the waters alone. Organic carbon is contributed to the CWTS through decomposition of plant material as the CWTS matures. Organic carbon is used as food by the microbes, which in turn produce sulphides which drive metals treatment through mineralization that is helped by biogeochemical processes. Presently, as there is excess copper in the soils in oxidized forms transitioning to reduced forms, these will bind to and consume the sulphides produced, transforming them to the sulphide-bound fraction 4 (Table 7). This in turn impacts the ability to treat water, as it uses the available sulphides that would otherwise treat metals in the water. When the mineral fractions of the soils have completed their transformation into sulphide-bound minerals, the soils will no longer be "sulphide hungry", allowing for the soil-produced sulphides to be utilized for metals treatment in the water. This progress can be tracked in results from the sequential extraction tests, the appearance of acid volatile sulphides (AVS) in the soils (iron sulphates, which will only occur after the copper is transformed), and the change of sulphate concentrations in the water.

Additional reserve treatment capacity can be stored in a CWTS through creation of a reserve of AVS (newly formed amorphous iron sulphides). AVS are referred to as such because of the testing method, which is also done alongside simultaneously extracted metals (AVS:SEM; at Minto, cadmium, copper, and zinc were tested for) to determine the ratio of iron sulphides to free metals. An excess of AVS suggests the metals would be non-bioavailable and not likely to leach. In the case of Minto, where the soils used in construction had excess copper, the appearance of measurable AVS would also indicate that the copper in the soils is nearing an endpoint of transformation to sulphide forms.

AVS was tested for in 2016 prior to adding the straw and wood chips and was non-detectable (hence, the decision to add the straw and wood chips). The appearance of small amounts of measurable AVS over time (cell 1A in June and cell 2A in September, 2017) indicates that the amount of sulphide produced in the soils is beginning to exceed the total amount of copper

placed with the original soils and the CWTS should eventually start performing the way it should have if substrates with high leachable copper had not been used. However, the AVS:SEM ratio is indicating there is significant copper in the soils still consuming the sulphides, and treatment performance is expected to improve as that continues to be remedied over time. An AVS:SEM ratio greater than one indicates excess copper in the soils has been reduced to sulphide form and is no longer consuming excess sulphides, allowing for AVS to form. Once the AVS:SEM ratio of all cells is consistently greater than one, we do not expect any further copper leaching to occur, and copper treatment within the CWTS should improve until this time.

Zinc (Figures B20 and B21) mineral forms have become stable over time, with most of these constituents found in the reduced or mineral form (fraction 4 and 5) by the end of 2017. Cadmium concentrations are at or near detection limits for all fractions (Figures B22 and B23). Molybdenum was mostly found in the most stable residual mineral fraction 5, which contained around 40% of the total molybdenum in the samples (Figures B24 and B25). Selenium was at or near the detection limit for all fractions at the end of 2017, and was barely detectable for the stable fractions 4 and 5 (Figures B26 and B27).

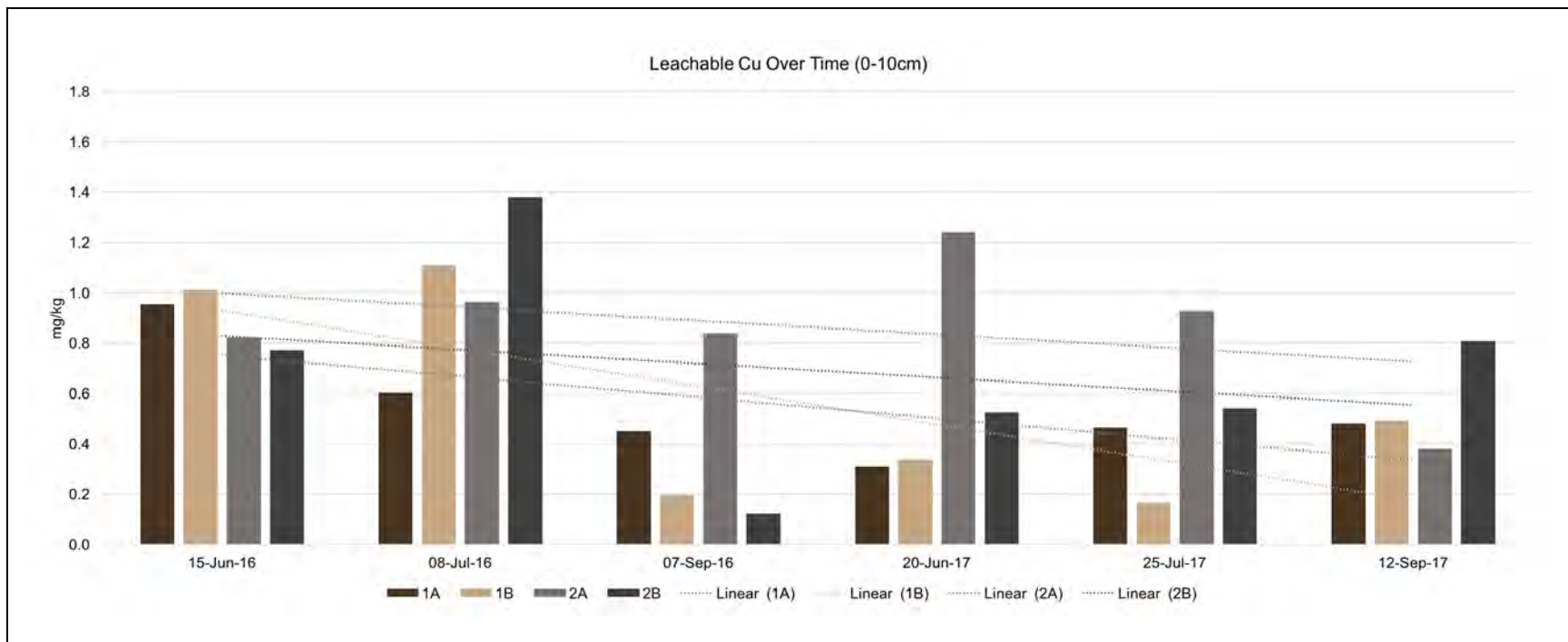


Figure 19 – Leachable copper concentrations in soils over time in the demonstration-scale CWTS. Figure shows concentrations in shallow soil (0-10 cm). Trendlines (dotted lines) show a general decrease in leachable copper over time.

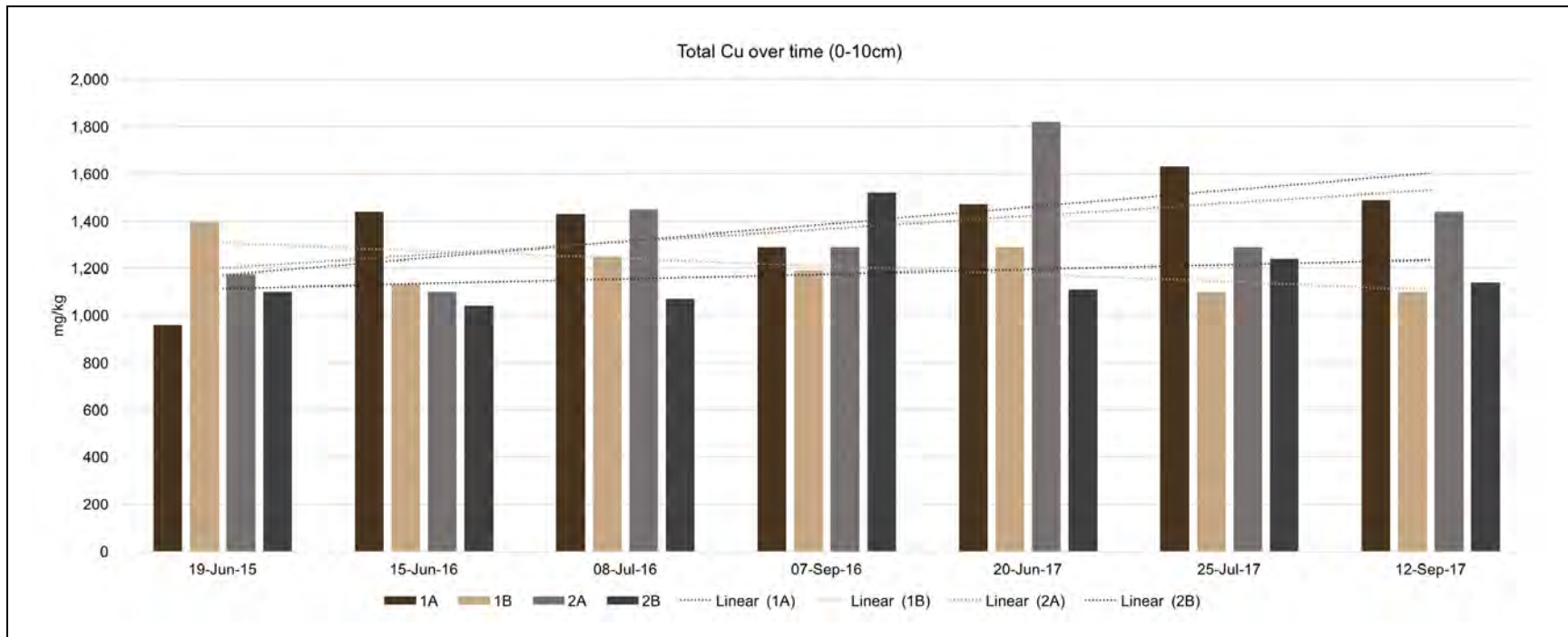


Figure 20 – Total copper concentrations in soils over time in the demonstration-scale CWTS. Figure shows concentrations in shallow soil (0-10 cm). Trendlines (dotted lines) show a general increase in total copper over time.

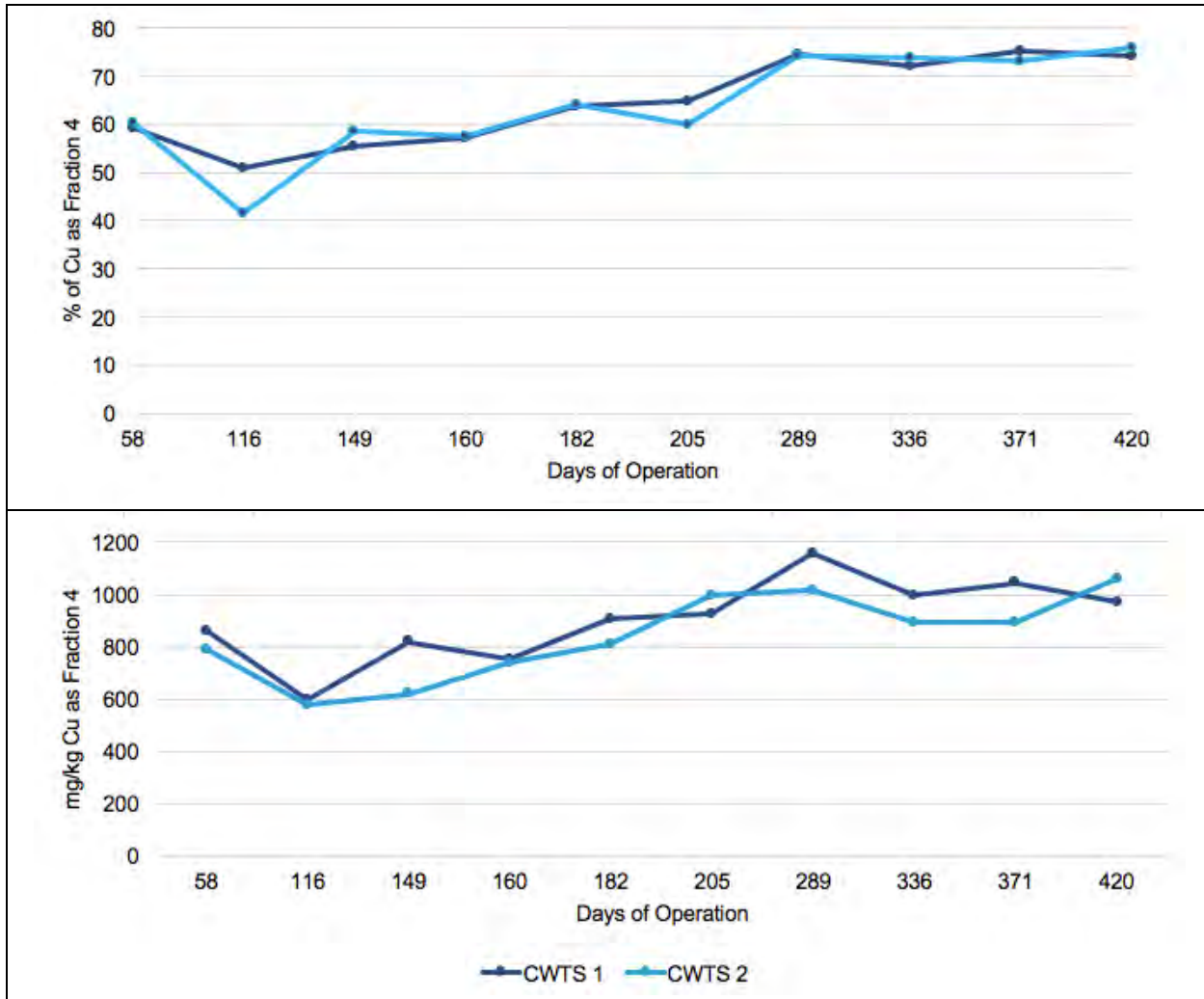


Figure 21 – Copper as sequential leach fraction 4 over time. Copper in the form of the targeted Fraction 4 (sulphide mineral form and bound to organics), increased in the CWTS over time as the soils matured. Additional information can be found in Appendix B.

5.7. Metals Uptake

The following are key findings regarding metals uptake, which are detailed further below:

- Overall, uptake of metals in *C. aquatilis* was low and generally lower in 2017 than in 2016 demonstration-scale CWTS results.
- Targeted treatment mechanisms are becoming more robust, rendering elements non-bioavailable.

Concentrations of the constituents of concern in *C. aquatilis* and moss from the demonstration-scale CWTS in 2017 were compared to those from 2016. *C. aquatilis* and moss in the demonstration-scale CWTS had greater copper concentrations than the pilot CWTSs, likely reflecting the bioavailable copper that was in the soils used for construction. Concentrations of copper in the *C. aquatilis* at the end of 2017 were similar or lower than 2016 concentrations (Figure 22). The moss had higher copper concentrations in the A cells than in 2016, but lower concentrations in B cells, indicating more treatment earlier in the CWTS as it matures (Figure 22). Over time, constituents sorbed to mosses will form reduced minerals, rendering them less bioavailable.

Cadmium concentrations in *C. aquatilis* and moss were similar in 2017 and 2016, except for higher concentrations in cell 1B where concentrations were higher for *C. aquatilis*, (Figure 23). Similar selenium concentrations were observed in both plant types in 2017 as in 2016, (Figure 24; Contango, 2016 and 2017). Concentrations of molybdenum in moss generally decreased from 2016 to 2017, while concentrations of molybdenum in *C. aquatilis* decreased significantly and now remain around the detection limit (Figure 25). In 2017, overall concentrations of zinc decreased in *C. aquatilis* and moss from 2016, except for cell 1B in *C. aquatilis* and cell 2A in moss where concentrations of zinc remained the same (Figure 26).

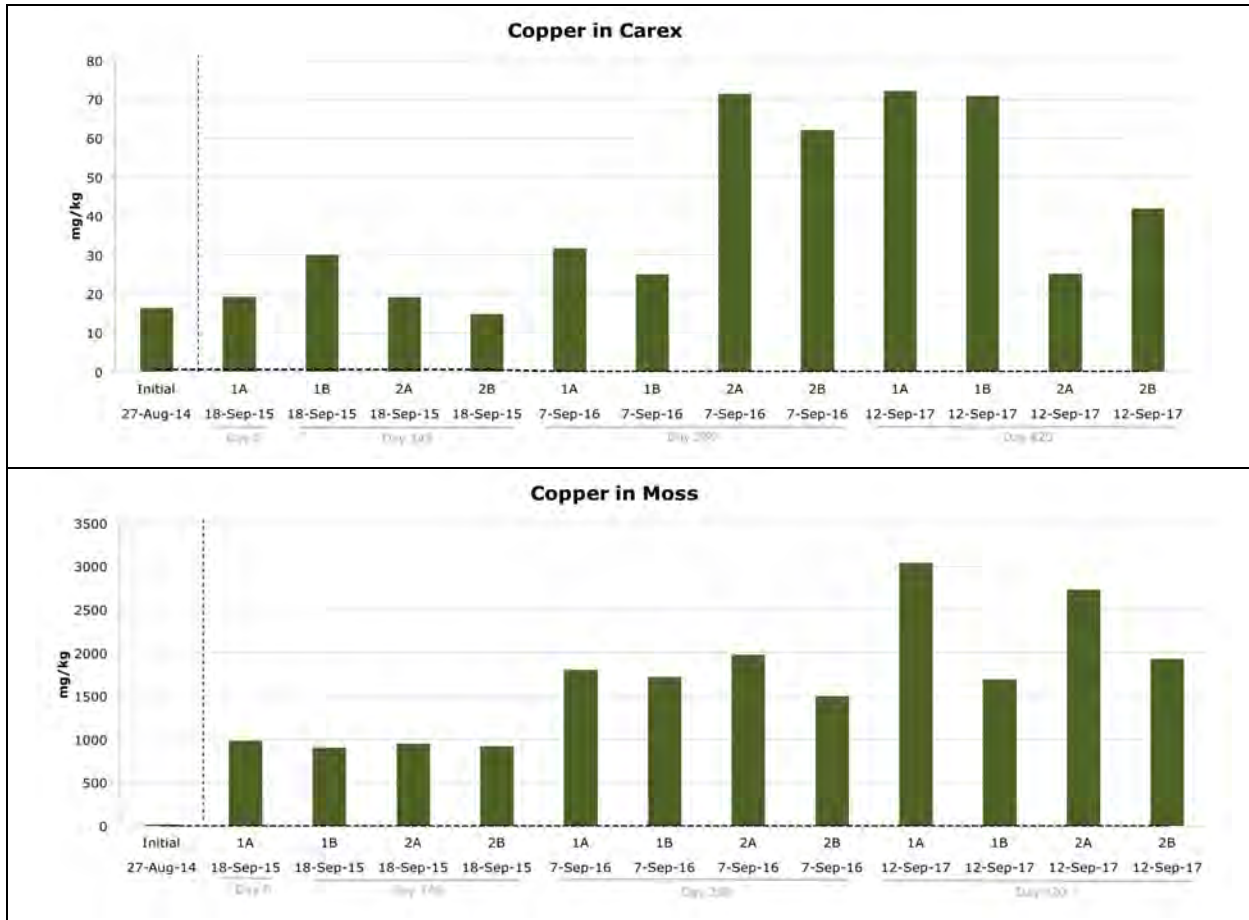


Figure 22 – Copper concentrations in plants.

The 2014 detection limit (DL; horizontal dotted line) for copper is 0.5 mg/kg, the 2015 DL is 0.1 mg/kg, and the 2016 and 2017 DL is 0.05 mg/kg. The initial data set is the average of three *Carex* replicates at construction.

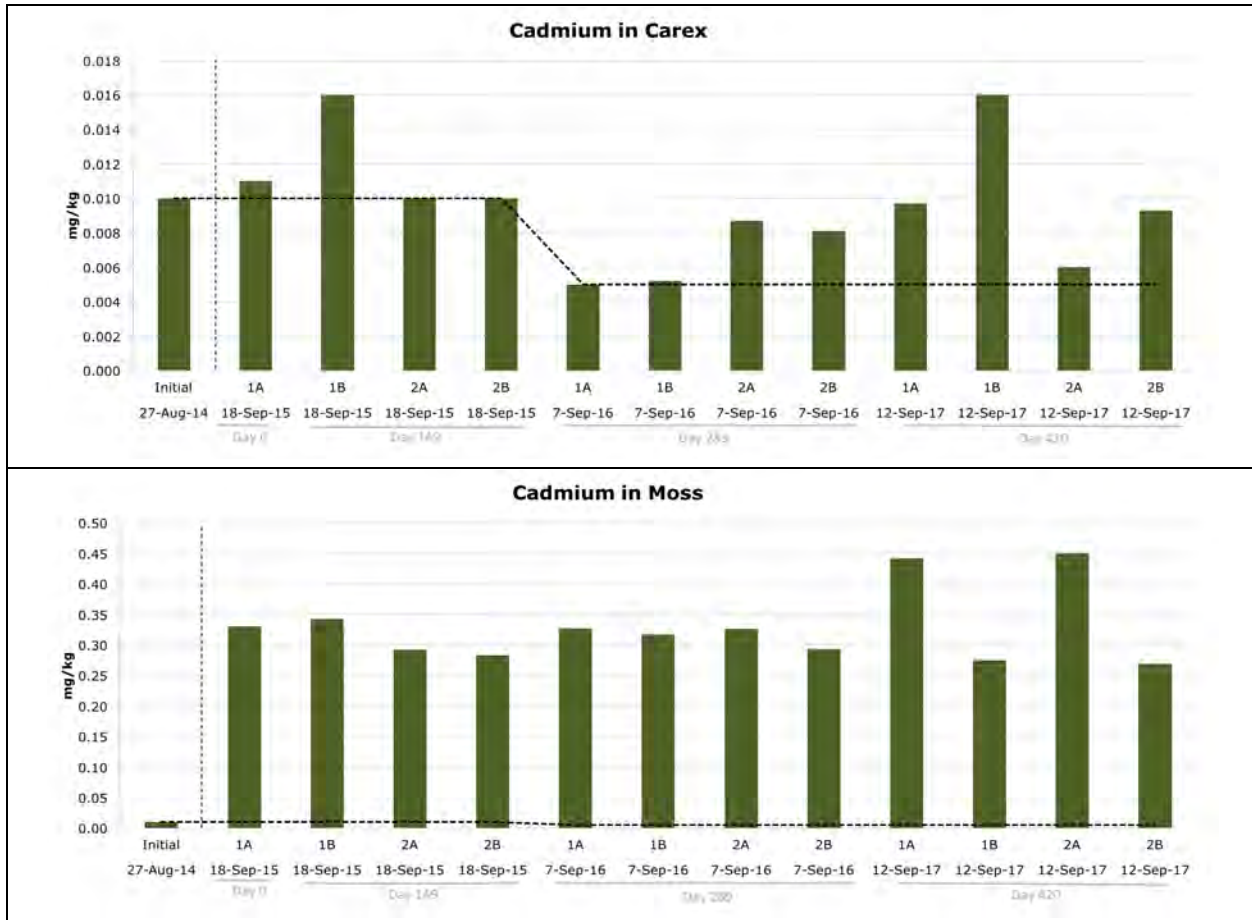


Figure 23 – Cadmium concentrations in plants.

The 2014 and 2015 detection limit (DL; horizontal dotted line) for cadmium is 0.10 mg/kg. The initial data set is the average of three *Carex* replicates at construction.

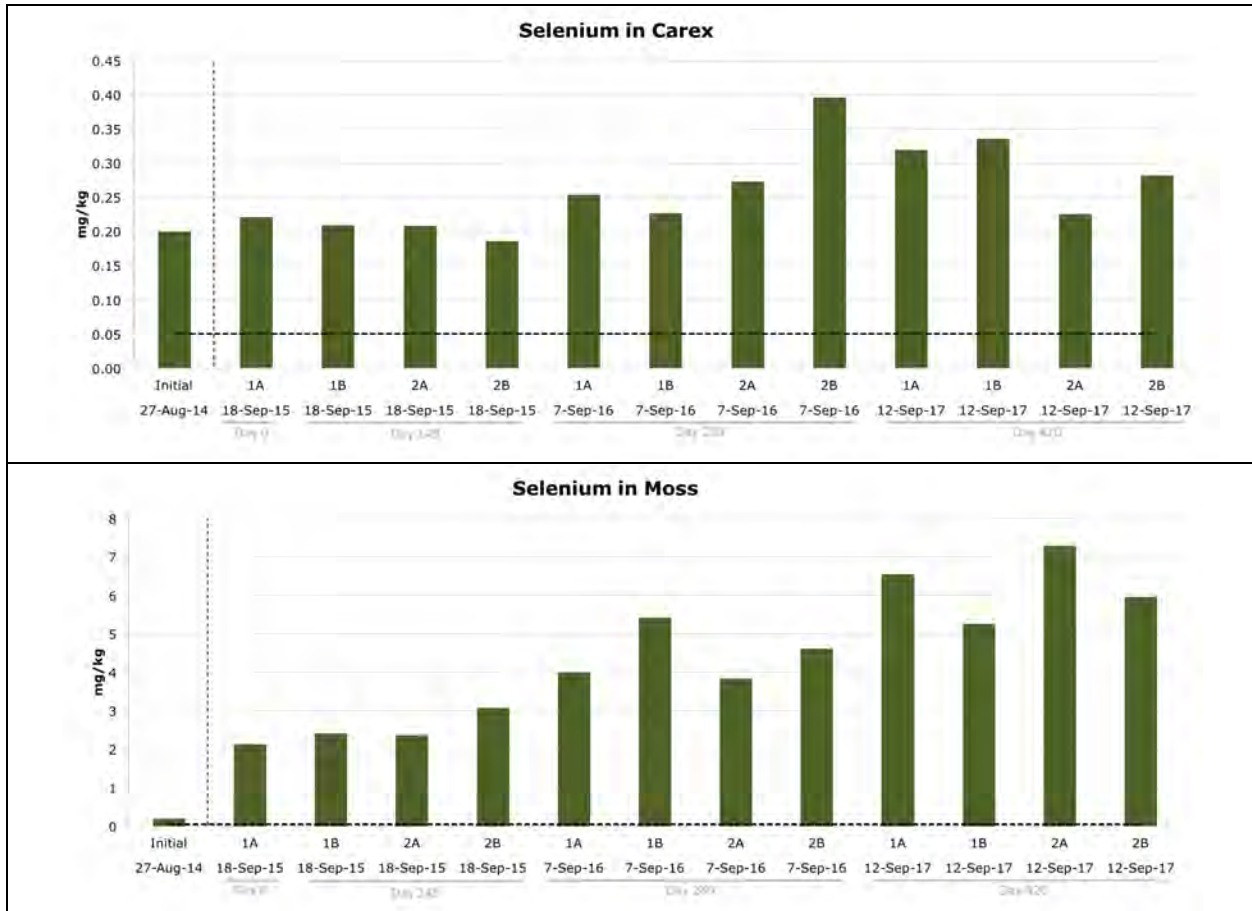


Figure 24 – Selenium concentrations in plants.

The method detection limit (DL; horizontal dotted line) for selenium is 0.2 mg/kg. The initial data set is the average of three *Carex* replicates at construction.

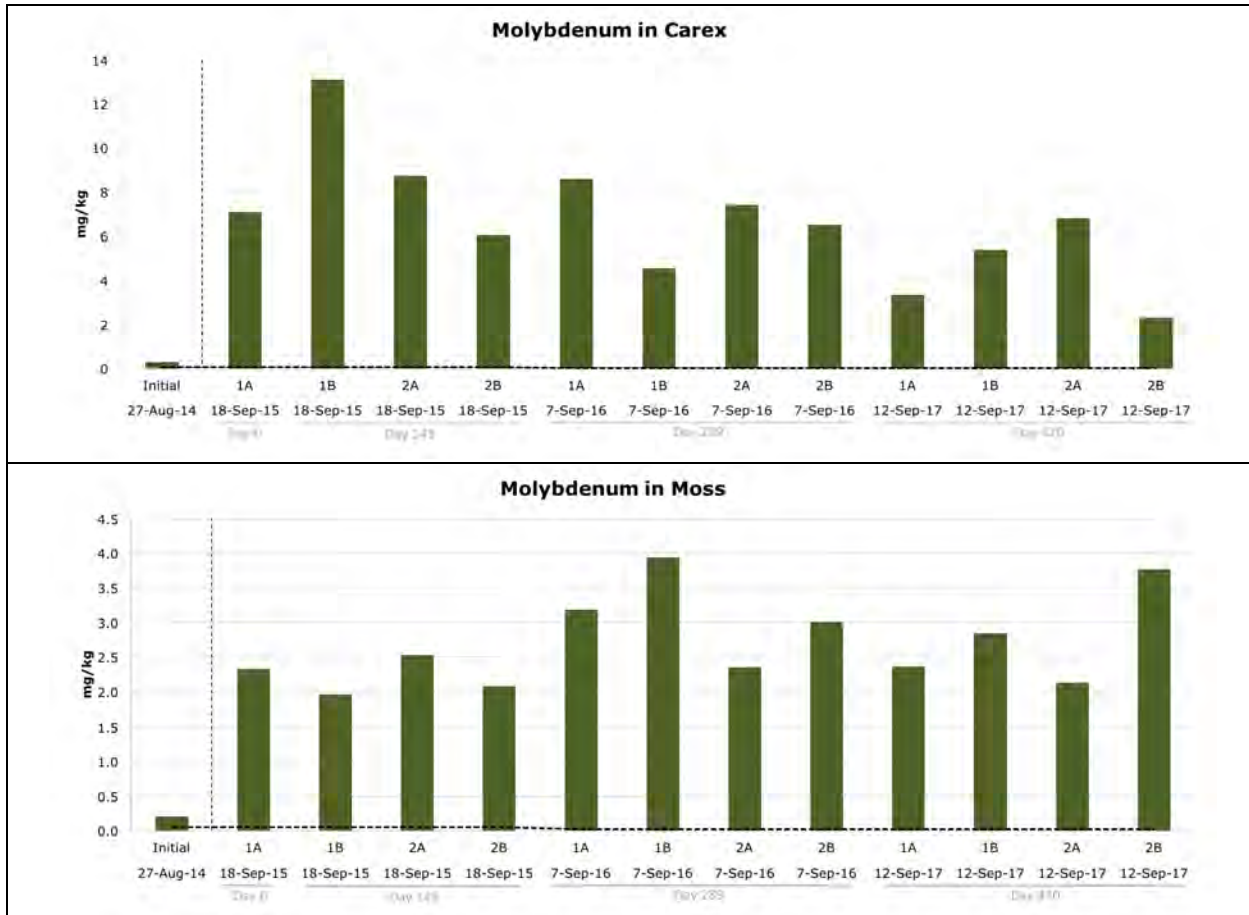


Figure 25 – Molybdenum concentrations in plants.

The 2014 and 2015 detection limit (DL; horizontal dotted line) for molybdenum is 0.05 mg/kg, the 2016 and 2017 DL is 0.020 mg/kg. The initial data set is the average of three *Carex* replicates at construction.

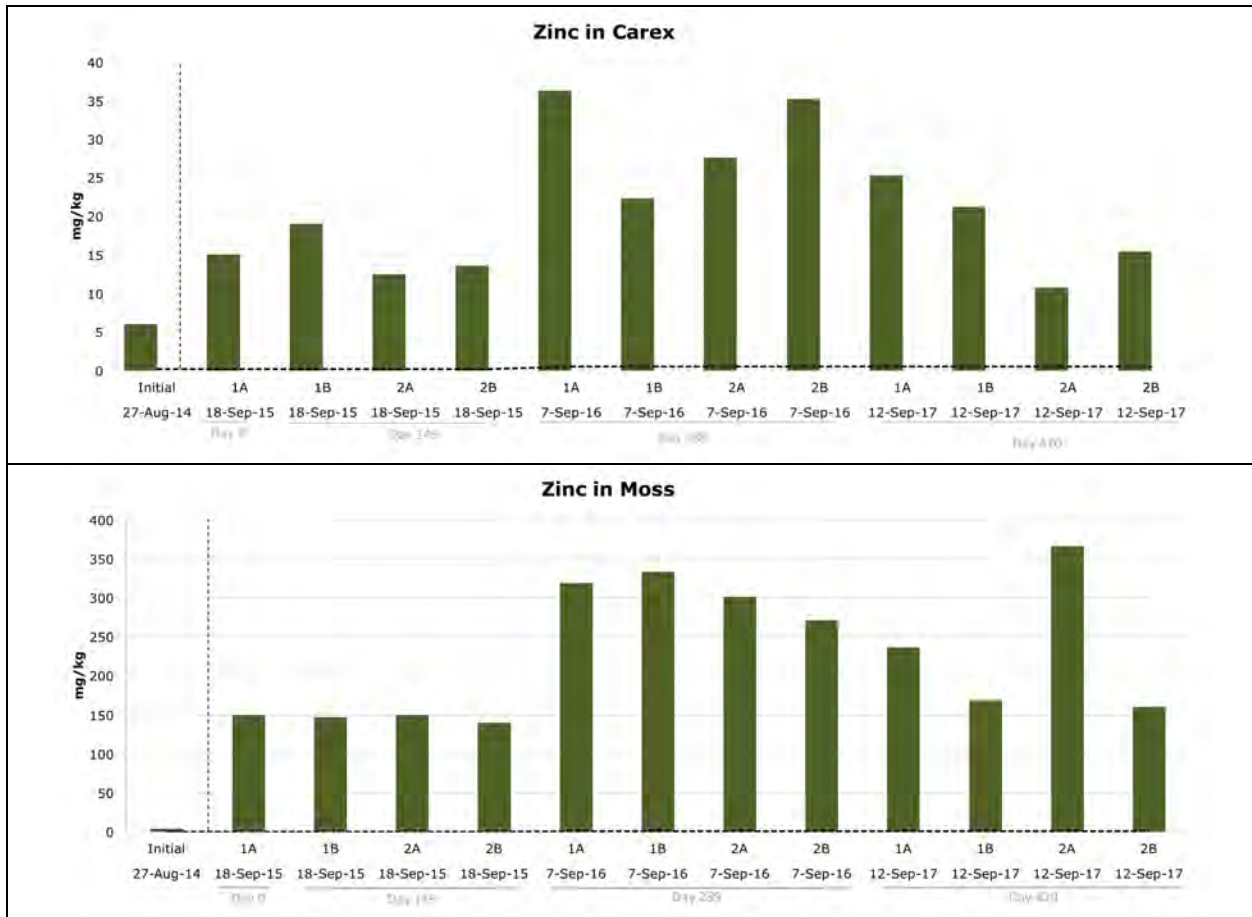


Figure 26 – Zinc concentrations in plants.

The 2014 detection limit (DL; horizontal dotted line) for zinc is 2.0 mg/kg, the 2015 DL is 0.002 mg/kg, and the 2016 and 2017 DL is 0.5 mg/kg. The initial data set is the average of three *Carex* replicates at construction.

5.8. Detritus Study

The following are key findings regarding the detritus study, which are detailed further below:

- The detritus study suggested that algae growth on the assay devices had reached a steady state (growth vs decomposition) by ~23 days of the study.
- After 83 days submerged in the CWTS, *C. aquatilis* decomposed on average 64%.

A detritus study was conducted in 2017 to assess decomposition rates of *C. aquatilis* in the CWTS over time as well as to determine the steady state of carbon contribution from algae growth on CWTS materials (Chimney and Pietro, 2006; Hammerly et al., 1989). Additional details describing the methods can be found in Appendix A. The study began on June 21, 2017 when six bags filled with 5g of oven dried *C. aquatilis* were submerged into each CWTS cell to determine the decomposition rate of *C. aquatilis* (Figure 27). Variability between samples are indicated by error bars (minimum and maximum values) in Figure 28. Six additional bags filled with 3.8 g of polyester filter fiber material were submerged into each cell of the CWTS to determine the algae growth rate. On July 25, 2017 and September 11, 2017 (after 34 and 83 days of submersion in the CWTS, respectively) one bag filled with *C. aquatilis* and one bag with the polyester fiber were sacrificed from each CWTS cell and the dried weights compared to initial sample weights (Table 9). This resulted in four replicates for each treatment and sampling date.

The weight of the polyester fiber bags increased by an average 23% after 34 days, and by 21% after 83 days, suggesting that the algae growth had reached a steady state prior to 34 days. After being submerged for 34 days in the CWTS, *C. aquatilis* decomposed on average 56% from the initial weight (decreasing from 5 g to 2.2 g) and continued to decompose to an average of 64% (decreasing from 5 g to 1.8 g) after submersion for 83 days in the CWTS (Table 9). There was little variability between cells. These detritus decomposition rates have been adjusted for by subtracting the weights of algal growth of the corresponding polyester fiber filled bag (Appendix A).

Four bags of each material remain in each cell for future sampling. The detritus study will continue in 2018 to enable monitoring and calculation of decomposition and accretion rates.



Figure 27 – Detritus study bags.

Left are mesh bags filled with sedges and polyester fiber fill stuffing. Left are mesh bags with *C. aquatilis* and control polyester prior to addition to the CWTS, middle are bags submerged in a CWTS cell and attached to depth stick, and right is a mesh bag with decomposed sedges and polyester fiber fill stuffing.

Table 9 – Results of the *C. aquatilis* detritus study.

| | Initial weight of <i>C. aquatilis</i> (g) | Dry weight after 34 days (g) ² | Decrease in weight after 34 days (%) | Dry weight after 82 days (g) ² | Decrease in weight after 83 days (%) |
|---------|---|---|--------------------------------------|---|--------------------------------------|
| 1A | 5.0 ¹ | 2.1 | 57% | 1.7 | 65% |
| 1B | | 2.1 | 59% | 1.7 | 67% |
| 2A | | 2.3 | 54% | 2.0 | 61% |
| 2B | | 2.4 | 52% | 1.9 | 63% |
| Average | | 2.2 | 56% | 1.8 | 64% |

¹ Initial weight prior to bags being placed in CWTS.

² Weights of *C. aquatilis* corrected by subtracting the increase in weight from the polyester fiber fill to account for algae growth.

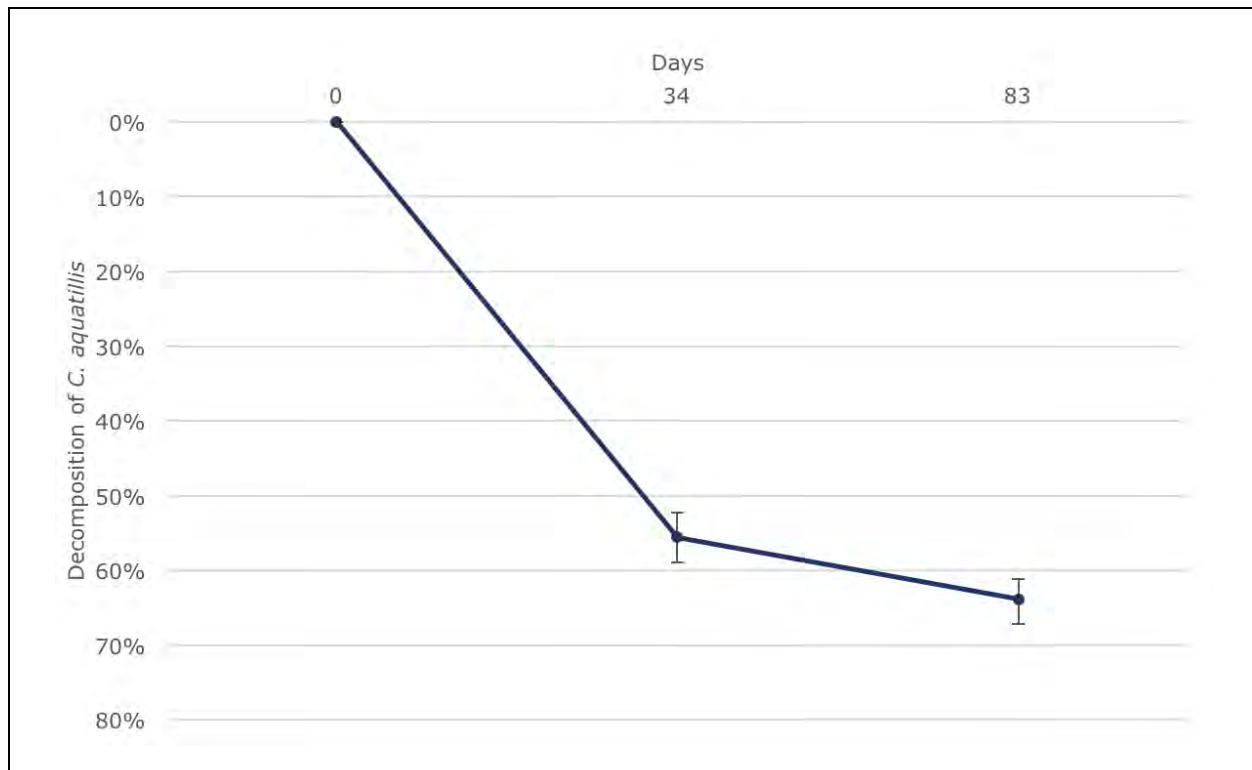


Figure 28 – *C. aquatilis* decomposition over time.

Decomposition was measured by the decrease in weight over time of the *C. aquatilis* samples compared to the initial weight. The decomposition rate was corrected for algae growth by subtracting the increase in weight of the polyester filter foam from the dry weight of the *C. aquatilis* samples over time. Error bars indicate the variation in results for each time point.

5.9. Beneficial Microbes

The following are key findings regarding beneficial microbe establishment in the CWTS, which are detailed further below:

- Establishment of sulphide-producing bacteria (SPB) increased throughout 2017 and was highest after commissioning was completed.
- SPB were found in highest abundance in root and soil samples.
- The average number of different types of sulphide-producing bacteria increased over time in all sample types tested (root, soil, detritus, and moss).
- Selenium-reducing and nitrate-reducing bacteria increased over time with the highest abundances found in *C. aquatilis* roots.

Microbes are the driving force of many treatment pathways that are targeted in CWTSs. The beneficial microbes in these CWTSs catalyze biogeochemical processes that remove specific constituents of concern from the water column. Careful design of CWTSs can create the environmental conditions needed to enhance the abundance and metabolic activity of these beneficial microbes. Accordingly, complimentary methods of genetic and growth-based testing were used to characterize the microbial populations associated with a range of microbial habitats in the demonstration-scale CWTS (e.g., soils, sediment, biofilms, aquatic mosses, and plant roots).

In the context of the Minto Mine CWTS, beneficial microbes include those that are involved in the reduction of selenium (i.e., selenate and selenite), nitrate, and sulphur compounds. Reduced sulphur can in turn treat copper, cadmium, molybdenum, and zinc through geochemical interactions. Information on each of these mechanisms and the associated microbial populations in the demonstration-scale CWTS is outlined in the following sections.

5.9.1. Sulphide-producing Bacteria

Treatment of metals and metalloids can be achieved by targeting the lithic biogeochemical sequestration of divalent metals through sulfide (i.e., S^{2-} , HS^-) precipitation as mineralized species (e.g., covellite $[CuS]$, chalcocite $[Cu_2S]$). These sulfide-bound species are relatively insoluble (CuS ; $K_{sp}=10^{-16}$; Stumm and Morgan 1996) and are transferred from the water column into the CWTS soil as non-bioavailable fractions (Murray-Gulde et al., 2003; Huddleston et al., 2008). Moreover, similar reactions occur with cadmium and zinc, rendering them non-bioavailable. As such, sulphide production is a key biogeochemical mechanism for water treatment at Minto Mine. Sulphides can be created by beneficial microorganisms through the reduction of sulphur-containing compounds, such as sulphate, sulphite, thiosulphate, and elemental sulphur.

Based on the information gathered in pilot-scale testing, the targeted soil redox for the demonstration-scale CWTS is between -100 and -250 mV to facilitate these reactions. This is in agreement with literature that indicates anaerobic conditions with relatively low ORP (-250 to -100 mV) are necessary to promote anaerobic metabolism in bacteria which oxidizes

organic matter and produces electrons, which in turn reduces sulfate to hydrogen sulfide (H₂S) and other sulfide species (i.e., bisulfide ion (HS⁻), sulfide ion [S²⁻]; Mitsch and Gosselink 2007). In these redox ranges, bacterial sulphide-production through reduction of sulphur compounds is expected, alongside increases in the proportion (percentage) and abundance of these microbes.

As expected, diversity (Table 10), proportion, and inferred abundance of sulphide-producing bacteria (SPB) increased as the soil redox decreased in the demonstration-scale CWTS with the highest proportions observed in 2017 compared to 2016, as the CWTS has matured (Figure 29, Figure 30, Figures B28 and B29 in Appendix B; Contango, 2017). Proportions of SPB increased in all sample types (soil, roots, moss, and detritus) over time through 2017 (Table 10). As observed in 2016, the *C. aquatilis* roots were again found to harbour the highest proportions and abundances of beneficial SPB, followed by the soil, detritus, and moss. Furthermore, the highest proportions were observed in the operational period for both soil and root samples. Root, detritus, and soil samples harboured the highest average number of different SPB types, followed by moss (Table 10). However, the average number of different types of SPB increased over time in every sample type tested.

The microbial analysis of various sample types in the CWTS has therefore confirmed that the commissioning period proceeded as expected and was successful in establishing beneficial SPB populations alongside reducing conditions. Monitoring of soil redox as well as microbial populations will continue to be monitored for stability or further improvement in 2018.

Table 10 – Average number of different types of sulphide-producing bacteria in 2014/2015, 2016, and 2017.

| Sample Type | 2014 & 2015 | 2016 | 2017 |
|-------------|-------------|------|------|
| detritus | NT | 6 | 9 |
| moss | 3 | 4 | 8 |
| root | 6 | 8 | 9 |
| soil | 4 | 8 | 9 |

NT – not tested. The number of different types is based on counting the number of operational taxonomic units (clustered at 97% identity) that are classified as known sulphide-producing bacteria.

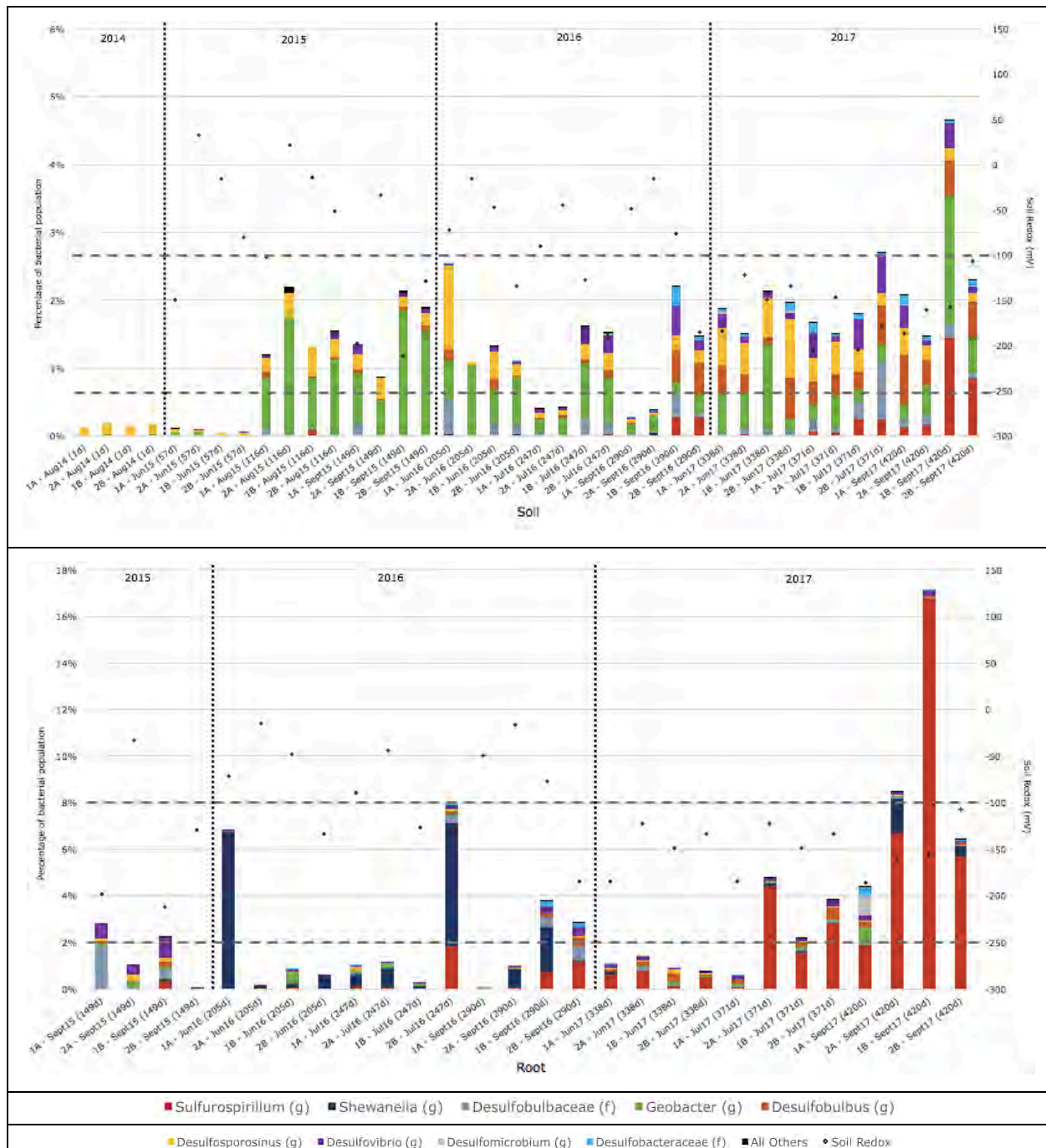


Figure 29 – Percentage and identity of sulphide-producing bacteria in soil (top) and roots (bottom) demonstration-scale CWTS.

The horizontal dashed lines indicate the targeted soil redox range. Organism classifications and data analysis methods have been updated from Contango (March 2016). The y-axis provides the percentage of the bacterial community (relative abundance) that corresponds to sulphide-producing bacteria through the reduction of sulphate, sulphite, thiosulphate, and sulphur. Percentage is based on identification via genetic sequencing. Organisms are either classified to the genus (g) or family level (f). The root y-axis is different from the soil y-axis as the % SPBs is much higher in one sample of root (1B – Sept17 (420d)).

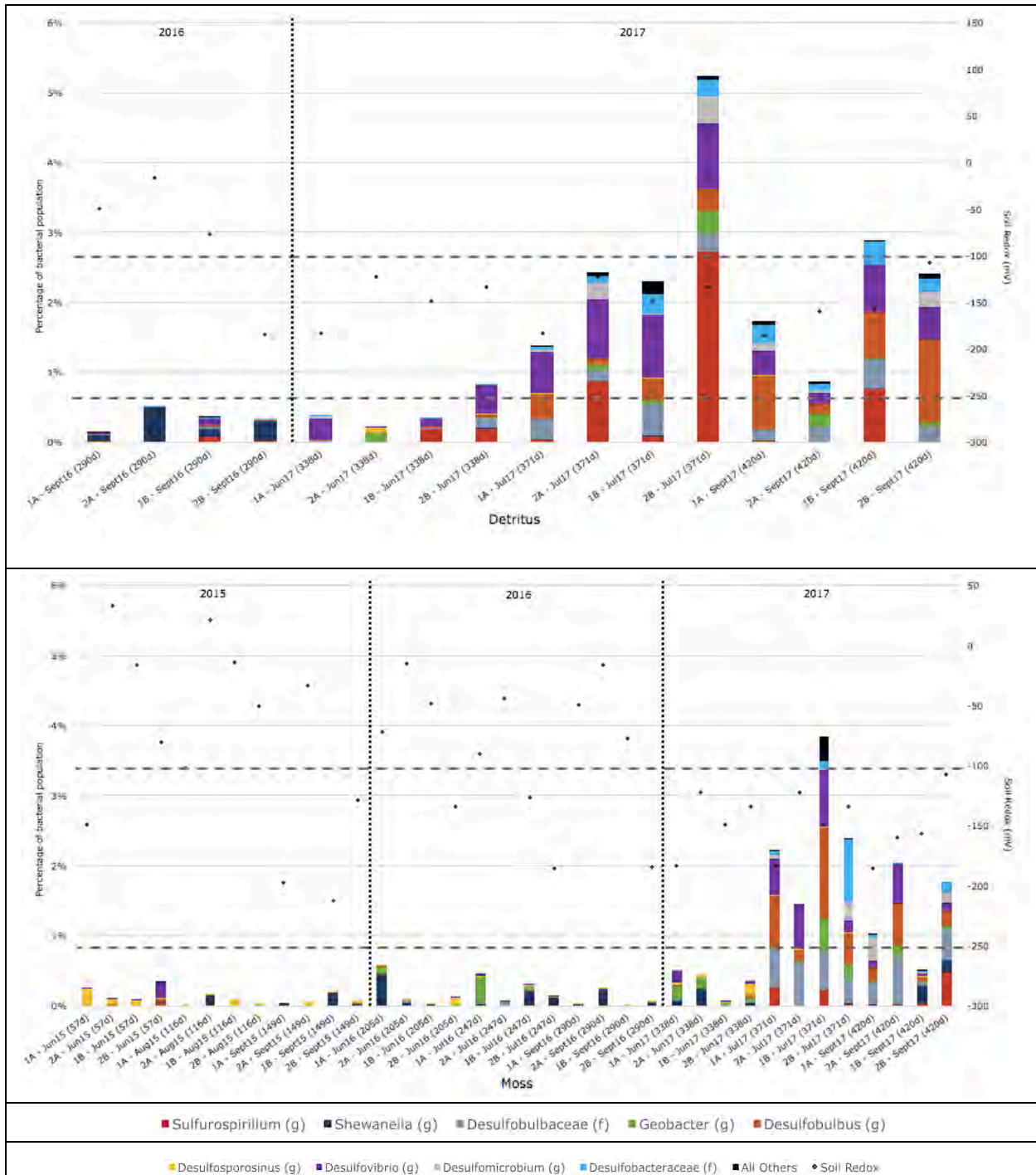


Figure 30 – Percentage and identity of sulphide-producing bacteria in detritus (top) and moss (bottom) demonstration-scale CWTS.

The horizontal dashed lines indicate the targeted soil redox range. Organism classifications and data analysis methods have been updated from Contango (March 2016). The y-axis provides the percentage of the bacterial community (relative abundance) that corresponds to sulphide-producing bacteria through the reduction of sulphate, sulphite, thiosulphate, and sulphur. Percentage is based on identification via genetic sequencing. Organisms are either classified to the genus (g) or family level (f).

5.9.2. Selenium-reducing Bacteria

The targeted selenium treatment pathways in the Minto CWTS include sorption to moss and soils, and subsequent microbial reduction of soluble (sorbed) selenate (Se(VI)) and selenite (Se(IV)) to insoluble elemental selenium (Se (0)). This reductive process can also be achieved directly in the water column, but is more effective when associated with mosses and biofilms due to their sorptive properties that bring the selenium in contact with beneficial selenium-reducing bacteria. Selenium reduction biogeochemical processes are achieved within the range of soil redox conditions targeted for sulphate-reduction as suggested by pilot-scale testing and literature (Contango, 2014).

Selenite-reducing organisms are ubiquitous in nature and as expected, were detected in all sample types, including algae, biofilm, moss, soil, sediment, roots, and detritus. Although organisms that reduce selenate to elemental selenium (rather than intermediary selenium compounds) are generally less abundant in the environment, they were found associated with all sample types, indicating that the conditions conducive to their proliferation have been created within the CWTS. Moreover, the abundance of selenite- and selenate-reducing organisms generally increased or remained stable over time in the demonstration-scale CWTS through the commissioning and operational periods in (Figure B30 in Appendix B). Aquatic mosses were found to initially host the highest abundance of both selenate- and selenite-reducing organisms, affirming the importance of the inclusion of moss in the CWTS. Over time, as the vegetation has established, selenium-reducing bacteria have increased in abundance on the roots of *C. aquatilis* (Figure B30 in Appendix B).

These findings indicate the commissioning period was successful and the demonstration-scale CWTS has established and maintained beneficial selenium-reducing microbes. Selenium is removed as it is sorbed to moss or detritus or by interacting directly with selenium in water that has been drawn into the root zone by plants. Abundance of selenium-reducing bacteria is similar to that found through 2016 and during pilot-scale soil testing, suggesting they have established as expected. Selenium-reducing microorganisms will continue to be monitored in 2018, alongside performance testing.

5.9.3. Nitrate-reducing Bacteria

Nitrate is sometimes a constituent of concern during operations and early closure owing to residuals from blasting activities. Even if not in exceedance of water quality guidelines in terms of receiving environment objectives, nitrate often requires treatment in order to subsequently achieve treatment of other constituents such as selenium and metals through sulphide production. Nitrate can be removed from water through denitrification by different types of microbes, including nitrate reducing bacteria which can reduce nitrate (NO₃) to nitrite (NO₂), and also denitrifying organisms that are capable of fully reducing nitrate to nitric oxide (NO), nitrous oxide (N₂O), and dinitrogen gas (N₂, which is the most abundant gas in air). Most-probable number (MPN) analysis was therefore used to quantify these organisms.

As observed in 2016, nitrate-reducing and denitrifying organisms were found associated with all sample types in the demonstration-scale CWTS (Figure 31; Contango, 2017). Roots and detritus had a high abundance of both nitrate and denitrifying organisms, with soil being similar to or slightly less than what was found during pilot-scale testing. These results indicate nitrate reducers have established in the CWTS during the commissioning period as expected. Nitrate-reducing microorganisms will continue to be monitored in 2018, alongside performance testing.

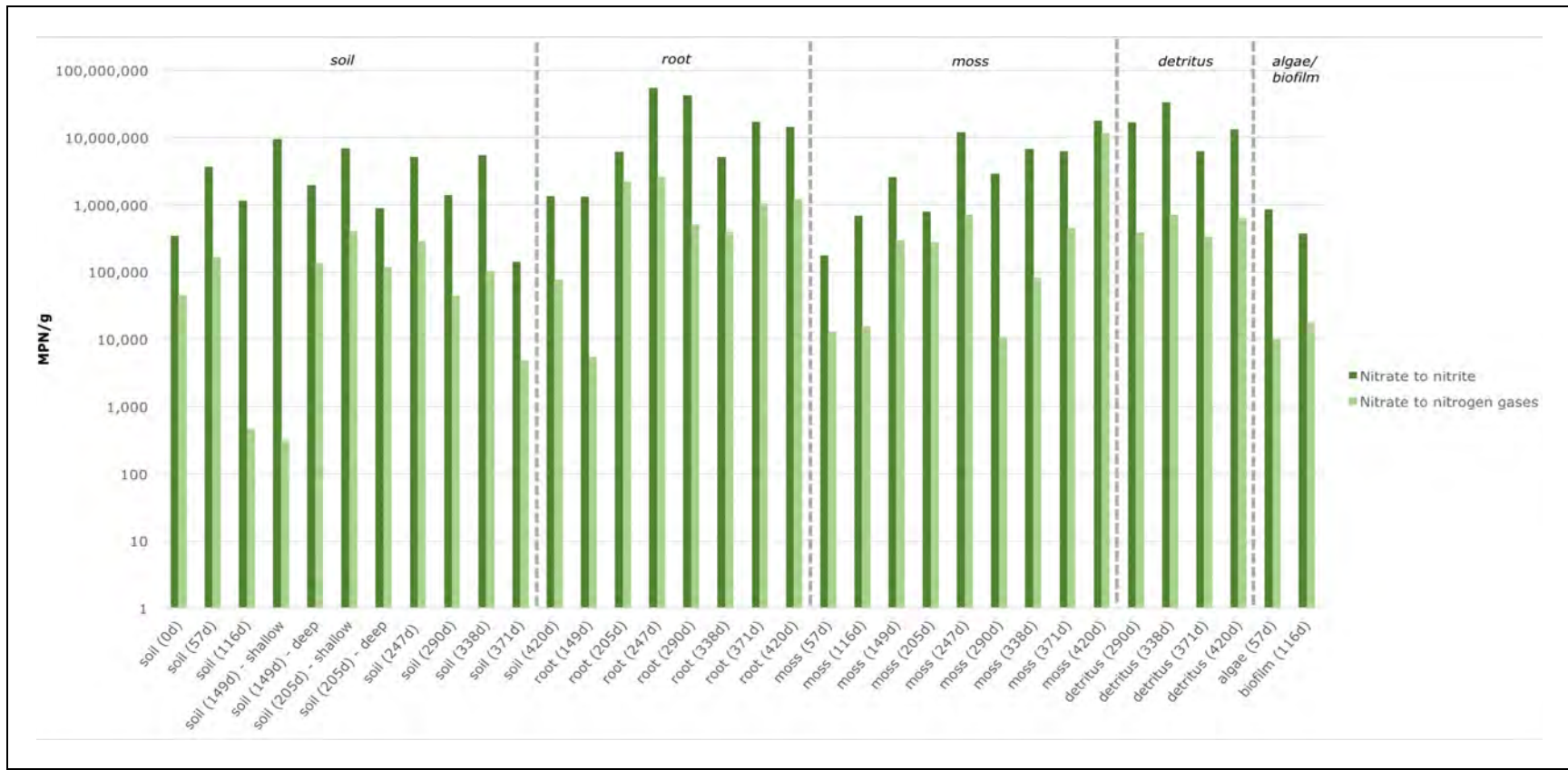


Figure 31 – Abundance of nitrate-reducing and denitrifying organisms in various CWTS sample types over time. Nitrate-reducing = reduction of nitrate to nitrite; denitrifying = reduction of nitrate to nitrogen gases. Shallow soil (0-5 cm); deep soil (10-20 cm); soil at 0d was that used for construction of CWTS.

6. Operational Challenges

The following are key findings regarding operational challenges, which are detailed further below:

- Aphids were again found in abundance on *C. aquatilis* in 2017.
- Efforts to control the aphid population on-site were made but an ongoing spraying regiment was not maintained and, therefore, aphids remained. However, no short-term detrimental effect on *C. aquatilis* viability was observed, despite the persistence of aphids.
- Damage to the above water vegetation was observed however new shoots were emerging in the CWTS and treatment COCs was not impacted by damage to the above water vegetation.
- Effects of aphids on *C. aquatilis* did not affect treatment.
- These issues with aphids are likely owing to the isolated nature of the demonstration-scale CWTS and not expected to affect the full-scale CWTS.

The Minto Mine's demonstration-scale CWTS, which is constructed of an emergent macrophyte monoculture of *Carex aquatilis*, experienced an aphid infestation in 2016 and 2017. The demonstration-scale CWTS is located in a relatively isolated area, away from other vegetation and potential sources of insects. It is known that aphids can migrate on air currents (Dixon, 1971), possibly over great distances (Riley et. al., 1995), which may be how they reached the demonstration-scale CWTS. Aphids are often monophagous, meaning they feed on one species of plant (Footitt and Maw, 1997) and it is likely that having additional vegetation available will not reduce the level of infestation on the *Carex* species planted in the CWTS. However, if additional surrounding vegetation is available, it could provide habitat for natural predators of aphids. With the demonstration CWTS currently located 50 m away from trees or other vegetation, there is little to no opportunity for natural predators to inhabit the area or incentive to travel the distance to the CWTS. The large buffer area (MVFE) around the demonstration-scale CWTS allows the aphids to colonize more robustly than anticipated in the full-scale CWTS onsite, which would not have the same buffer zone. This would not be an issue in the full-scale CWTS.

Aphids can be controlled, naturally, by predatory insects such as ladybugs, lacewings, and parasitic wasps (Flint, 2001). Ladybugs were observed in very small numbers on the *Carex* plants but in insufficient numbers to control the aphid population. Lacewings are found throughout North America and would be expected to be present in the Minto Mine region (Russel and Diaz, 2015). Several types of parasitic wasps that prey on aphids are known to be present in the Yukon (Finnamore, 1997). Other control methods involve the use of insecticidal soaps, which are recommended as they are non-toxic to most other insects and kill aphids through contact (the soft bodies are suffocated by the fatty acids in the soap; Ubl and Munnerlyn, 2009).

To quantify the aphid population on-site, sticky, yellow insect traps were installed at W10 and W15 as well as eight (two per cell) in the CWTS in 2017 (Figure 32). However, none of the traps at any of the locations were successful in trapping aphids and instead trapped numerous

other insects. It was observed that the sticky traps at W10 and W15 trapped a larger quantity and diversity of insects compared to the traps installed in the CWTS. This suggests that the larger population and diversity at the W10 and W15 areas assisted with keeping aphid populations under control in these areas. Due to the isolated area of the CWTS, away from other vegetated areas, the CWTS hosted a smaller quantity and diversity of insects which were not able to keep the aphid population under control.

Efforts were made in 2017 to control the aphid population by applying a mild insecticidal soap (Scott's EcoSense Bug B Gone Insecticidal Soap concentrate mixed with water) or a soap solution using a hand-held sprayer. Although the insecticidal soap was more effective than the soap solution, an ongoing spraying regiment was not maintained long enough to decimate the population. Care must be taken when using insecticidal soap to spray all surfaces of plant leaves, as aphids frequently inhabit the underside of leaves. Applications should be repeated every 4-7 days (follow label instructions) until pests are eliminated (Ubl and Munnerlyn, 2009). A stronger insecticidal soap (Trounce's Yard and Garden Insecticide) was applied on September 13, 2017 in another effort to reduce aphid populations; however, no discernable change was noticed, perhaps due to the lateness in the season. Insecticidal soaps with natural plant-based pyrethrins may provide control with fewer negative impacts than insecticides like malathion, permethrin, and acephate because pyrethrins break down quickly (Flint, 2001).

Series 1 of the CWTS appeared to have a larger aphid infestation and resulted in more damage to the above water vegetation. Regrowth will be monitored in 2018 and replanting of Series 1 may be required. The aphids will continue to be monitored in 2018 and compared with other background areas (e.g., W10 and W15) to see if increases in aphid populations are specific to the CWTS, or general to the area. In 2018, it is recommended that a stronger insecticide be applied early in the season and on a frequent, predetermined schedule.



Figure 32 - Insect traps.

Insect traps installed in CWTS cells (left and right), insect trap installed at W15 (center) in 2017.





Figure 34 – Aphids observed on *C. aquatilis*.
The left picture was taken in 2016 and the right picture was taken in 2017. Note the small green and black aphids on *C. aquatilis* leaves.

7. Summary of Results

When designed and implemented in a strategic and scientifically guided manner, CWTS can mitigate risks posed by many constituents. A treatment plan including processes to precipitate insoluble species of these constituents for sequestration into the soils of the wetland are very desirable as this mechanism captures the constituents and stores them in stable form in the soil, rather than transferring the constituents to an indeterminate fate (e.g., through plant uptake that can potentially bio accumulate in wildlife or be re-released in plant decomposition). This study addressed several important design considerations regarding implementation of a CWTS at full-scale for the treatment of metals and metalloids to meet the overriding objective of completing commissioning of the CWTS and progress through operational performance. A summary of key findings from the 2017 studies and recommendations to meet the objectives are listed below.

Monitor explanatory parameters and performance to determine when commissioning is complete, and the operational period has begun:

- Dissolved oxygen (DO) decreased from an average of 8.4 mg/L during commissioning-B in 2016, to an average of 5.3 mg/L during operations in 2017. The DO in the water column is likely the result of photosynthesis of algae and mosses.
- Despite this DO level in the water column being in oxidizing ranges, stable reducing conditions were achieved in the CWTS soils within the targeted soil redox range (-100 to -250 mV).

Assess removal of constituents from the water:

- Copper treatment in the CWTS was masked by leaching from the soils used in construction of the CWTS into the water, but this has mostly been remedied now by the wetland treating this copper and turning it into more stable sulphide forms in the soil.
- During the operational period the demonstration-scale CWTS successfully achieved an average decrease in concentrations of 0.0169 µg/L for cadmium (from 0.0261 µg/L to 0.0092 µg/L), 31.8 µg/L for copper (from 49.1 µg/L to 17.3 µg/L), 3.6 µg/L for molybdenum (from 6.3 µg/L to 2.7 µg/L), 3.5 µg/L for selenium (from 4.0 µg/L to 0.5 µg/L), and 47.3 µg/L for zinc (from 49.2 µg/L to 1.9 µg/L).
- Molybdenum and selenium treatment in the operational period is notable as the removal rates were negligible within the margins of error of the testing method in the commissioning-A period.

Determine the hydraulic residence time (HRT) by tracer study and associated correction factor to apply to the nominal (calculated) HRT:

- The tracer study effectively demonstrated the HRT (2.25 days) and flow symmetry through the CWTS.
- There was a single flow path in the CWTS (shown by a single peak in the tracer study)
- Water is incorporating into the CWTS soils (shown by the long tail for depletion of the tracer).

- The nominal HRT is calculated from the area of the CWTS and the depth at the in-situ measuring points. This nominal HRT does not account for depth variations, embankment slopes, vegetation (using space in the water), or substrate pore space involvement. It was found that once all of these factors are in play, the correction factor from nominal to actual is only 0.01 added to the depth of the CWTS, which is incorporated into the HRT calculation as expressed in Equation 3.

Evaluate CWTS performance, and determine achievable concentrations of contaminants of concern (thermodynamic minimums):

- All targeted constituents are being treated by mineralization and sequestered to the soils (minimal plant uptake).
- The lowest concentrations consistently achievable for the treatment design (thermodynamic minimums) were reached by the end of the A cells for cadmium and copper.
- RRCs for cadmium and zinc in the 2017 demonstration-scale CWTS were artificially low because low flow rates did not provide the resolution needed to determine a RRC.
- Removal rate coefficients (RRCs, k) have been developed that can be used for full-scale sizing.
- Copper leaching from soils has decreased but is still likely making the RRC artificially low in this CWTS; however, the RRC is expected to improve once copper leaching has subsided.

Update site-specific removal rate coefficients (from commissioning period) with data from operational period:

- Removal rate coefficients (RRCs, k) have been developed that can be used for full-scale sizing.
- Copper leaching from soils has decreased but is still likely making the RRC artificially low in this CWTS.

Determine amount of water loss due to evapotranspiration and effect on outflow concentrations:

- The evapotranspiration studies revealed a significant loss of water, which will impact calculations of loads to the receiving environment (making them lower than previously estimated).
- In May and June, an average water loss of 5.3 L/day/m² was observed, which is equivalent to 18-20% of water (~700 L/day lost in the demonstration CWTS).
- During the evapotranspiration trials, copper leached into the water as it was transformed from an oxide mineral to a sulphide mineral (because of the copper in the soils used for construction). This is not representative of what would occur during periods with no flow in a full-scale CWTS, where soils with minimal leachable copper are used and copper is deposited in sulphide form (fraction 4) by the biogeochemical activity of the CWTS (Section 5.6).

Monitor metals leaching from mineralized soils used in construction:

- In 2017, leachable copper concentrations in soils decreased in the top 0-10cm while total copper concentrations increased.

Assess stability of constituents of concern in soils:

- Most constituents, including copper, have shifted primarily into stable reduced and residual minerals fractions in the soil.
- Acid volatile sulphides (AVS) were non-detectable in the CWTS in 2016. In 2017, small amounts of AVS were detected in cells 1A and 2A which indicates that residual sulphides are starting to become available for metal treatment and that copper in the soils are becoming rendered inert through sulphide mineralization.

Determine the rate and extent of detritus decomposition (*C. aquatilis* leaves) in the CWTS over time:

- The detritus study suggested that algae growth on the assay devices had reached a steady state (growth vs decomposition) by ~23 days of the study.
- After 83 days submerged in the CWTS, *C. aquatilis* decomposed on average 64%.

Assess treatment mechanisms (including microbes):

- Establishment of sulphide-producing bacteria (SPB) increased throughout 2017 and was highest after commissioning was completed.
- SPB were found in highest abundance in root and soil samples.
- The average number of different types of sulphide-producing bacteria increased over time in all sample types tested (root, soil, detritus, and moss).
- Selenium-reducing and nitrate-reducing bacteria increased over time with the highest abundances found in *C. aquatilis* roots.

Determine an appropriate method for insect pest control (aphids) in the CWTS:

- Aphids were again found in abundance on *C. aquatilis* in 2017.
- Efforts to control the aphid population on-site were made but an ongoing spraying regiment was not maintained and, therefore, aphids remained. However, no short-term detrimental effect on *C. aquatilis* viability was observed, despite the persistence of aphids.
- Damage to the above water vegetation was observed however new shoots were emerging in the CWTS and treatment COCs was not impacted by damage to the above water vegetation.
- Effects of aphids on *C. aquatilis* did not affect treatment.
- These issues with aphids are likely owing to the isolated nature of the demonstration-scale CWTS and not expected to affect the full-scale CWTS.

9. Closure

We trust the information herein satisfies your present requirements. Should you have any questions, please contact the persons listed below. We appreciate the opportunity to provide the services detailed in this report and look forward to discussing any comments you may have.

Respectfully submitted,

Contango Strategies Ltd

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Appendix R - 2017 Annual Socio-Economic Monitoring Report



Minto Mine
2017 Annual Socio Economic Monitoring Report

Prepared by:
Minto Explorations Ltd.
Minto Mine
March 2018

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1 Introduction

This report has been prepared by Minto Explorations Ltd., a subsidiary of Capstone Mining Corp., in regards to the Minto Mine property (Minto), located in central Yukon. The following report summarizes the results of the socio economic available data at Minto for 2017, as required by the Socio Economic Monitoring Program framework.

The Minto Mine Socio-economic Monitoring Program (Minto Explorations, Yukon Government, Selkirk First Nation, 2014) is a program that has been developed in conjunction with Selkirk First Nation and the Yukon Government to monitor the socio economic effects of Minto Mine on SFN. The primary components of the program include; the mine providing information relating to SFN (e.g. employment data, training information etc.), a community based survey (conducted by SFN and YG), and information from SFN and YG relating to Pelly Crossing or SFN. The information from all of those components is then used in the preparation of an annual report produced by a third party consultant.

Not all of the data that has been requested from historical records is available. Going forward Minto will collect the required and necessary data in order to provide more accurate information for the bi-annual reports. Minto has given best efforts to collect and obtain historical data and going forward accuracy of information and data collection will continue to be further refined.

1.1 Factors at Minto that may have a socio-economic impact

The Minto Mine is an open pit and underground copper mine located 240 kilometres north of Whitehorse in central Yukon, Canada. Minto is located on Selkirk First Nation Category “A” land.

An initial cooperation agreement (CA) between Selkirk First Nation and Minto was agreed upon and signed in 1997, and was later amended in 2009. The agreement serves as a formal document that covers governance, business partnerships, training and employment, and royalties of the Minto Mine on Selkirk First Nations land.

The community of Pelly Crossing is located along the Klondike Highway on the banks of the Pelly River, 282 kilometers northwest of Whitehorse. Pelly Crossing is home to SFN people which includes 336 people (2011 census) 305 which are first nation. The average income of population aged 15 years and over in Pelly Crossing is \$26,585 with the average house price being \$274,106 (2011 National Household Survey). The median population age of Pelly Crossing is 38 years of age (2011 census).

The city of Whitehorse is the capital of Yukon and is the largest community in the territory with a population of 27,889 (Yukon government website) or 76% of the total Territorial population.

The remote location and access to Minto dictates a fly in fly out (FIFO) camp operation. In Yukon, there is a general shortage of available professional and skilled workers. The location is also impacted by low amounts of locally manufactured goods and materials.

The advanced and post-secondary education and training opportunities available in Yukon, is generally lower than opportunities further south. This impacts the local labour pool resulting in a shortage of potential workers with mining career related experience, and educational backgrounds. Recruitment of

local candidates is also impacted by lower overall literacy rates in the North, and a shortage of local candidates possessing a valid driver's license.

Other factors that may have impacted socio-economic indicators include:

- Implementation of socio-economic monitoring program
- Permitting and Regulatory delays
- Declining copper prices
- Mine life uncertainty

2 Minto and Contractors Safety Statistics

The below table (Table 2-1) summarises the safety statistics for Minto Employees and site contractors for 2017. The total incidents include minor first aids treated at the site, any property damage, near-misses that could have resulted in an incident, medical aids (where treatment is required off site) and lost-time accidents where a worker would be unable to return to their duties and had to miss work. In 2017, there were 3 lost time accidents, all 3 were contractor employees.

| 2017 Total incidents | Minto | Contractors |
|----------------------|-------|-------------|
| 57 | 22 | 35 |

3 Employment

Minto utilizes a preferential hiring recruitment approach as outlined in our Cooperation Agreement, with Selkirk First Nation. Our preferential hiring involves the following: Positions are first advertised and offered in the following order of priority: SFN, NTC (Northern Tutchone) Pelly Crossing Resident, OFN, Yukon, and Western Canada.

3.1 Employment Income and Distribution

The following sections outline information and figures that demonstrate salaries are higher for those who are in major centres and/or employed outside of Yukon. Potential reasons for this for Minto include:

- 7 out of 8 Managerial staff live outside Yukon.
- The majority of professional, supervisory and designated staff are residents of the rest of Canada (Non-Yukon residents)

Other factors for this could potentially be linked to a lack of potential candidate pools in Yukon of professional and managerial experienced staff. Further, the post-secondary education requirements for these roles cannot be obtained in Yukon.

The Company operates a fly in fly out (FIFO) camp model which is attractive to employees who can stay in their current hometowns and not have to move North. This approach has become somewhat standard

practice for the mining industry in Western Canada, our peer group, and Minto operates in a fashion to be competitive in this market. Employees expect a FIFO in a remote mining location.

Major centres of Whitehorse and Rest of Canada have the highest income. One of the possible reasons for this is that those areas have a larger qualified candidate pool? Outlying areas including Pelly Crossing and Rest of Yukon have less availability of qualified candidates for skilled, professional and managerial positions.

3.1.1 Minto - Average employment income by Residency

| | Pelly | Whitehorse | Yukon | Rest of Canada |
|-------|-------|------------|---------|----------------|
| Minto | 29.86 | \$34.17 | \$33.08 | \$42.61 |

3.1.2 Contractors - Average employment income by Residency

| | Pelly | Whitehorse | Yukon | Rest of Canada |
|--------|---------|------------|---------|----------------|
| Pelly | \$27.85 | \$29.15 | \$28.34 | \$31.13 |
| Dumas | 18.50 | \$20.67 | \$20.75 | \$21.82 |
| Sodexo | \$16.27 | \$17.83 | \$16.09 | \$16.43 |

Potential contributing factors include:

- Dumas Contracting is located in eastern Canada indicating hiring from a preferred talent pool in this location
- Most Sodexo employees are entry-level non-skilled workers. Sodexo, like many Remote Site Service providers, has a high turnover rate. However, this number was approximately 106% in 2017, it could be due to the uncertain future mine plans, however, we've noticed that a change in on-site management has made a positive difference and lessened turnover. Sodexo's voluntary turnover at Minto for 2017 was 40%. In total there were 35 new hires in 2017 and 30 exits (including voluntary and involuntary).

3.1.3 Minto and Contractors – Annual and cumulative total employee income by Group

| | Pelly Crossing | Whitehorse | Yukon | Rest of Canada |
|--------|----------------|----------------|----------------|----------------|
| Minto | \$512,458.5 | \$4,257,665.43 | \$1,468,130.90 | \$9,285,929.74 |
| Pelly | \$403,310.08 | \$2,771,763.42 | \$467,939.54 | \$1,587,027.14 |
| Dumas | - | \$149,558 | \$157,267 | \$6,131,670 |
| Sodexo | \$121,708.92 | \$608,544.60 | \$81,139.28 | \$243,417.84 |

3.1.4 Minto – Northern Employment by Group

| | SFN | Yukon FN | OFN | Other Yukon | Other Canadians | Total |
|-------|-----|----------|-----|-------------|-----------------|-------|
| Minto | 17 | 16 | 1 | 37 | 75 | 146 |

3.1.5 Minto - Employment by Residency

| | Pelly Crossing | Whitehorse | Other Yukon | Canada | Total |
|-------|----------------|------------|-------------|--------|-------|
| Minto | 8 | 49 | 13 | 76 | 146 |

3.1.6 Contractor - Employment by Residency

| | Pelly Crossing | Yukon | Canada | Total |
|--------|----------------|-------|--------|-------|
| Pelly | 6 | 41 | 15 | 62 |
| Dumas | 0 | 7 | 43 | 50 |
| Sodexo | 3 | 13 | 13 | 29 |

3.1.7 Minto – 2017 New Hires by Group

| | SFN | Yukon FN | OFN | Other Yukon | Other Canadians | Total |
|-------|-----|----------|-----|-------------|-----------------|-------|
| Minto | 8 | 0 | 1 | 13 | 27 | 49 |

3.1.8 Minto - Employment by Job Categories and Group

| | SFN | Yukon FN | Other Yukon | OFN | Other Canadians | Total |
|--------------|-----------|-----------|-------------|----------|-----------------|------------|
| Management | 0 | 0 | 1 | 0 | 10 | 11 |
| Professional | 1 | 4 | 13 | 0 | 38 | 56 |
| Skilled | 3 | 4 | 10 | 1 | 22 | 40 |
| Semi-skilled | 10 | 8 | 13 | 0 | 3 | 34 |
| Entry Level | 3 | 0 | 2 | 0 | 0 | 5 |
| TOTAL | 17 | 16 | 39 | 1 | 73 | 146 |

3.1.9 Minto and Contractors – Annual and cumulative total employees by group

| | Aboriginal | Yukon (Non-FN) | Total Yukon | Male | Female | Other Canadian | Total |
|--------|------------|----------------|-------------|------|--------|----------------|-------|
| Minto | 30 | 37 | 70 | 128 | 18 | 76 | 146 |
| Pelly | 23 | 28 | 47 | 48 | 14 | 15 | 62 |
| Dumas | 5 | 2 | 7 | 49 | 1 | 43 | 50 |
| Sodexo | 12 | 4 | 16 | 17 | 12 | 13 | 29 |

3.2 Voluntary Exits

In 2017, Minto had a slight increase in our voluntary turnover rate from the 2016 rate of 23.8%. A total of 40 employees voluntarily left Minto, which represents a voluntary turnover rate of 27.6%.

The results of voluntary exit surveys indicate the following main reasons for resignations:

- Most of the voluntary turnover was at the beginning of the year was a result in the Company announcing a shut down at the end of the year. This decision was abandoned mid-year.
- Enhanced opportunity at other Mines coming on line, as commodity prices picked up.

4 Business

As part of Minto and SFN's cooperation agreement there is a requirement for the company to provide preferred opportunity notification to SFN to negotiate and potentially be awarded a contract to supply the requirement. SFN has developed partnerships with a number of Minto's vendors for which the details of financial benefit Minto is not privy to. As such, this section summarizes expenditures by the company that is the primary vendor and does not account for any SFN proportional expenditures as a result of those partnerships.

In 2015, Minto and SFN worked jointly to establish new or maintained contracts to ensure involvement from SFN and support our First Nations partners. The contractual arrangements highlighted below represent the majority of the opportunities that SFN and Minto share with service providers. As well as financial gain, SFN also does benefit from employment opportunities on some contracts.

- Borealis Shuttle – Pelly Crossing Shuttle Service-SFN Summer Students
- Capital Helicopters- Helicopter Support
- Driftwood Drilling- Exploration Drilling
- Dumas- UG Mining
- Dyno Nobel Canada- Blasting supplies and services
- Glacier Water Services- Water Hauling
- Manitoulin Transport- Freight Hauling
- Northern Vacuum Services- Vacuum Truck Rental
- Nuway Crushing- Crushing Services
- Parkland Fuel- Fuel Supply
- Pelly Construction- 988 loader rental
- Pelly Construction- Mining Services
- Selkirk Development Corp- Office Lease
- Sodexo- Catering Services
- Standard Bus- Bussing of Staff/Contractors
- Tintina Air- Secondary Air Support
- Yukon Inn- Employee lodging

The six rights of procurement must be met in selection of such vendor relationships.

- Right Materials (to fill need)
- Right Place (Yukon preference)
- Right Quantity and Quality (High quality and ability to supply)
- Right Supplier (Service, technical and aftermarket support, value added service)
- Right moment (product available when needed)
- Right price (competitive commercial price)

In total Minto spent \$64,729,636 on Yukon vendors in 2016ⁱ. This represented 59% of total spend that stayed in the Yukon, supporting local business and developing partnerships for long term mutual benefit. Minto selects the appropriate local vendors based on vendors that meet selection criteria that support Minto’s corporate social responsibility. Such partnerships are built on transparency, human rights and labor compliance, supplier status, financial, geographical, and environmental compliancy. The framework for successful local suppliers is based on common shared goals, continuous improvement, and vendors that support Minto’s policies and procedures.

In addition to support of our First Nations partners, Minto also strives to support Yukon based companies and service providers based on ability to service our needs and meets commercial acceptance criteria. In analyzing a business for suitability Minto follows best practice guidelines and the six rights of procurement in selecting potential suppliers.

Minto will continue to maintain and increase its spend with local suppliers as they invest in supporting the mining industry and Minto is committed to sustainability in developing the relationships for long term mutual benefit.

1. Mine Capital and Operating Expendituresⁱ

| Indicator #33: Minto Explorations operations & capital expenditures by group | | | | | |
|--|------------------------|-----------------|------------------|------------------|------------------|
| | | Pelly Crossing | Other Yukon | Canada | Total |
| 2016 | Capital expenditures | | \$ 5,431,010.25 | \$ 1,077,837.72 | \$ 6,508,847.97 |
| 2016 | Operating expenditures | \$ 5,018,911.53 | \$ 54,279,714.13 | \$ 34,746,723.04 | \$ 94,045,348.70 |

4.1 Yukon business names by group

See attached **Appendix “A”** noting all Yukon Business Names by group. Note that not all business are captured due to some expenditure by employees and reimbursed through expenses and all contractor purchased items.

4.2 Minto Royalty Payments ⁱ

| Indicator #36: Minto royalty payments | | | | |
|---------------------------------------|--|------------------------|-------------|------------------------|
| | | SFN | Yukon | Total |
| Minto Royalties Paid 2016 | | \$ | \$ | \$ |
| Gravel Royalties | | 1,308.00 | | 1,308.00 |
| Net Smelter Royalties | | 1,214,278.46 | | 1,214,278.46 |
| Quartz Mining Act Royalties | | 3,399,118.00 | | 3,399,118.00 |
| | | | | |
| Total | | \$ 4,614,704.46 | \$ - | \$ 4,614,704.46 |

4.3 Minto property tax payments and other fees ⁱ

| Indicator #37: Minto property tax payments and other fees | | | | | | |
|---|---------------------|----------------------|---------------|---------------------|----------------------|---------------|
| | | SFN | Yukon | Other Canada | Other | Total |
| Minto Fees & taxes Paid 2016 | | \$ | \$ | \$ | \$ | \$ |
| Land Leases | \$ 86,826.60 | | | | | \$ 86,826.60 |
| Property Taxes | | | \$ 292,839.31 | | | \$ 292,839.31 |
| Landing Fees | \$ 25,000.00 | | | | | \$ 25,000.00 |
| Trappers' Compensation | \$ 10,000.00 | | | | | \$ 10,000.00 |
| Skagway Municipal Taxes | | | | | \$ 39,473.28 | \$ 39,473.28 |
| | | | | | | |
| Total | \$121,826.60 | \$ 292,839.31 | \$ - | \$ 39,473.28 | \$ 454,139.19 | |

ⁱ Please note that data presented in this section is for 2016 year. 2017 data was unavailable at the time of completion of this report.

5 Capacity, Training and Education

Minto, working with our major contractor partners, supported many different capacity building, training and educational initiatives in 2017. Through a combination of “on-the- job” training and mentoring, combined with sponsoring apprenticeships, pre-apprenticeships and other educational initiatives, we continued to build upon work done starting in past years - to create a workplace that enhances our current employees skills and also supports the ongoing development towards a more advanced local labour force.

5.1.1 Selkirk First Nation and Other First Nation specific training in 2017

Mill Competency Program

- Minto continued with the Mill Operator Competency Program in 2017, specifically targeting, local entry-level workers.

Apprenticeship training

- Minto continued sponsoring One SFN student in apprenticeship training (Warehouse Partsperson) however this employee failed the exam levels and is in the process of rewriting his level 1 training within that program of study.
- Additionally Minto is currently sponsoring another OFN within the Millwright Apprenticeship program, and this employee has now successfully completed his program, and is a Certified Red Seal journeyperson Millwright.

SFN Summer Student

- In 2017, Minto employed an SFN Summer Student over a 6-week period. During that time the student developed a number of transferable skills by working with Site Services, Environmental and Warehouse Departments.

Environmental Monitor-in-Training

- Minto offered an Environmental Monitor-in-Training program to local SFN citizens. We hoped to have two candidates go through the program; we ended up with one.
- The Trainee learned specific skills, such as how to: inspect and coordinate site waste management; monitor wildlife activity and determent on site; participate in small scale reclamation activities; proper chain-of-command for water and soil samples leaving site for testing; assist and conduct routine environmental monitoring activities according to Environmental Monitoring Plan and established protocols, including:
 - Surface water, groundwater and soil sampling;
 - Flow measurements;
 - Fisheries and other biological monitoring
- The training went very well and we were able to provide the candidate with full-time employment over a 1-year term.

6 Cultural Well-being

Minto's approach to community investment is based upon opportunities to further build and maintain our social license, maintain good relationships with our partners and maintain a local presence and good reputation in the communities where we operate and where our employees live and work. The goal of this is to strengthen accountability and working partnerships with stakeholders while providing a foundation to understand and consider the needs, opinions and interests of the community.

Minto employs several methods of community engagement with different levels of involvement from the community and other stakeholders. These methods include formal and informal ways that are best suited for the various stakeholders. While Minto currently employs many different engagement methods, they are largely utilized in an ad hoc way. In the absence of signed, guiding document the current general strategy is that management reviews ways we engage and uses management best efforts and discretion for methods of engagement.

A community engagement plan was prepared and signed off by Minto management in 2015. A method of engagement and frequency table was prepared and presented to Selkirk First Nation Chief and Council.

Examples of community and cultural engagement initiatives include the following:

- Fort Selkirk educational tours with Selkirk citizens and Minto employees and contractors
- Sports Sponsorship
- Christmas Turkey Distribution
- High school Bursaries, and attendance by Senior Minto Management at Graduation ceremonies.
- Selkirk First Nation Elder's workshops held at the Mine site, whereby Minto employees and Contractors get to participate in traditional cultural activities, such as beading workshops, birch bark crafts and traditional sewing.

In 2017 Capstone spending included the following designed to enhance and protect SFN cultural and community wellbeing;

- \$500 provided to each of the 3 SFN graduating students in 2017
- \$9,350 worth of turkeys, delivered to each home in Pelly Crossing for Christmas
- \$2,500 to support Yukon sports
- \$2,500 in contributions to SFN events, including the Selkirk Bears Hockey team.

Minto also continued to support the primary industry event in the territory - the 2017 Geoscience Forum and Trade Show which is the territory's largest conference and industry event. We also continued to support the supported the Yukon Chamber of Commerce, and the Yukon Chapter of the Special Olympics.

Appendix A – Yukon Businesses used by Minto in 2017

| | |
|---|---|
| Acklands Grainger | Marcel McGinty |
| ALBERTA FUEL DISTRIBUTORS INC. | Mercer Contracting |
| Air North | Mile 918 Driver Development |
| Ajax Steel Limited (Steel Only) | MIC MAC TOYOTA (YUKON) LTD. |
| Ajax Steel Limited | Mobile Maintenance Services |
| Alkan Air Ltd. | Napa Whitehorse (0331) Div of Uap Inc |
| All-West Glass Whitehorse Limited | Northern Fusion Welding Fabrication |
| ALX Exploration Services | Northern Industrial Sales (Whitehorse) |
| Aon Reed Stenhouse Inc. | North 60 Petro Ltd |
| Aqua Tech Supplies & Services | Northern Windows & Doors |
| Arctic Star Printing | NUWAY CRUSHING LTD. |
| Boring Guy Equipment Repair | Northwestel Inc. |
| The Brick | Office Supply Centre |
| Bud's Industrial Installations (Yukon) Ltd. | Pacific Northwest Freight Systems |
| Carmacks Hotel | Patricia Halladay Graphic Design |
| Canada Games Centre | Peacock Sales Limited |
| CHALLENGER GEOMATICS LTD. | Pelly Construction |
| The Chocolate Claim | PolarCom Certified Personal Computers ML & Associates |
| City Of Whitehorse | Quality Bearing Supply Ltd |
| Clean Choices | R.C. Crane and Construction |
| Clayton Johns | Reactive Design |
| Cobalt Construction Ltd | Sandvik |
| Dimok Timber Ltd | Selkirk Development Corporation |
| Dog Powered Sports Association of the Yukon | 39539 Yukon Inc. |
| Duncan's Limited | Selkirk First Nation |
| Dynamic Systems | Secure Mobile Shredding |
| Dyno Nobel | Stephane Gingras |
| The Edgewater Hotel (2009) Ltd. | Shoppers Drug Mart |
| Ecol Electric Corp. | Small's Expediting Services |
| Finning | Larry Smith |
| Fountain Tire | Staples#251 Whitehorse |
| General Waste Management | Superior Propane |
| General Enterprise Ltd. | Territorial Auto Parts |
| Tom Gill | Tahyah Van Bibber |
| Government Of The Yukon | The Whitehorse Star Ltd. |
| GP Distributing | Tintina Air Inc. |
| Bluewave Energy | Total North Communications Ltd. |
| GRIFFITHS HEATING & SHEET METAL | Total Fire Protection Services Ltd. |
| High Country Inn | Totaltrac Yukon Inc. |
| Hi Tech Fluid Power | TransNorth Helicopters |

| | |
|---|--|
| Home Hardware | True K9 Security Detection Inc. |
| INTEGRAPHICS LIMITED | Underhill Geomatics Ltd. |
| Inkspirationz Graphix | Whitehorse Chamber of Commerce |
| Integraphics Ltd. | Westmark Whitehorse Hotel & Conf. Center |
| JACOBS INDUSTRIES LIMITED | Whitehorse Beverages |
| Java Connection | Whitehorse Motors Ltd. |
| Dywidag Systems | Woodland Heating and Sheetmetal |
| Kathleen Burke Cleaning Service | Yukon Energy Corporation |
| Kilrich Industries Ltd | Yukon Hospital Foundation |
| Kindra Stewart | Yukon Mine Training Association |
| Klondike Motors | Yukon Chamber of Commerce |
| Lamarche & Lang | Yukon Chamber Of Mines |
| Listers Motor Sports | Yukon Government |
| Locksmith Services Ltd. | Yukon Honda |
| MacPherson Rentals | Yukon Inn |
| Mac's Fireweed Books (Maximillians Corporation) | Yukon Pump Limited |
| Maintenance Enforcement Program | Yukon Radiator Shop |
| Marsh Lake Tents & Events | Yukon Service Supply Company |
| Marj Eschak | Yukon College |
| Research Northwest | YUKON YAMAHA |
| George McGinty | Yukon Workers' Comp Health & Safety Bd |
| Kenny McGinty | Yukon Women in Mining Association |
| Kevin McGinty | |